INFILTRATION CONTROL: THE CRITICAL DECISION IN MANHOLE REHABILITATION

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ABSTRACT

Sewer manhole rehabilitation is often discussed in terms of lining material, coating thickness, surface preparation and return-to-service time. Field experience indicates that active infiltration is often the critical decision point that determines whether a lining system becomes a durable asset protection system or a coating applied over an unresolved hydraulic problem. This paper presents a field-based case study approach to infiltration diagnosis and control during sewer manhole rehabilitation. It focuses on the operator decisions required to identify different forms of infiltration, select appropriate control methods, determine whether a structure is ready for lining and understand how unresolved water movement can affect coating adhesion, lining continuity, substrate durability and the surrounding ground condition.

Using practical examples from manhole rehabilitation works, the paper outlines a decision-making sequence for infiltration: observe, classify, control, verify and only then proceed to lining. A reported Midcoast council case study is also discussed, where infiltration reduction was associated with material operational savings over time.

The paper concludes that infiltration control should be treated as a core rehabilitation discipline and key procurement criterion to create the best possible conditions to achieve the design life of the lining, rather than a minor preparation activity. The success of a lining system depends on the decisions made before the coating is applied and not solely on the coating material used.

1.0 INTRODUCTION

This paper argues that infiltration control is one of the most important decision-making stages in sewer manhole rehabilitation. The operator must not only identify that water is present, but determine the type of infiltration, its likely pathway, the risk it presents, the appropriate control method and whether the asset is genuinely ready to proceed to lining. This approach is consistent with the broader industry focus on capturing the practical judgement of experienced water industry operators, particularly where decisions must be made under field conditions rather than idealized workshop conditions.

2.0 CONTEXT Sewer manholes are exposed to a combination of hydraulic, chemical, structural and environmental stresses. In coastal and high-water-table regions, infiltration through joints, cracks, pipe penetrations, construction joints and degraded substrates can significantly affect asset condition and rehabilitation outcomes. Infiltration is commonly treated as a visible defect to be sealed before coating. Experienced operators understand that it is more than visible water entering a structure. It is evidence of an active pathway between the external ground environment and the internal sewer asset.

That pathway may include hydrostatic pressure, soil movement, void formation, root pathways, damaged joints, pipe penetration defects or degraded concrete and mortar. For manhole rehabilitation, the presence of active infiltration creates several risks. The substrate may not be suitable for primer or lining application. Active water can interrupt adhesion and cure. Water pressure may continue behind the lining system. The lining may then be forced to act as a water-retaining membrane rather than a bonded protective system. Unresolved pathways may also continue to erode surrounding material and weaken confidence in quality assurance evidence after coating.

3.0 EXPERIENCE

TriKing is a specialist infrastructure rehabilitation company, based in Port Macquarie, NSW. TriKing has been built on the experience and learnings of its founder, through many years of experience both locally and internationally. TriKing specializes in manhole rehabilitation, infiltration control, surface preparation, polyurea lining, pump stations, bunds and treatment infrastructure. The concepts outlined in this paper are based on the real-life learnings and experience in live sewer conditions, as applied to a successful boutique business that is TriKing.

4.0 DISCUSSION

4.1 Infiltration as the rehabilitation decision point

A lining system is intended to protect the asset from corrosion, chemical attack, hydraulic exposure and ongoing degradation. For the lining to achieve its design life, its life, it must be applied to a prepared and stable substrate. Active infiltration disrupts that process. Where water continues to move through the substrate or joint, primer may not properly penetrate or bond to the substrate. Water may create pinholes, blistering, weak bond zones or discontinuities. Moisture may continue to accumulate behind the lining after the work is complete. In severe cases, the coating can become a barrier placed over an unresolved water-pressure problem.

The practical rule is simple: a lining system should not be asked to solve an infiltration problem that should have been solved before lining. The lining protects the asset after the substrate and infiltration conditions have been made suitable. The infiltration repair controls the water pathway. They work together, but they are not the same task.

