NEW CONTRACT STRUCTURE LEADS TO OPTIMUM SEWER REHABILITATION PROGRAM

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Abstract:

Being the region's largest Water Corporation, Sydney Water maintains an extensive program of rehabilitation for their underground sewers. As with all Water Authorities, the Corporation aims to obtain the maximum return for their investment.

An innovation incorporated in their recent Sewer Rehabilitation Program was a package of work that combined both investigation and rehabilitation of sewer lines around the harbour foreshores with the aim of reducing the ingress of salt water into the system. It required the contractor to conduct source detection then propose a program of rehabilitation that offered the greatest reductions in salt water ingress up to the fixed value allocated to the Contract.

The aim of structuring the contract in this way was to reduce project administration and tendering costs through a relatively seamless process from source detection to rehabilitation. The structure meant that the Client maintained control while the operation remained the responsibility of the Contractor.

Completion of the work meant the development of innovative work methods due to the locations of the pipelines and manholes and the nature of the rehabilitation required. Investigations showed that the rehabilitation mix needed to produce the optimum improvements varied substantially between catchments.

This Paper will detail how the various steps of the contract were carried out, the innovative methods needed to complete the work, and the results obtained.

Introduction:

The reduction of infiltration and inflow into sewers is typically one of the main objectives of a sewer rehabilitation programme.

Infiltration from leaking or damaged pipes and manholes results in additional pumping and water treatment costs in processing the additional water quantity. Infiltration can also lead to overflows if the system fails to cope with the additional demands. Typically, the problem becomes worse in wet weather as groundwater levels rise, causing flow to enter leaking pipelines at a greater rate.

For Sydney Water, sewer catchments adjacent to the waterfront have additional problems.

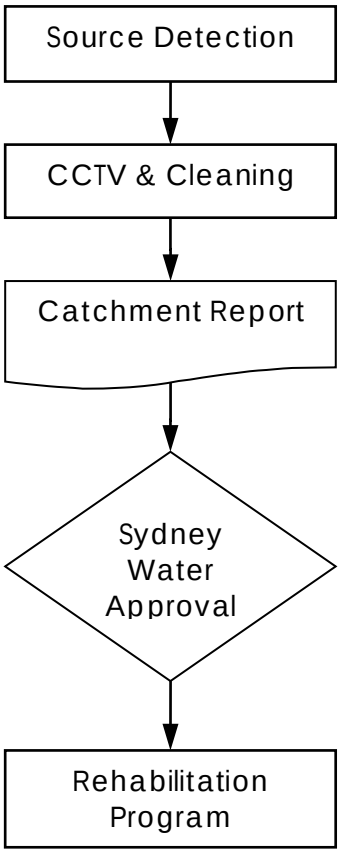
Typically, around Sydney Harbour, wastewater flow is collected from harbourside suburbs and drains under gravity to carrier mains along the foreshore. These waterfront carriers deliver it to sewage pumping stations situated at the lowest point of the system. From here the flow is pumped to a treatment plant.

Many of these pipelines are actually in the water, buried below the high tide level. They are subject to tidal ingress of salt water. Salt water can be particularly destructive, causing additional corrosion in cast iron pipes, pumps and water treatment equipment.

Recognising that rehabilitation of waterfront sewer systems poses problems that require different solutions to those applicable to catchments elsewhere, Sydney Water developed a contract format tailored to their specific needs.

Features of the Contract Format:

Sydney Water's Sewer Rehabilitation Program SRP 2005 included a separate package of works that aimed to result in the identification and elimination of the ingress of seawater into waterfront sewers.



Designated Package 3B, the tender specified much more than rehabilitation of designated pipelines. It required the Contractor to conduct source detection then propose a program of rehabilitation that offered the greatest reductions in salt water ingress up to the fixed value allocated to the Contract.

By bundling source detection with rehabilitation, it was hoped to obtain better value through a reduction in tender and administrative costs.

Thirty-two "problem" waterfront catchments were nominated and given a priority order for investigation.

The steps in the contract were:

1. Source detection
2. CCTV and cleaning in areas where source detection indicated salt water ingress problems
3. Preparation of a catchment report and a rehabilitation program to reduce ingress
4. Obtaining Sydney Water approval for the proposed rehabilitation work
5. Undertake rehabilitation work to reduce ingress
6. Testing the effectiveness of the solution

The contract format aimed to ensure that, while the Client maintained control of the project, its operation would be the responsibility of the Contractor.

