Catchpit Safety Review

Stage 2: Risk Assessment

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Executive Summary

This report forms the second stage of a technical review into the health and safety risks associated with stormwater catchpits within the Auckland Region. This technical review has been undertaken in response to the tragic death of a young woman on the 3rd of June 2017 in a road catchpit on Royalpark Place in Favona, Mangere.

The Stage 1 review found that Auckland Council and Auckland Transport are managing public safety around catchpits in a similar manner relative to other local authorities around New Zealand, and internationally. Stage 1 identified that drowning at catchpits is an extremely rare occurrence, however it was identified that a risk assessment should be undertaken to assess the risk of drowning against other catchpit health and safety risks. The objective of this Stage 2 study is:

Undertake an assessment of public health and safety risks from stormwater catchpits, describe the Existing Controls currently used to address these risks, and if appropriate set out potential interventions to address any residual risks which require further action.

This catchpit safety risk assessment has sought to identify and assess public and operational safety risk associated with catchpits managed / maintained by Auckland Transport and Auckland Council. Although this study has been driven by a specific incident, a holistic approach has been utilised in an effort to ensure that all risks are considered and that any other risk is not unacceptably increased in order to decrease another. The risk assessment process is based on Auckland Council's Risk Management Framework and has been informed by a working group of Auckland Council, Auckland Transport, Opus and industry representation via workshops held on the 12th September 2017 and 27th September 2017.

The risk assessment has been performed on a 'standard catchpit', however a high level assessment of how risk could vary with other approved catchpit types is also summarised. A risk register (refer Appendix A) has been developed containing the existing hazards, controls and risk ratings identified. **In many cases the risk rating for hazards without Existing Controls would be high or extreme, however in all cases safety risks are lower with Existing Controls in place**. Most notably the catchpit grate itself is an Existing Control which helps to isolate the public from drowning and fall hazards. The Existing Controls, coupled with the extremely rare occurrence of serious incidents, mean catchpits are, when used as designed and intended, safe devices. **This emphasises the importance of continually reviewing, monitoring, and improving the existing controls**.

Key findings from the risk assessment process:

1. None of the catchpit hazards identified are considered a High or Extreme risk when Existing Controls are in place. There are a number of Moderate and Low risks.

2. The likelihood of a person becoming stuck in a catchpit leading to death is assessed as Rare.

3. There are a number of other risks - assessed as Moderate, including a person falling into an open or missing catchpit grate when obscured by water, a catchpit grate becoming blocked and leading to drowning on the ground surface, and operation/maintenance staff working in a live road corridor and being struck by a vehicle.

This assessment has identified potential Additional Controls which may further reduce residual risks associated catchpit safety hazards. These have been evaluated against the relative benefits (health and safety risk reduction) and constraints (barriers to implementation) through workshops. The outcome of the assessment are the below recommendations. Recommendations are split into:

- **Catchpit Drowning Hazard Recommendations** – these directly relate to the tragic incident that occurred on the 3rd June 2017.

- **Other Safety Recommendations** – a number of other safety recommendations have been identified that could be implemented by Auckland Council or Auckland Transport.

Recommendations to mitigate the risks from public access to catchpits are:

1. Raising awareness within the community, of catchpit hazards, has the potential to reduce the likelihood of hazards related to drowning or falls. **It is recommended Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to**

improve public awareness of catchpit hazards and Council processes for retrieving items from catchpits.

2. It is recommended that **Auckland Council consider updating their existing safety assessment tool to identify if there are any catchpits where there is a higher risk to the public. This can then be used to enable prioritisation and then undertake a feasibility assessment of retrofitting interventions.**

3. Subject to the results of the outcome of the assessments in recommendation 2, making catchpit access only possible with a special tool may be suitable for new catchpit designs, retrofitting existing catchpits identified as having a higher risk to the public or maintenance contractors and as part of Auckland Transport and Auckland Council renewals programmes. It is expected this will have negligible effect on the health and safety risk to maintenance contractors. Although products do exist using this type of mechanism, no product currently exists on the market for standard catchpits and would therefore require further design and development. Requirement for adoption of lockable catchpits in the Code of Practice should be reviewed based on the outcome of initial trials. **It is recommended Auckland Transport and Auckland Council Healthy Waters department work with suppliers to develop a design standard and specification for lockable catchpit grates and consider update the Code of Practice accordingly.**

4. **Subject to the outcome of the assessments in recommendation 2, it is recommended Auckland Council and Auckland Transport consider developing a programme to retrofit the specified lockable catchpit grate to existing catchpits where there is deemed a greater risk of public attempting to access a catchpit (refer Recommendation 3).**

5. **Highlight in the Auckland Transport Code of Practice the need to assess public and operator safety in catchpit/surface drainage design, in accordance with the Health and Safety at Work Act 2015 and Auckland Transport's Safety in Design requirements.**

6. Austroads acknowledges proprietary continuous capture inletting devices such as KerbDrain provide a solution in locations where flat crossfall and road gradients result in the wide spread of gutter flow or where constrained by other utilities. These devices can significantly reduce, if not eliminate, a number of catchpit safety risks including unauthorised access to sumps by members of the public. However, Austroads advises consideration needs to be made regarding the potential for increased maintenance requirements. It is recommended **Auckland Transport identify where 'continuous capture inletting' could be appropriate as an alternative to new conventional kerbs and channel and update the Code of Practice accordingly.**

7. Managing risk assumes Existing Controls are applied and operating effectively. Without them risk would be significantly higher. **In light of the increased awareness of safety at catchpits, it is recommended health and safety procedures in relation to catchpit maintenance are reviewed for opportunities to reduce the health and safety risk to the public and maintenance contractors.**

Other Safety Recommendations are:

8. The current standard catchpit design has a minimum 50mm back entry inlet, however this narrows significantly below the grate frame. **It is recommended Auckland Transport work with suppliers to identify how the back entry on the standard catchpit could be improved to reduce the safety risks associated with surface water (e.g. blockage).**

9. Although removal and replacement of all deciduous street trees that result in catchpit blockage is not considered practicable, the following update to the Auckland Transport Vegetation in Road Corridor Guidelines is recommended to reduce the likelihood of blockage over time or damage from tree roots. **It is recommended Auckland Council and Auckland Transport include a requirement to consider selection of tree species that practically minimise leaf fall to reduce the risk of blockage and surface water hazards.**

10. There is ambiguity within the Auckland Transport Code of Practice on when cycle-friendly catchpit grates are to be used. Section 13.5.7 specifies cycle-friendly grates are *to be installed in all new road construction*. Section 17.8.5 states cycle-friendly grates are required *where cyclists may travel close*

to the drainage channel. **It is recommended Auckland Transport clarify in the updated Auckland Transport Code of Practice where cycle-friendly catchpit grates are to be used.**

11. Stage 1 of this study identified there are a large variety of 'standard' catchpits used across New Zealand. **It is recommended Auckland Council communicate the findings of this report to other local authorities, who could consider how the risk profile may change with their 'standard' catchpit.**

Contents

1 Introduction

This report forms the second stage of a technical review into the health and safety risks associated with stormwater catchpits within the Auckland Region. This technical review has been undertaken in response to the tragic death of a young woman on the 3rd of June 2017 in a road catchpit on Royalpark Place in Favona, Mangere.