4.2 Types of infiltration requiring different decisions

Not all infiltration presents the same risk or requires the same response. Point infiltration occurs where water enters through a defined opening, pinhole, construction defect, localised crack or small penetration. These leaks can appear minor but may indicate a direct water pathway through the wall. The operator decision is whether the defect can be sealed locally or whether it forms part of a broader pathway requiring additional injection around the area.

Joint infiltration commonly occurs at ring joints, construction joints, cover slab joints, pipe penetrations or where precast sections have moved or deteriorated. Joint infiltration is often more significant than a visible trickle suggests because the joint may provide a continuous circular pathway around the structure. In these situations, the operator must decide whether to chase the visible leak only or treat the joint as a wider infiltration path. Oakum can provide temporary containment and back-pressure, allowing the injection material to form a more effective seal rather than being washed directly through the defect.

Crack infiltration may be linear, branching or spider-cracked. The decision-making is more complex because water can move through hidden pathways behind the visible crack. A poor response may chase the centre of the visible leak only. A stronger response builds control around the crack system, often working the perimeter first to reduce uncontrolled movement before addressing the main ingress point. Pipe penetration infiltration requires a similar level of judgement. The operator must determine whether water is entering around the pipe, through the bench, through a failed collar, through a gap behind the pipe or through a broader defect linked to external voiding.

Weeping or damp substrate is another important distinction. A wall may not have a visible running leak but may still be too damp for standard primer and coating. Moisture can be present as sweating, weeping, condensation or absorbed water within the substrate. The operator must distinguish between active infiltration, residual wash water, condensation from dew point conditions, moisture held in degraded material and humidity driven by sewer temperature and airflow.

In some cases, infiltration is not just a leak. It may be a symptom of broader substrate failure. Warning signs include crumbling wall material, exposed steel, loose rings, displaced joints, significant root intrusion, large voids or multiple injection points in a small area. In these cases, infiltration control may assist with localised water-pathway sealing and support around the defect, but it should not be confused with full structural ground improvement unless supported by investigation, design and verification.

4.3 A practical decision sequence

The operator decision sequence can be described in five steps: observe, classify, control, verify and proceed or hold. Observation occurs after initial access and cleaning, because dirt, grease, biological growth and loose material can hide infiltration pathways. Observation should include active water movement, staining, root pathways, mineral deposits, soft or degraded mortar, ring joint defects, pipe penetration leaks, dampness after washing, visible cracks and evidence that water has been moving for a long period.

Classification requires the operator to decide whether the condition is residual dampness, a minor point leak, a joint or crack leak, active flow under pressure, or infiltration associated with substrate instability. This classification determines whether the asset can be dried and retested, locally injected, treated through a controlled injection sequence, stopped as a lining candidate until the water is controlled, or escalated for engineering review.

Control then follows the classification. For active leaks, this may include drilling injection ports, installing mechanical packers, using oakum to create temporary back-pressure and injecting a component resin until the leak is controlled. The control sequence matters. For a joint leak, the operator may need to contain the pathway before injecting. In a spider crack, the operator may work around the outside before addressing the centre. In a high-flow leak, the operator may need to treat the worst ingress first to reduce water movement before completing the remaining repair. The work is not simply pumping material until water stops. The operator must avoid over-pressurising weak substrates, recognise blind holes and stop if the defect pattern suggests broader asset failure.

Verification is the hold point before lining. The operator should verify that visible water movement has stopped, the repaired defect has held under site conditions, the surrounding substrate is sound, moisture is within the selected primer tolerance, the surface is clean and any abnormal condition has been recorded. The final decision is whether to proceed or hold. If active infiltration remains, lining should not proceed.