The success of the project would be judged on the measured reduction in seawater ingress. Thus, the Contractor was in touch with the overall aims of the project.

A budget of approximately $5,000,000 was allocated for this section of the project.

The objectives of the project can be summarised as:

- Reduction in ...
  - Operating Costs of Pumping Stations
  - Maintenance of Equipment
  - Salinity Levels of Sewerage
  - Level of Flows

- Treatment Volumes & Cost
- Corrosion from Salt Water

- Improvement in ...
  - Life of assets (mechanical & civil)
  - Capacity of System

- Operational Improvements ...
  - Reduction of Surcharges/Overflows
  - Reduction in Community Complaints
  - Reduction of Environmental Impact

The Project:

The contract was awarded to Interflow Pty Limited, a sewer rehabilitation specialist with many years' experience working on Sydney Water contracts.

The first stage of the project was to identify the locations of infiltration. This would narrow down the problem areas which could then be targeted for further investigation.

Testing the salinity of wastewater entering a manhole can be used to determine the quantity of seawater entering the system. Sewage normally has a salinity of less than 0.1%, while seawater salinity is 3.5%.

Salinity testing was conducted starting at manholes nearest the pumping stations, and, if high salinity values were found, testing was undertaken progressively upstream to identify sources of infiltration. The easiest way to measure salinity is to measure conductivity of the wastewater as it provides a sensitive and accurate correlation.

	Salinity	Conductivity
Sewage	<0.1%	40 to 200 mS/m
Seawater	3.5%	5,000 mS/m

Flow measurements were also taken at the manholes.

Samples for salinity testing were taken during a time period from one hour before high tide to two hours after. Testing showed that in some of the lines, over 90% of the flow was from seawater. On other lines, there was no significant infiltration.

Once salinity testing had isolated the problem pipeline sections, CCTV inspection was used to identify the causes of the problems.

From this, a rehabilitation program was developed to most efficiently achieve the required infiltration reductions. The program proposed rehabilitation of both pipelines and manholes.

The nature of rehabilitation required meant developing new working methods.

Salt water had caused heavy encrustation in cast iron pipelines which could not easily be removed by conventional jetting. Interflow was required to develop a cleaning technique that combined jetting with percussion that could remove the encrustation without causing further damage to the pipeline.

Many of the pipelines were below the high tide level and some of the manholes were actually located in the water. New procedures had to be developed to allow safe working at such locations.

The components of the rehabilitation system used to provide sealing against inflow into the deteriorated sewers included:

- Expanda Pipe wound-in-place liners. On a project where massive inflow of water was a central feature, a liner that could be installed in a rigid condition without the need for heating or curing provided important advantages

- Epoxy end seals. Epoxy around the outside of the liner where it entered manholes to provide a long term seal. The ribbed outer surface of the Expanda Pipe liner provides an effective key for the epoxy to provide a strong seal

- The Interflow LCR. This provides a secure seal at connections to lined pipelines. It uses silicate resins contained in a felt tee and installed without excavation.

- Epoxy rehabilitation of deteriorated manholes. A thick layer of epoxy mortar, bonded to the deteriorated concrete manhole with a "bonding bridge" layer provides structural repair and long term sealing. Where inflow through the manhole wall was substantial, initial sealing of the cracks with hydrophilic polyurethane was necessary to allow the epoxy mortar to be successfully applied and cured.

Two Contrasting Catchments

Sydney's 32 waterfront catchments were ranked by Sydney Water according to the order rehabilitation was required.

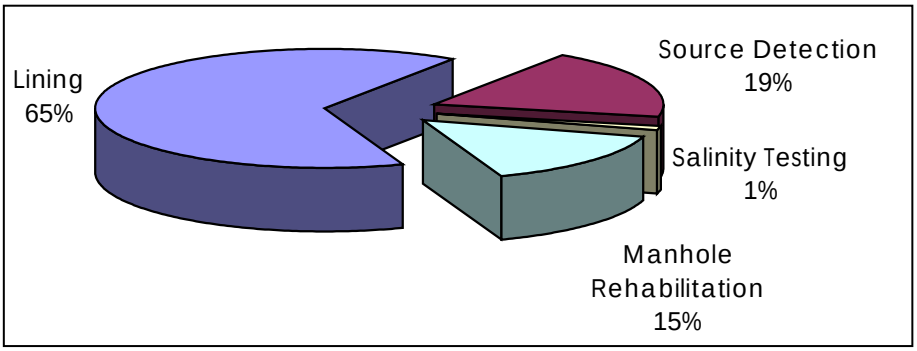
Salinity testing, flow measurement and condition assessment showed that different combinations of rehabilitation technologies were required among the catchments to achieve the required salt water ingress reduction.