Stage 1 of the catchpit safety review has been previously undertaken by Opus[1] and addressed the following scope as outlined in the Terms of Reference for Stage 1 (dated 6th July 2017):

1. Technical Overview;
2. Research and review of previous similar incidents both nationally and internationally;
3. Review of current best safety practice;
4. Summary of relevant Auckland Council and Auckland Transport policies, technical standards and practices;
5. Findings.

The outcome of the Stage 1 review found that the Royalpark Place catchpit is typical of those found in the Auckland area. The review had also found that Auckland Council and Auckland Transport are managing public safety around catchpits in a similar manner relative to other local authorities around New Zealand, and internationally. Although Stage 1 identified that drowning at catchpits is an extremely rare occurrence, it was identified that a risk assessment should be undertaken to assess the risk of drowning against other catchpit health and safety risks.

1.1 Stage 2 Objective and Scope

Stage 2 of this catchpit safety review leads on from the findings of the Stage 1 report. The objective of Stage 2 is:

Undertake an assessment of public health and safety risks from stormwater catchpits, describe the Existing Controls currently used to address these risks, and if appropriate set out potential interventions to address any Residual Risks which require further action.

The scope covered within this report follows that defined in the Terms of Reference for Stage 2 (dated 7th September 2017) and includes the following:

1. Identification and assessment of catchpit safety risks;

2. Identification of safety interventions / modifications which could be applied to existing and future catchpits by:
    a. Undertaking stakeholder workshops with Auckland Council Healthy Waters and Auckland Transport;
    b. Liaising with key suppliers / manufacturers regarding potential catchpit design changes / innovations and safety modifications;
    c. Undertaking Safety in Design for catchpits workshop with stakeholders;

3. Review of potential safety interventions / modifications by:
    a. Assessing effectiveness of safety interventions / modifications through a tabulated comparison of options and outcomes from the risk mitigation identification;
    b. Further supplier liaison if required;
    c. Development of recommendations for prioritisation of any improvements, based on the assessment of overall effectiveness.

4. Conclusions

5. Recommendations

[1] Royal Park Place Catchpit Safety Review – Stage 1, Opus, 29th October 2017

2 Background

2.1 General

As defined by Auckland Council Glossary of Stormwater Terms March 2016, a catchpit is a stormwater device composed of a grate, small chamber and sediment trap. Catchpits may be owned privately or publicly and are usually associated with drainage of roading or hardstanding areas. The Auckland Transport Code of Practice[2] specifies that "catchpit inlets should be designed to intercept and convey all stormwater runoff flow from the minor (10 year Annual Recurrence Interval and lower) storms while limiting risk and degree of interference with traffic, safety risk and risk of flooding due to blockage".

Auckland Council's GIS database indicates there are approximately 118,000 catchpits in the Auckland Region, managed by Auckland Transport or Auckland Council in accordance with Section 45 of the Local Government Act (Auckland Council) 2009 (LGA). Auckland Transport carry out maintenance work above the grate. All below grate maintenance work is carried out by Auckland Council Healthy Waters department, in accordance with the Local Government Act 1974.

Auckland Transport have advised that the expected renewal life for road drainage assets is as follows:

- Catchpit: 80 years
- Kerb and Channel: 50 years

Approval is required from Auckland Transport and Auckland Council Healthy Waters department for any work affecting the road drainage system, as well as from Watercare in combined sewer areas.

2.2 Standard Catchpit Design

2.2.1 Typical Catchpit Description

Despite the large variety of catchpit grate types, typical catchpits are predominantly made up of the same features (refer Figure 1):

- A surface level grate to collect runoff. The grate is heavy, and contractors usually use a specialist tool to enable access for maintenance. Most existing catchpits around Auckland are made of cast iron (CI) which has been used for many years. Some new catchpits are being manufactured with ductile iron (DI). This is due to the inherent strength of DI making it more suitable for higher load rating situations. Ductile Iron has more impact and fatigue resistance as opposed to the brittleness associated with cast iron (email correspondence 31/07/17, Steve Martin, Hygrade Products). DI is often also used for 'cycle friendly' grates and is also generally lighter than cast iron grates (Opus, 2017). More effective catchpits (e.g. megapit) are being manufactured with galvanised steel grates. Grates manufactured in the last 10-12 years are cast with bolt holes to enable them to be fixed in place.

- A 'back entry' inlet to collect higher flows during more intense rainfall events. A minimum clearance of 50mm through to a typical maximum of 150mm. Typically these have an opening of 100mm at the surface, however at the grate frame level the gap significantly reduces acting as the control point for capacity. This surface opening is consistent with the 100mm maximum spacing for vertical components specified in the Fencing of Swimming Pools Act 1987.

- A reinforced concrete chamber, typically 1.4-1.8m deep;

- The chamber includes a sump below the outlet pipe. The sump is designed so silt and sediment within runoff can settle and be collected within the sump, rather than discharge into the downstream environment. The sump is typically 450mm above the floor of the pit, however this can vary depending on the level of the outlet pipe. The sump is normally part full with water.

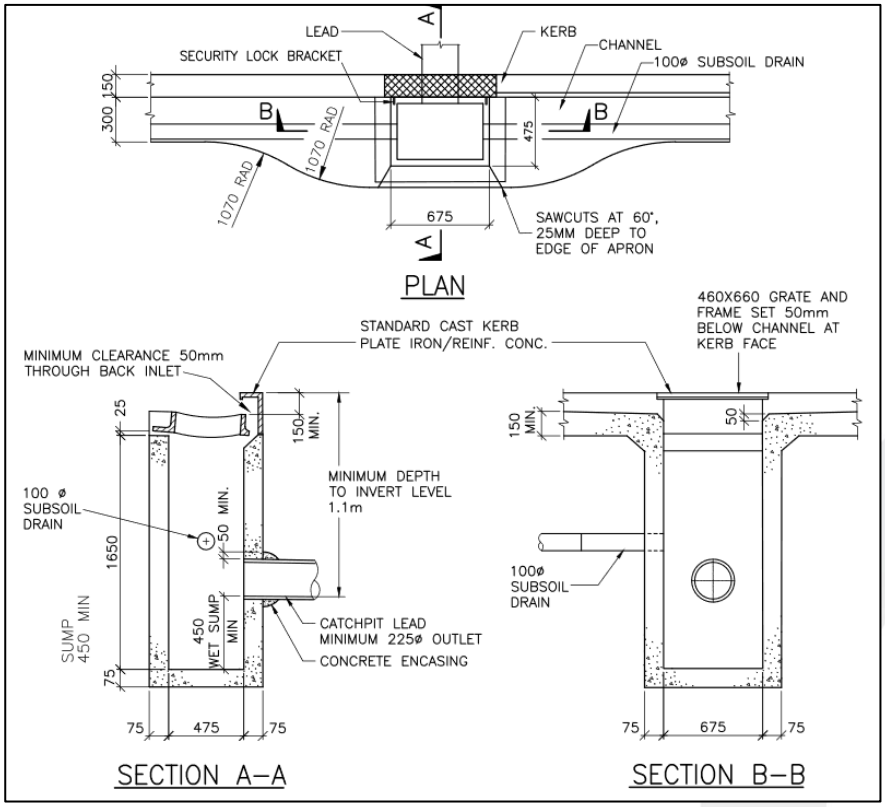
[2] Auckland Transport Code of Practice - Chapter 17: Road Drainage, 2013

Auckland Transport Code of Practice (Section 17.8.3) sets out non-standard high-capacity catchpits approved for use. These include:

- Street Catchpit (also referred to as a Max Pit) – large cycle friendly grate and large back entry.
- Splay Pit (also referred to as a MetroPit) – no grate, only large back entry.
- Megapit, or similar product the Hush Pit – large cycle friendly grate and large back entry.

