Just Keep Pumping

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OVERVIEW

The future we plan for includes higher intensities of development and rainfall. It is prudent to assume that as we find better ways to harvest and manage runoff we will be asking more from the drainage systems we already own.

There are many ways in which we ask more from our drainage systems over time. Increased reliance in non-hydraulic terms is influenced by the frugality-guided evolution of our drainage infrastructure systems. Typically the most critical structures are older, more difficult to replace, and have more layers of value and risk built 'on top' of the drainage system. These value layers can be comprised of infrastructure supported or protected by the drainage systems as well as services such as traffic flow, emergency response, or development potential which assume a certain performance level from our drainage assets. As development intensifies each unit of performance in our drainage systems is worth more to our citizens.

In hydraulic terms, it is expected we will levy more units of performance by asking our existing systems to convey more water. Many techniques by which we might accomplish this apply a fundamental precept of increasing total volume through a system without increasing peak flows.

For many existing drainage systems there lies a potential conflict at the intersection of increasing hydraulic and non-hydraulic reliance. Often our older, more valuable drainage systems are vulnerable to degradation mechanisms exacerbated by increased duration or total volume of flow. Generally these degradation systems are characterised by loss of water integrity allowing transportation of soil material from around pipes and structures. Deflection can occur in response to soil loss leading to accelerating and cumulative degradation.

Written from a local government perspective, this paper focuses on the development of injection-grouting techniques to treat common degradation mechanisms affecting municipal drainage systems. Archetypal applications, potential benefits and methodology considerations are discussed together with diagnostic, estimating, monitoring, and contract management considerations.

OBJECTIVES

This project is part of a broader initiative to reduce the total risk and cost of ownership associated with our runoff management assets.

With the focus of this paper being injection grouting we first identify common degradation mechanisms then explore contextual factors and observations which can indicate the presence or likelihood of these degradation mechanisms in forms which can be treated by grout injection.

We will also aim to distil from our research information which can be useful in assessing injection grouting against alternative treatments, and in the planning and execution of injection grouting projects.

METHOD

Six Case studies will be presented recounting our experiences applying injection-grouting techniques in a range of contexts including minor drainage, trunk drainage, riparian assets, and flood mitigation infrastructure.

Discussion highlights benefit/difficulty influences such as maintaining water or traffic flow, buried utilities, private assets, high energy flows, and steep grades and compares injection grouting applied as a stand-alone treatment to a discreet problem to injection grouting within the context of a larger project with objectives including increasing hydraulic capacity.

RESULTS

Experiments were conducted using internal labour and concrete injected under gravity. To sample potential opportunities presented by higher pump pressures and different grout types, subsequent projects were developed as a partnership between Council and a local civil contractor.

Whilst most technical challenges can be overcome it remains difficult to estimate the risk, or measure the success, of a grout injection project. In our current contract model uncertainty is mostly borne by the principal, a situation which can under-incentivise innovation by project partners.

CONCLUSIONS

The economic and risk benefits of this technique are potentially high vs alternative measures but the scoping is tricky and success can be difficult to measure.

From our experiences so far we have learned a lot about how to plan and execute injection grouting projects and how further targeted research could improve this technology.

We have also identified exciting prospects including the potential to realign drainage structures and to inhibit or temporarily reverse chemical degradation mechanisms