Connells Point

Connells Point catchment on the Georges River south of Sydney is a typical suburban waterfront catchment. Wastewater collected from houses is reticulated to carriers running along the waterfront to a sewage pumping station at the lowest point. From here the collected wastewater is pumped through rising mains to sewage treatment plants.

Most of the carriers along the shoreline were earthenware pipes. Salt water was entering through cracks in the pipelines and leaking joints. Extensive lining of the pipelines was needed. Manholes were mostly in reasonable condition.

Many of the pipelines and manholes were in difficult locations. Some were in the water, and others were in shorefront bushland accessible only by barges from the water.



Rehabilitation program expenditure mix: Connells Point

Circular Quay

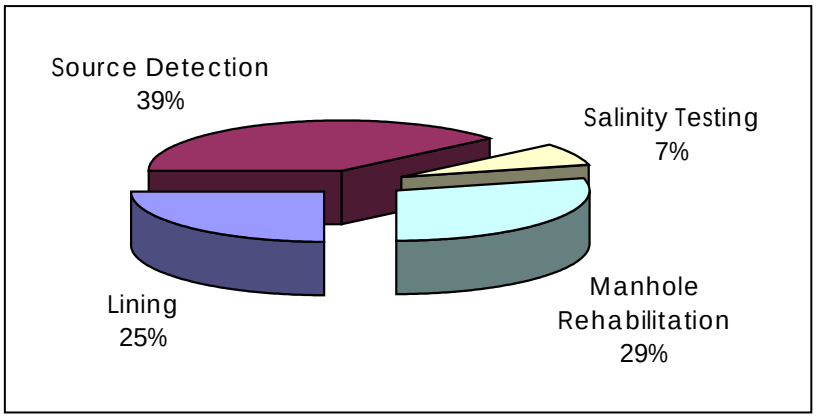
Circular Quay is in Sydney's central business district and main tourist centre, taking in the Harbour Bridge, Opera House and ferry terminal.

Cleaning of the pipelines and manholes at Circular Quay was a major task. The predominance of restaurants and hotels in the area meant that the sewer system was substantially clogged with large quantities of grease and fat.

Investigation showed that a higher proportion of manhole rehabilitation was required compared to other catchments. At least one of the manholes was exposed to the sea and completely filled at high tide to the extent that flow measurement at that manhole was impossible.

Part of the reason for the comparatively good condition of the pipelines was that Interflow had carried out conventional pipeline renewal contracts in the vicinity of Circular Quay over previous years.

The location meant that most of the rehabilitation work at Circular Quay had to be done at night, with the area being completely cleared each morning before the start of the business day.



Rehabilitation program expenditure mix: Circular Quay

Results

Results of the program have exceeded expectations. Flow reductions of over 90% at high tide have been regularly achieved. The salinity of the flow shows that salt water ingress has been all but eliminated.

The program has shown that rehabilitation of the entire catchment is not necessarily required to meet the project's desired outcomes.

Results at Connells Point and Circular Quay, where the rehabilitation programme was completed within the allocated budget total, showed particular success. In summary, the results were:

Connells Point:

	UOM	Pre-Rehab	Post Rehab	Improvement
Flow	l/s	26.4	0.18	99.3%
Salinity	ppt	30.1	3.74	87.6%

Circular Quay

	UOM	Pre-Rehab	Post Rehab	Improvement
Flow	l/s	~ 80	1.73	98.6%
Salinity	ppt	33.5	5.9	82.3%

For Sydney Water, the continuity of process from source detection to rehabilitation has meant less administration and tendering cost. The form of the contract allows Sydney Water to maintain control but operation remains the responsibility of Contractor.

Having the Contractor in tune with the intent of the project, rather than just carrying out rehabilitation, has meant a learning curve for Interflow and the need to further develop their capabilities. The continuity of the process has lead to more efficient work scheduling and a more cost effective project.

The results obtained indicate that the objectives of the program have been met. Sydney Water has intentions of continuing with this type of contract for selected sewer catchment types.