There are also a large variety of 'standard' catchpits, used throughout New Zealand (Opus, 2017).

Figure 1: Standard catchpit detail[3]



2.2.2 Modes of Failure

As described in the Stage 1 report (Opus, 2017), catchpits are, when used as designed and intended, safe devices, however are subject to significant wear (particularly from vehicles) and like all infrastructure will degrade over time and require renewal. The following list details typical modes of failure for catchpits which may lead to safety hazards for members of the public and / or maintenance workers:

- Blockage - such as from accumulation of debris or litter;
- Damage – such as from material fatigue (wear and tear), incorrect maintenance procedures, or intentional vandalism;
- Stolen or missing grates (refer Section 2.3.3);
- Unauthorised access – such as from being left open or replaced incorrectly;
- Grate becomes jammed preventing access for maintenance / repairs;
- Back entry becomes damaged (e.g. from vehicle collision.

2.3 Catchpit Inspection and Maintenance

2.3.1 General

Consultation with asset owners was undertaken as part of the Stage 1 catchpit safety review and included discussion around what inspection, reporting and maintenance programmes are currently being implemented (Opus, 2017). This section contains a summary of the advice received from Auckland Transport and Auckland

[3] Auckland Transport Code of Practice – Chapter 17: Road Drainage, 2013

Council on the programmes they are responsible for. **The performance record against the inspection and maintenance requirements described below has not been reviewed as part of this assessment.**

2.3.2 Inspection and Reporting Programme

Roads are inspected by drive-by vehicle inspection frequently by Auckland Transport, depending upon road hierarchy:

- Regional arterial or collector roads (Service Level 1 to 4) are inspected weekly;
- Local roads (Service Level 5) are inspected fortnightly;
- Low traffic volume roads (Service Level 6, 7 and 8) are inspected bi –monthly.

Any missing catchpit grates that are identified during these inspections are replaced.

Road sweeping occurs frequently, and at least 3 times per year. Any missing catchpit grates identified are reported as part of this activity for replacement.

All catchpits are cleaned twice per year (refer Section 2.3.5). Catchpit maintenance is recorded and date stamped using GPS in an Auckland Council's geospatial dataset.

2.3.3 Missing Grates

Catchpit grates occasionally go missing across the Auckland Region. AT report 599 grates that have gone missing in South Auckland between July 2012 and May 2017. Auckland Council Healthy Waters department have replaced 52 missing grates across the region over the same period.

Missing catchpit grates represent a significant safety risk to the public. If a missing grate is reported by the public, Auckland Transport treat it as an emergency incident. Auckland Transport has a 1 hour response KPI to this request.

2.3.4 Retrieving Items Lost in Catchpits

Auckland Council will retrieve items lost down a public drain or catchpit at no charge following a customer request. This process involves:

1. A member of the public contacts the Auckland Council Call Centre;
2. A call centre operator will log a request, including details on the asset and location;
3. The call centre operator will contact the relevant maintenance contractor;
4. The contractor will contact the customer to confirm a time to meet on site.

Auckland Council has a 4 hour response KPI to this request. This service and process is not explicitly advertised (such as on Auckland Council's website). According to information received from Auckland Council, for the year of 2016 there were 102 requests made by members of the public for retrieval of items from drains or catchpits.

2.3.5 Catchpit Maintenance

Catchpit cleaning in Auckland is undertaken by a specialist Roadside Sump Cleaning Vehicle (RSCV). The usual procedure followed by contractors when cleaning catchpits is:

1. The RSCV is parked in close proximity to the catchpit;
2. The grate on the sump is opened by hand using a special tool to hook and pull up the grate;
3. Next the drop pipe will be lowered into the sump until it gets to the bottom of the sump or to a build-up of sediment;
4. The vacuum system is turned on and sediment sucked into the lower end of the drop pipe and into the truck until all debris is removed;
5. If necessary, a water blaster can be used to assist in cleaning the sides of the sump;
6. When all cleaning has been completed, the grating on top of the sump is replaced;
7. Sump contents are disposed of at a specialist facility.

Catchpit maintenance is recorded and date stamped using GPS in an Auckland Council's geospatial dataset.

Auckland Council have advised[4] three different types of RSCV are currently used:

1. Left hand drive, low entry, single operator vehicle with sump cleaning equipment on the left hand (footpath) side.
2. Right hand drive vehicle, usually two person, with sump cleaning equipment at the rear of the vehicle.
3. A right hand drive vehicle, usually two person, with sump cleaning equipment on the left hand (footpath) side.

There are a number of catchpit 'inserts' used across the Auckland Region, primarily to capture pollutants (e.g. Enviropod, LittaTrap, TetraTrap). These add complexity to operation and maintenance activities and have the potential to increase health and safety risks to maintenance contractors[5].

[4] Daniel Reeves, Auckland Council, Workshop 27th October 2017
[5] Meeting, Daniel Reeves, Auckland Council Healthy Waters department, 19/10/2017

3 Risk Assessment Process

3.1 General

This section describes the process of assessing health and safety risks associated with catchpits. Findings have been informed by a working group of Auckland Council, Auckland Transport, Opus and industry representation via workshops held at Auckland Council on the 12th September 2017 and 27th September 2017.

The catchpit safety risk assessment has sought to identify and assess public and operational safety risk associated with catchpits managed / maintained by Auckland Transport and Auckland Council. It is noted that although this study has been driven by the tragic death of a member of the public, a holistic approach has been utilised in an effort to ensure that all risks are considered and that any other risk is not unacceptably increased in order to decrease another.

3.2 Methodology

Auckland Council's Risk Management Framework has been adopted to assess catchpit safety risk.

Hazards to the public and operational staff associated with catchpits have been identified and agreed at the workshops on the 12th September and 27th September.

The **consequence** of each hazard has been assessed and given a score based on Health and Safety criteria set out in Appendix C of the Risk Management Framework (refer Figure 2). This risk assessment has considered risks and consequences associated with Health and Safety only. The Auckland Council Risk Management Framework (undated, provided September 2017) also includes other consequences such as legal, financial and environment that have not been considered for this study.