4.4 Relationship to lining performance and asset longevity

The liner is only as reliable as the decision made before the liner was applied. The performance of a lining system depends on the substrate being clean, sound and suitable for the selected primer system. Active infiltration threatens several requirements at once. It can prevent proper surface preparation, interfere with primer adhesion, introduce water behind the lining, create weak points and reduce confidence in the finished asset.

Uncontrolled infiltration can also contribute to long-term asset deterioration by allowing ongoing water movement through and around the structure. Over time, this can contribute to erosion of fines, enlargement of pathways, root intrusion, joint degradation, corrosion acceleration and increased hydraulic load into the sewer network. Where injection material migrates into the defect path and surrounding voids, it may provide localised support and reduce further movement of water and fines. However, this should be presented carefully. It is a practical asset-protection benefit, not a substitute for designed structural ground stabilisation unless that outcome is specifically investigated and verified.

4.5 Economic significance of infiltration control

Infiltration control can shift manhole rehabilitation from a local maintenance activity to a network-level financial return. In one report in Midcoast council, Harrington case study, infiltration reduction of approximately 49% was achieved, resulting in significant operational savings. While these figures require confirmation and should be interpreted within their specific project context, they demonstrate that the savings in operational cost can materially exceed the original rehabilitation cost.

This is important because water entering the sewer network through defective manholes does not remain a small asset defect. It becomes additional hydraulic load that must be transported, pumped, treated and managed across the wider system. In wet weather or high-water-table conditions, this can contribute to increased pump run hours, treatment load, overflow risk, operational response and accelerated asset deterioration. The financial outcome from the Harrington example supports a broader industry lesson: effective infiltration diagnosis and control can create measurable value for utilities before the protective lining system is even considered.

4.6 Quality assurance and training value

Quality assurance is critical because infiltration control is often hidden after lining. Once the lining is applied, the client cannot see what was done underneath. A comprehensive Inspection and Test Plan (ITP) should form part of the contractual deliverables. Evidence should include pre-cleaning condition photos, post-wash inspection photos, visible infiltration photos or videos, injection location photos, packer locations, evidence of oakum or containment where used, evidence that active infiltration stopped, moisture readings or surface condition notes, primer selection notes, coating thickness records and final lined asset photos. If the infiltration repair is not evidenced before lining, the most important part of the rehabilitation may become invisible at handover.

The operator decision-making process also has training value. Experienced operators develop pattern recognition: whether water movement is isolated, spreading, pressure-driven or linked to broader asset deterioration. These skills should be captured in procedures, field training and competency assessments. An ITP/checklist can enforce hold points, but it cannot replace the judgement required to interpret what the asset is doing under real site conditions. The purpose of a good procedure is to make that judgement repeatable, visible and teachable.

5.0 CONCLUSION

Infiltration control is one of the most important stages in sewer manhole rehabilitation. It directly affects substrate readiness, primer selection, lining adhesion, coating continuity, long-term durability and confidence in the completed asset.

The key finding from field experience is that infiltration control is not a single task. It is a decision-making process. Operators must observe the condition, classify the infiltration type, select the correct control method, verify the outcome and determine whether the manhole is ready to proceed to lining.

The success of sewer manhole rehabilitation should therefore be assessed not only by the lining material applied, but by the quality of the decisions made before application. In this sense, infiltration is the critical decision point between short-term coating and long-term asset rehabilitation. The reported Harrington case study, further demonstrates that infiltration control can also provide measurable economic value to utilities. Where infiltration reduction decreases the volume of unwanted water entering the sewer network, the benefits may include reduced pumping, reduced treatment load, reduced wet-weather risk and improved asset performance. For that reason, infiltration control should be treated as a primary project outcome, not simply as preparation before lining.

6.0 ACKNOWLEDGEMENTS

The author acknowledges the contribution of experienced field operators involved in sewer manhole rehabilitation works, and the practical support of council and utility staff who provide site access, asset history and operational feedback. Reference to the Harrington case study and associated figures remains subject to final confirmation and permission from the relevant council representatives before external submission.

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