Figure 2: Extract from Auckland Council Risk consequence template

	Insignificant/Level 1	Minor/Level 2	Moderate/Level 3	Major/Level 4	Extreme/Level 5
Financial	No impact on achievement of key performance targets. Business can continue as normal, localised failure only. Financial loss <1% operating budget.	Up to 1% impact on achievement of key performance targets Limited to a single business area of the organisation. Financial loss 1-3% operating budget.	Up to 5% impact on achievement of key performance targets Financial loss 3-6% operating budget	Up to 10% impact on achievement of key performance targets. Financial loss 6-10% operating budget. Impact to multiple and diverse areas of the organisation.	Greater than 10% impact on achievement of key performance targets. Financial loss >10% operating budget.
Skills and knowledge	Permanent staff turnover equal to or 1.25 times industry average Insignificant skill gaps	Permanent staff turnover 1.25 – 1.5 times industry average Few specialist skill gaps	Permanent staff turnover 1.5 – 1.75 times industry average Some specialist skill gaps	Permanent staff turnover 1.7 – double industry average Major specialist skill gaps	Permanent staff turnover is more than double industry average No internal or external specialist skills available
Legal	Council sued for a sum < $10,000	Council sued for > $10,000 < $100,000	Council sued for > $100,000 < $250,000 Complaint to the Ombudsman or other statutory offices	Council sued for > $250,000 < $1,000,000 Legislative non-compliance involving the prosecution or the potential for a fine or a significant criticism of Council by Judiciary or Ombudsman Adverse ruling by the Ombudsman or other statutory officer with power to investigate or make rulings.	Council sued for > $1,000,000 Legislative non-compliance involving the potential for imprisonment of a Councillor or Senior Officer. Judicial review of a Council decision on a matter relating to funding or rates.
Environment (Natural and Built)	Small localised and reversible environmental impact resulting in: • slight, short term damage to (use of) land and/or water • slight short term damage to land and/or water ecosystems • No noticeable species reduction. Occasional inconsistency with the intent of legislation, Auckland Plan, and Council's Mission, Goals and Principles.	Contained and reversible (minimal) environmental impact resulting in: • localised minor reversible damage to (use of) land and/or water • localised minor reversible damage to land and/or water ecosystems. • Temporary reduction in one species Minor erosion and/or damage to property. Minor inconsistency with the intent of legislation, Auckland Plan and Council's Mission, Goals and Principles.	Measurable damage to the environment; significant corrective action resulting in: • Localised, medium term reversible damage to (use of) land and/or water • Localised, medium term reversible damage to land and/or water ecosystems. • Moderate reduction in one or more species. Moderate erosion and/or damage to property. Recovery time 1 month. Repeated inconsistency with the intent of legislation, Auckland Plan and Council's Mission, Goals and Principles.	Irreversible localised damage (major) to the environment resulting in: • Widespread long term reversible damage to land (use of) and/or water • Widespread, long term reversible damage to land and/or water ecosystems. • Significant reduction in one or more species. Severe erosion and/or damage to property. Recovery time up to 6 months. Repeated and significant inconsistency with the intent of legislation, Auckland Plan and Council's Mission, Goals and Principles.	Extensive irreversible damage (widespread) to the environment resulting in: • Widespread, irreversible damage to (use of) land and/or water • Widespread, irreversible damage to land and/or water ecosystems. • Permanent loss of one or more species. Destruction of property/widespread flooding. Recovery time exceeding 6 months No recognition of the intent of legislation, Auckland Plan and Council's Mission, Goals and Principles.
Health and Safety (*Organisational and External*)	Injury requires first aid treatment, Insignificant discomfort requiring intervention e.g. workstation assessment.	Injury or illness requires treatment by a medical or other registered practitioner.	Injury or illness results in at least three days of lost time. Notice issued by regulator or Health and Safety Representative.	Injury or illness results in thirty days lost time, or a permanent disability. Organisation breaches law resulting in prosecution and penalties	One or more fatalities Considerable penalties and prosecutions. Multiple law suits and jail terms.

The **likelihood** of a hazard occurring is based on Appendix D of the Risk Management Framework (refer Figure 3). The assessment of likelihood is informed by the guidance provided by the Working Group during the workshops on the 12th September and 27th September as there is limited data available to inform the likelihood of a catchpit hazard occurring. An associated score is assigned on this basis.

Figure 3: Auckland Council risk likelihood guidance

	General description	Frequency expression
Almost certain 5	Risk event expected to occur in most circumstances	90% chance within next 12 months; or 18 out of every 20 years
Likely 4	Risk event will probably occur in most circumstances	55% chance within next 12 months; or 11 out of every 20 years
Possible 3	Risk event should occur at some time	25% chance within next 12 months; or 5 out of every 20 years
Unlikely 2	Risk event could occur at some time	10% chance within next 12 months; or 1 out of every 10 years
Rare 1	Risk event may occur only in exceptional circumstances	Up to 4% chance within next 12 months; or once in 25 years

The Auckland Council Risk Management Framework sets out a Risk Matrix in Appendix D for assigning a risk level to each hazard based on the likelihood and consequence scores (refer Figure 4).

Figure 4: Auckland Council risk matrix

4 Risk Assessment

4.1 General

This risk assessment is for a 'standard catchpit' (Section 2.2). A high level assessment of how risk could vary with other approved catchpit types is summarised in Section 4.2 below. There are also a large variety of 'standard' catchpits used across New Zealand. These have not been assessed as part of this assessment.

A risk register (refer Appendix A) has been developed containing the existing hazards, controls and risk ratings identified during the workshops and consultation undertaken with Auckland Council Healthy Waters and Auckland Transport. **In many cases the risk rating for hazards without Existing Controls would be high or extreme.**

It is assumed for the purpose of this assessment that the Existing Controls are applied and operating effectively and therefore the risk rating without controls in place has not been presented in the risk assessment table within this report. In all cases safety risks are lower with Existing Controls in place. **This emphasises the importance of continually reviewing, monitoring, and improving the existing controls**. The importance of Existing Controls is reflected as a recommendation in Section 6.

A summary of the Catchpit Safety Risk Register is shown in Table 2.

4.2 Other Approved Catchpits

A number of alternative catchpit types are approved for use by Auckland Transport. A list of the most common of these is provided in Table 1 and includes a summary of how the risk profile may differ compared to a standard catchpit. It is assumed the grates are not bolted down.

Table 1: Comparison of risks between 'standard' catchpits and other approved catchpits.

Catchpit Type	Impact to Risk Relative to 'Standard' Catchpit Design
Street Catchpit / MaxPit	Reduced likelihood of blockage risks due to more effective inlet and back entry. Reduced likelihood of cycle or vehicle accident due to cycle-friendly, on grade, grates. Reduced likelihood of injury to maintenance personnel due to lighter grates.
SplayPit / MetroPit	Eliminates risk related to public entry to catchpits as there is no grate. Eliminates cycle or vehicle accidents due to inappropriate grate installation as there is no grate. Reduced likelihood of blockage risks due to more effective back entry.
Megapit / Hush Pit	Reduced likelihood of blockage risks due to more effective inlet and back entry. Reduced likelihood of cycle or vehicle accident due to cycle-friendly, on grade, grates. Reduced likelihood of injury to maintenance personnel due to lighter grates.

Table 2: Catchpit Safety Risk Register

Ref ID #	Hazard Description	Impact	Existing Controls[1]	Likelihood	Consequence	Residual Risk Rating (RAG)
1	**Public Hazards**					
1.1	Child trapped on catchpit inlet during storm event	Could lead to injury	Catchpits cleaned twice per year, or on public call out to minimise risk of blockage. Requirements for spacing of new catchpits within Code of Practice (Auckland Transport, 2013).	1	3	Low
1.2	Person tries to open catchpit grate	Could lead to injury	Heavy catchpit grates used to mitigate against unauthorised access, makes opening difficult. Some catchpit grates are lockable.	3	3	Moderate
1.3a	Person attempts to retrieve item without becoming stuck	Could lead to injury	Heavy catchpit grate makes opening difficult. Existing system in place to enable public to contact Auckland Council and have item retrieved by maintenance personnel.	5	1	Moderate
1.3b	Person attempts to retrieve item and becomes stuck	Could lead to death/injury via drowning or lack of oxygen		1	5	Moderate
1.4	Contact with contaminated water in catchpit sump	Could lead to illness/disease	Public isolated from sump by catchpit grate.	1	2	Low
1.5	Person falls into open/missing catchpit grate	Could lead to injury	Catchpits inspected 6-52 times per year depending upon road service level. Catchpits cleaned twice per year, or on public call out. AC/AT emergency response procedure to replace grate on public notification.	1	3	Low
1.6a	Person falls into open/missing catchpit grate when it is obscured and full of water during or immediately after a storm event.	Could lead to death (child)/injury	Catchpits inspected 6-52 times per year depending upon road service level. AC/AT emergency response procedure to replace grate on public notification	1	5	Moderate
1.6b	Person trips on dislodged/damaged catchpit grate when it is obscured and full of water during or immediately after a storm event.	Could lead to injury	Catchpits cleaned twice per year, or on public call out. AC/AT emergency response procedure to replace grate or clear blockage on public notification.	1	3	Low

Ref ID #	Hazard Description	Impact	Existing Controls[1]	Likelihood	Consequence	Residual Risk Rating (RAG)
1.7	Blocked catchpit grate/back entry leads to water depth hazard on ground surface	Could lead to death/injury/illness (e.g. for child)	Catchpits inspected 6-52 times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out.	1	5	Moderate
1.8a	Blocked catchpit inlet reduces performance of drainage network increasing the likelihood of flooding on road other than high speed road (<50km/h) leads to loss of control of vehicle or accident as a result of evasive action from driver	Could lead to injury[2]	Catchpits inspected 6-52 times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out.	1	3	Low
1.8b	Blocked catchpit inlet on high speed road (>50km/h) leads to loss of control of vehicle or accident as a result of evasive action from driver	Could lead to injury[2]		1	3	Low
1.9a	Cyclist accident due to open/missing/dislodged/damaged catchpit grate	Could lead to injury[2]	Catchpits inspected 6-52 times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out. AC/AT emergency response procedure to replace grate on public notification.	1	3	Low
1.9b	Cyclist accident on unsafe catchpit arrangement/grate	Could lead to injury[2]	Auckland Transport Code of Practice[6] specifies cycle friendly grates to be installed in all new road construction and progressively across network (refer Section 13.5.7).	1	3	Low
1.10a	Vehicle accident on open/missing/dislodged/damaged catchpit grate – 2 Wheel Vehicle	Could lead to injury[2]	Catchpits inspected 6-52 times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out. AC/AT emergency response procedure to replace grate on public notification.	1	3	Low
1.10b	Vehicle accident on open/missing/dislodged/damaged	Could lead to injury	As per 1.10a. Additionally people wear seat belts (cars only) and have other safety features.	1	2	Low

[6] Auckland Transport Code of Practice - Chapter 13: Cycling Infrastructure Design, 2013

Ref ID #	Hazard Description	Impact	Existing Controls[1]	Likelihood	Consequence	Residual Risk Rating (RAG)
	catchpit grate – 4 Wheel Vehicle / Bus					
1.11	Damaged cast iron back entry – sharp edges	Could lead to injury	Catchpits inspected 6-52 times per year depending upon road service level.	1	2	Low
2	**Operations & Maintenance**					
2.1a	Contractor hurt trying to open catchpit grate while using T-bar tool	Could lead to injury	Catchpit T-bar tool, H&S training on Manual Lifting and correct PPE designed to reduce the chance of injury	1	3	Low
2.1b	Contractor hurt trying to open catchpit grate without using T-bar tool	Could lead to injury	H&S training on Manual Lifting and correct PPE designed to reduce the chance of injury	1	3	Low
2.2	Repetitive strain from opening multiple grates	Could lead to injury	Catchpit T-bar tool designed to reduce the chance of injury. Workload management.	1	3	Low
2.3a	Maintenance worker struck by vehicle in live road corridor while maintaining catchpit.	Could lead to injury	Left hand drive vehicle, sucker located on left hand side (i.e. operator excluded from live road corridor). Appropriate traffic management plans for the level of road. All operators trained to a minimum of Level 1 traffic controller. Standard operating procedures.	1	1	Low
2.3b		Could lead to injury/death	Right hand drive vehicle, sucker located at rear of vehicle. Appropriate traffic management plans for the level of road. All operators trained to a minimum of Level 1 traffic controller. Standard operating procedures.	1	5	Moderate
2.3c		Could lead to injury/death	Right hand drive vehicle, sucker located on left hand side. Appropriate traffic management plans for the level of road. All operators trained to a minimum of Level 1 traffic controller. Standard operating procedures.	1	5	Moderate
2.4	Malfunctioning or inappropriate use of sump cleaning equipment/truck	Could lead to injury/illness	Appropriate training/qualification/certification of personnel prior to use.	1	3	Low

Ref ID #	Hazard Description	Impact	Existing Controls[1]	Likelihood	Consequence	Residual Risk Rating (RAG)
2.5	Confined Space with water hazard	Could lead to injury	Correct application of work procedures and strict adherence to health and safety procedures	1	3	Low
2.6	Contact with contaminated water/debris from catchpit sump	Could lead to illness/disease	Appropriate PPE and training/qualification/certification of personnel prior to use. Maintenance contractors provided with access to first aid equipment, water, sanitiser, etc.	1	3	Low
2.7	Fall/stuck in open/dislodged/damaged catchpit	Could lead to injury	Correct application of work procedures and strict adherence to health and safety procedures	1	3	Low
2.8	Contractor damages / breaks grate / lid during catchpit maintenance	Could lead to injury	Contractor educated on correct maintenance procedures. Maintenance requirements considered in catchpit design.	1	3	Low

[1] Where applicable refer to Section 2.3 of the Catchpit Safety Review Report – Stage 2 regarding consultation with Auckland Council and Auckland Transport on maintenance and reporting schedules

2 Review of data provided from Auckland Transport has shown that no recorded deaths or serious injuries occurred in 2016 as a result of the specific hazard. Therefore, AT consider that consequence rating of 3 is appropriate. As further data becomes available these risks should be reviewed.

4.3 Key Risk Assessment Findings

The following key findings have been identified during the risk assessment process:

1. The Working Group do not consider any of the hazards identified are High or Extreme residual risks, when Existing Controls are in place. There are a number of Moderate and Low residual risks.

2. The likelihood of a person becoming stuck in a catchpit leading to death is considered Rare (Score 1). This is supported by the findings in the Catchpit Safety Report - Stage 1 (Opus, 2017). This risk is assessed as Moderate, based on the potential consequences.

3. There are a number of other risks currently assessed as Moderate that have the same likelihood score and consequence score as a person stuck in a catchpit leading to death:

    a. A person falling into an open or missing catchpit grate when obscured by water
    b. A catchpit grate becoming blocked and leading to drowning on the ground surface
    c. Operation/maintenance staff working in a live road corridor and being struck by a vehicle

    In most cases these risks are assessed as Moderate, rather than High due to the Rarity of the event occurring. The actual likelihood of each event occurring can vary while still resulting in a 'Rare' risk rating, however there is insufficient data to refine this further.

4. Further mitigation measures that reduce the likelihood of a drowning at a catchpit will not reduce the Risk score as 'Rare' is already the lowest score that can be applied by the Auckland Council Risk Matrix. This doesn't mean further action cannot, or should not, be undertaken. The actual likelihood may be able to be reduced, even if the Likelihood Score is not reduced.

5. Important points regarding interpretation of the results of the AC Risk Matrix:

    a. The Auckland Council Risk Matrix is only a tool to guide decision making and has some limitations.
    b. There is no differentiation between one death and one thousand deaths in the consequence assessment.
    c. **In applying the risk matrix it is not appropriate to compare one risk to another – each risk should be assessed in isolation to determine whether the residual risk is acceptable** (i.e. a High risk may be acceptable for one risk if all possible controls have been applied, but a Moderate risk may not be acceptable for another).
    d. It is unlikely to be practicable to eliminate all risk or achieve a score of Low across all risks. Further systems or processes could be put in place to control some risks, however it is not possible to control the freewill of people.

4.4 Risk Assessment Conclusion

The Working Group agreed that it was appropriate to investigate further mitigation measures that could reduce the health and safety risk to the public from catchpits, provided it did not unacceptably increase other risks.

5 Risk Mitigation

5.1 General

Auckland Council and Auckland Transport generally implement one or more Existing Controls to reduce the level of risk associated with the hazards described in Section 4. However, it is not always possible to eliminate risk and, as identified within the risk register (Table 1 and Appendix A), some level of residual risk is likely to still exist.

Within this section, Additional Controls have been assessed to determine if they can be practicably implemented to further reduce Residual Risk for each of the hazards previously identified.

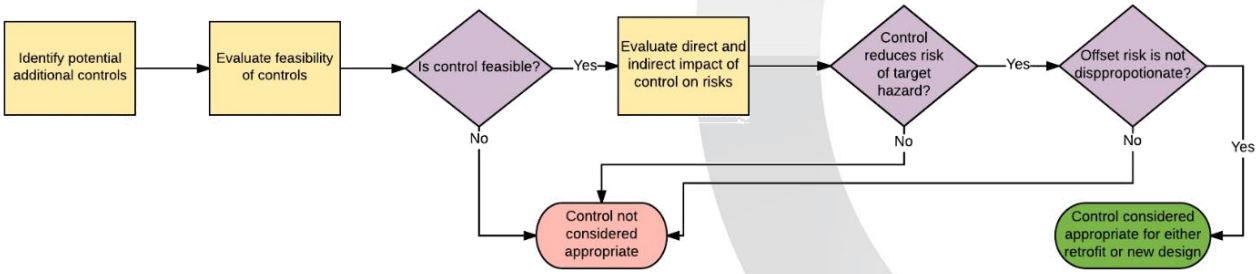
With reference to the original objective of this study, further risk mitigation is focussed on public health and safety risks. Risks associated with operations and maintenance hazards have been considered in the assessment process to assess whether any intervention on public risk has a negative impact on operational risk. Section 6 provides some recommendations with respect to Operation and Maintenance risk management.

5.2 Assessment of Potential Additional Controls

The following methodology (summarised in *Figure 5*) has been followed to identify and evaluate potential additional controls:

1. Identify potential Additional Controls;
2. Evaluate feasibility of Additional Controls by considering relative benefits (health and safety risk reduction) and constraints (barriers to implementation) through the workshops with the Working Group and subsequent analysis;
3. Evaluate impact of Additional Control on target hazard risk;
4. Identify whether implementation of any given Additional Control would result in a new hazard, or increase to the risk associated with an existing hazard;
5. Evaluate if Additional Control is appropriate for retrofit of existing catchpits or for new catchpit installations.

Figure 5: Flowchart of additional control evaluation process



A high level assessment of each Additional Control has been undertaken and is provided in Table 3.

Table 3: Assessment of Potential Additional Controls

Ref.	Potential Additional Control	Benefits	Constraints	Impact to Other H&S Risks	Outcome	Appropriate for Retrofit?	Appropriate for New Designs?
1	DANGER warning on catchpit back entry	• Informs the public and potentially reduces the likelihood of hazard from drowning or falls • Low cost to incorporate in new design • Could be imprinted into new concrete back entry with minimal additional cost.	• Will be difficult to retrofit on catchpits with steel back entry. • Any signage encourages vandalism (if installed as sign rather than imprint) • Relatively high cost for retrofitting existing catchpits. • Does not eliminate or isolate public from hazard of drowning or fall. • Most vulnerable people (e.g. children) may not be able to read warning. • Not all catchpits have back entry	• Safety risk to contractors from installation and additional maintenance to existing catchpits within live road corridor.	Control may provide some reduction in risk likelihood without significant increase of risk to new or other hazards. Some catchpits are already imprinted with a message 'Drains to Sea', or similar. In appropriate discharge of pollutants into the stormwater system is a significant issue across the Auckland Region. Discharge ends up in streams and at bathing beaches. Although not specifically assessed, the environmental risk associated with inappropriate discharge of pollutants should continue to be communicated to the public. The relative benefit of a health and safety warning imprinted on catchpit back entry is considered smaller than the potential environmental benefit from 'Drains to Sea' imprinted on back entry.	No	No
2	Contact number for retrieving items stamped on catchpit back entry	• Informs the public that help is available and potentially reduces the likelihood of hazard from drowning or falls • Low cost per to install or retrofit catchpit. • Could be imprinted into concrete back entry with minimal additional cost.				No	No
3	Improve public education on catchpit issues/dangers	• Reduces the duration of hazard exposure (e.g. blockage, damage, open) • Informs the public and potentially reduces the likelihood of hazard from drowning or falls • Relatively low cost to apply – website, adapt existing education programmes, advertising.	• Does not eliminate or isolate public from hazard of drowning or fall. • Message might not reach the most vulnerable people. • Message may be forgotten or misunderstood.	• No negative impacts to other H&S risks identified	Control may provide some reduction in risk likelihood without significant increase of risk to new or other hazards.	Yes	Yes
4	Improve public communication on advising AT/AC of missing catchpits / contamination risk	• Reduces the duration of hazard exposure (e.g. blockage, damage, open) • Reduces the likelihood of hazard from drowning or falls • Relatively low cost to apply – website, adapt existing education programmes, advertising.	• Does not eliminate or isolate public from hazard of drowning or fall.			Yes	Yes
5	Remove/replace deciduous street trees that increase blockage risk	• Reduces the likelihood of grate blocking by removing a key source of blockage. • Could be applied via Auckland Design Manual, but would require long term for real impact.	• Likely unachievable in existing urban areas due to impact on streetscape/neighbourhoods therefore would have negligible impact in short or medium term.	• Inherent risk to arborist undertaking tree removal • Risk to contractor during removal of trees from working in / adjacent to live road corridor • Street trees in urban environments offer other benefits including reduced air pollution	Removal of tree will have significant negative impact on streetscape and the environment. Creates significant additional health and safety risks to public and workers removing/replacing large number of trees. The increased risk from this control is considered disproportionate to benefits offered. Consider updating relevant Auckland Design Manual document and / or Auckland Transport Vegetation in Road Corridor Guidelines (currently in draft form) to explicitly consider selection of tree species in areas where a greater risk to the public is identified.	No	Potentially
6	Use more effective inlet catchpits instead of standard catchpits (refer Section 2.2.1)	• Reduces the likelihood of catchpit blocking • Reduces the likelihood of aquaplaning or surface drowning hazards • Existing products already available. • Can be retrofitted in some cases. • Use ductile iron which is stronger than typical cast iron grates (damage less likely)	• Higher cost per catchpit • Catchpit grates can still be opened by the public, unless they are bolted down. • Site constraints may limit application of this control, e.g. existing services in the berm, or insufficient space available for a larger catchpit.	• Installation health and safety risk for contractor installing in live road corridor. • Bolted down inlets increases hazard to maintenance contractors through repetitive strain and/or increased time in hazardous road corridor (Ref. 9).	This control is already undertaken on occasion and it may continue to be appropriate for use on a case by case basis, particularly if undertaken in combination with a grate that can only be opened with a special tool (Ref 14). A site-specific assessment would be required to demonstrate that the benefits offered outweigh the constraints.	Potentially	Potentially

Ref.	Potential Additional Control	Benefits	Constraints	Impact to Other H&S Risks	Outcome	Appropriate for Retrofit?	Appropriate for New Designs?
		• Grates cycle friendly	• Additional/different maintenance requirements to standard catchpit. • Increases likelihood of blockage of downstream network increasing maintenance costs.				
7	Use splay catchpits instead of standard catchpit (refer Section 2.2.1)	• Isolates public from hazards of drowning or falls • Eliminates hazards for cyclists	• Not suitable for use in all locations (i.e. areas with multiple utilities within berm), or insufficient space available for a larger catchpit. • Where located adjacent to shared use path can impact maintenance if vacuum truck cannot reach manhole from road. Also requires management of shared use/cycle lane traffic.	• Potential to increase blockage downstream leading to increased risk to maintenance workers • Increases maintenance requirements • Can create hazard during maintenance to shared use path/cycle lane.	This control is already undertaken on occasion and may continue to be appropriate for use on a case by case basis. An assessment would be required to demonstrate that the benefits offered outweigh the constraints and potential increased risks to other hazards.	Potentially	Potentially
8	Improve back entry design to reduce ponding	• Reduces the likelihood of inlet blocking • Reduces the likelihood of aquaplaning or surface drowning hazards	• No product currently on the market for standard catchpits, so requires further design and development, although high capacity inlet catchpits have this technology. • Increases likelihood of blockage of downstream network increasing maintenance costs. • Increases litter/debris that enters downstream waterways.	• Potential to increase blockage downstream leading to increased risk to maintenance workers and increased flood risk to the public	This control may be appropriate for use on a case by case basis, however requires further design and development to consider feasibility. An assessment would be required to demonstrate that the benefits offered outweigh the constraints and potential increased risks to other hazards.	No	Potentially
9	Avoid catchpits in cycle lanes/high cycle areas	• Eliminates hazard of cycle injuries	• Potential reduction in system performance/increased flood risk as catchpits may not be able to be located in optimum drainage locations. • Increases surface water hazard for cyclists/public.	• Potential to increase flood hazard within cycle lanes/road corridor.	Removal of existing catchpits unlikely to be suitable due to impact on cycleway/road operation and drainage. Control may be suitable for use in new designs on a case by case basis. An assessment would be required to demonstrate that the benefits offered outweigh the constraints and potential increased risks to other hazards. Consider expanding guidance in the Auckland Transport Code of Practice to include requirement that designs minimise number of catchpits required in high cyclist traffic areas.	No	Potentially
10	Use ‘continuous capture inletting’ (e.g. KerbDrain) rather than conventional kerbs and channel	• Eliminates likelihood of falls or drowning • Reduces the likelihood of inlet blocking due to multiple inlets/system redundancy • Reduces flow width in the carriageway, reducing surface water hazard to road users. • Eliminates catchpit hazards for cyclists • Tested and approved for use overseas (e.g. UK, Australia)	• Capital and maintenance costs likely to be higher in most applications. Sumps still required to capture sediment. • Gross pollutants left in the street. • Difficult to inspect to identify blockage locations. • Potential increased risk to maintenance contractors • Potential operational impact if inlets are partially blocked when roads are resealed – requires a set back from road seal.	• Maintenance requirements uncertain. Austroads (refer Section 5.3.2) notes that consideration needs to be made for increased routine maintenance. Maintenance requirements should be assessed for Auckland context prior to adoption.	Significant works required in order to replace existing road drainage. Unlikely to be suitable due to increased risk to maintenance contractors and risk posed to public and contractors from associated works. Control may be suitable for use in new designs on a case by case basis. An assessment would be required to demonstrate that the benefits offered outweigh the constraints and potential increased risks to other hazards.	No	Potentially

Ref.	Potential Additional Control	Benefits	Constraints	Impact to Other H&S Risks	Outcome	Appropriate for Retrofit?	Appropriate for New Designs?
11	Use grated channel	• Eliminates likelihood of falls or drowning • Reduces the likelihood of inlet blocking due to multiple inlets/system redundancy • Reduces flow width in the carriageway, reducing surface water hazard to road users. • Eliminates catchpit hazards for cyclists	• Capital and maintenance costs likely to be higher in most applications. Sumps still required to capture sediment. • Gross pollutants left in the street. • Potential increased risk to maintenance contractors • Potential operational impact if inlets are partially blocked when roads are resealed – requires a set back from road seal.	• Requires increased maintenance consisting of high pressure washer and vacuum along length of drain, increasing health and safety risk to operators from both repetitive strain and being located in the live road corridor.	In most cases this will not be suitable for the road corridor due to the significantly higher operational and maintenance requirements and increases health and safety risks to operators. Grated channels can be used in some circumstances, as outlined in Section 17.8 of the AT CoP, particularly in shared public space. Grated channels should be considered as part of a Safety in Design approach (Ref. 17).	No	Potentially
12	Install bolts on all catchpit grates	• Isolates public from hazards of drowning or falls.	• Increases hazard to maintenance contractors through repetitive strain and/or increased time in hazardous road corridor • Catchpits can still be opened by the public as bolt holes on standard catchpits are only at one end, so grate can potentially be pivoted. Alternative is to tap and bolt a metal bar across the centre of the catchpit grate. • May result in some catchpits not being maintained adequately due to bolts seizing and unable to be removed.	• Increases hazard to maintenance contractors through repetitive strain and/or increased time in hazardous road corridor	Control would result in a significant increase of risk to maintenance contractors. Control unlikely to be appropriate for retrofitting or new designs. Suggest use of special tool for achieving the desired outcome from this control (refer control ref. 11)	No	No
13	Install bolts on higher priority catchpit grates only	• Reduces the likelihood of hazard from drowning or falls					
14	Make catchpits only openable with special tool (like manholes)	• Isolates public from hazards of drowning or falls. • Maintenance contractors already use a tool to open catchpits. • Negligible additional operational or maintenance workload or risk.	• No product currently on the market for standard catchpits, so requires further design and development, although products do exist with this technology. • Likely higher cost per catchpit. • Based on discussion with supplier, retrofit onto standard catchpit sumps requires both the grate and frame being replaced (this can be done on most existing sumps).	• Negligible impact to maintenance contractors.	This control may be suitable for retrofit on a case by case basis. An assessment would be required to demonstrate that the benefits offered outweigh the constraints and potential increased risks to other hazards. Implementation of control in new catchpit design may offer convenient method of reducing safety risk associated with unauthorised access to catchpit without significant impact of increased risk to new or other hazards.	Potentially	Yes
15	Include an insert within catchpits to capture items dropped down catchpits (e.g. Littatrap)	• Would capture items dropped down a catchpit at a higher level than the sump water level making them easier to retrieve. • May assist in prevents a person falling in and becoming stuck. • Existing product already available for standard catchpits • Provides additional treatment of stormwater flows by providing capture of gross pollutants	• Does not eliminate or isolate public from hazard of drowning or fall. • Potentially encourages people to access catchpits to retrieve their lost item.	• Increases hazard to maintenance contractors through additional maintenance requirements	As this intervention does not isolate people from the catchpit, is not designed to provide a health and safety function (unlike a grate) and may encourage access, it is not recommended as a specific health and safety measure. Nonetheless, where a gross pollutant trap (e.g. LittaTrap or similar) can be justified on environmental risk, it is likely to have a health and safety benefit for the public. Other catchpit inserts (e.g. Enviropod or TetraTrap) would not provide the same Health and Safety benefit as they do not isolate gross pollutant (or personal items) within arm's reach.	No	No
16	Include an insert within catchpits to prevent the public getting stuck headfirst (e.g. horizontal bar across centre of inside catchpit unit).	• Provides a partial barrier to people becoming stuck and reduces likelihood of hazards of drowning or falls.	• No product currently on the market for standard catchpits, so requires further design and development • Potential reduction in system performance/increased flood risk	• Likely significant increased risk to contractor to retrofit inside an existing catchpit – requires activity in confined space in live road corridor. • Increases hazard to maintenance contractors through additional maintenance requirements	Control may help to mitigate but does not eliminate drowning hazard. This control is considered more difficult to implement relative to others which achieve the same or better outcome (e.g. catchpits openable with special tool). Control likely to have construction risks associated with it (e.g. confined space entry) and increased maintenance requirements.	No	No

Ref.	Potential Additional Control	Benefits	Constraints	Impact to Other H&S Risks	Outcome	Appropriate for Retrofit?	Appropriate for New Designs?
17	Safety in Design applied to the location and type of catchpits/drainage	• Can eliminate or minimise hazard before potential hazard exists	• Does not address risks from existing catchpits	• Depends on treatment proposed	Consider expanding guidance in the Auckland Transport Code of Practice to explicitly require Safety in Design for catchpits.	No	Yes
18	Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots.	• Utilises information already gathered to proactively target interventions or maintenance activities.	• May misrepresent risk in some areas where faults are reported relative to other areas. • Potential increased cost to proactively maintain compared to reactively.	• No negative impacts to risks identified	Proactively maintaining known hotspots already occurs with respect to flooding, however there is the opportunity to take this further by considering public health and safety as well as flooding.	Yes	Yes
19	Review and formalise the process for maintenance contractors to report and manage missing / damaged grates.	• Reduces the duration of hazard exposure (e.g. blockage, damage, open) • Relatively low cost to apply – procedures and training for staff	• Will only happen twice per year when catchpit maintenance is undertaken	• No negative impacts to risks identified	This control likely to provide reduction in risk likelihood without increase of risk to new or other hazards. Consideration will be required of the impact on maintenance logistics.	Yes	No

5.3 Excluded Controls

A number of Additional Controls were identified and ruled out early on by the Working Group. A summary of these Additional Controls is included in Table 4.

Table 4: Potential Additional Controls not considered for further investigation

Potential Additional Control	Reason Not Considered for Further Investigation
Avoid catchpits in areas of play (e.g. close to playgrounds)	Not practicable. Removal of catchpits would result in increased flood risk and associated increase in public safety risk.
Additional screening to reduce probability of items entering catchpit	This would increase risk of blockage resulting in increased flood risk and associated increase in public safety risk.
Increase spacing between catchpits to reduce number of hazard locations	This would reduce capacity of the drainage system to manage storm events leading to increased flood risk. Removal of catchpits would result in increased flooding and associated increase in public safety risk.
Increase inspection / cleaning frequency	At a regional level Auckland Council and Auckland Transport consider that inspection / cleaning frequency has been optimised based on the operational requirements of the network and does not offer significant benefit regarding public safety.
Make catchpit grates heavier	Increased health and safety risk to maintenance contractors is considered to offset any potential benefit to reduction of public safety risk.

5.4 Risk Treatment for Existing Catchpits

Auckland Council's Risk Management Framework identifies Risk Treatment as:

> *The process to modify (positively) the risk in terms of its consequence or likelihood. For each risk, consideration is either:*
>
> *Treat – additional control measures to reduce consequences and/or likelihood*
>
> *Tolerate – accept current level of risk.*
>
> *Terminate – remove the source of risk.*
>
> *Transfer – transfer risk to a third party generally by means of insurance or to another entity*.

Recommended Additional Controls in Table 5 have been grouped into Risk Treatments for Existing Catchpits. A Risk Treatment is set out for each of the public safety risks identified in the Catchpit Safety Risk Register (Appendix A).

Risk Treatment relates to mitigating risk from existing catchpits. Additional Controls which can be considered for new catchpit installations are discussed in Section 6.

Table 5: Summary of Recommended Risk Treatment for Existing Catchpits

Priority	Control ID	Proposed Risk Treatment Control	Detail
1	3 & 4	**EDUCATION** Improve public education on advising of catchpit issues/dangers and the importance of reporting missing catchpits	Raising awareness within the community of hazards associated with stormwater assets represents an easy-to-implement intervention which has the potential to reduce the likelihood of hazards related to drowning or falls. However, this control does not eliminate risk and should be considered along with more specific controls for higher priority catchpits. Auckland Council currently have a process in place for members of the public to request retrieval of lost items in a catchpit. This service is not explicitly advertised on their website. Additionally, Auckland Council have a web page dedicated to stormwater issues including flooding, blockages and missing / displaced assets (although there is no information relating to general safety issues concerning stormwater assets / catchpits). Auckland Transport currently have a process in place for members of the public to report missing catchpit grates. These reports are treated as an emergency incident and responded to within 1 hour. Auckland Council and Auckland Transport could prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes. This could include: 1. Improved advertising of the service to retrieve lost items in catchpits and reporting missing/damaged catchpits. 2. Communicating hazards – website, schools, Our Auckland magazine, events, Council organisation staff and contractors, etc. The scope of this Public Communication Plan could be expanded to cover other hazards in the road corridor.
2	14	**GRATE DESIGN IMPROVEMENT** Make catchpits only openable with special tool	Upgrading existing higher priority catchpits so they can only be opened with a special tool represents an opportunity to isolate the public from the risk of drowning or falls associated with standard catchpits. This technology already exists in some overseas catchpits, however is not currently available for catchpits sold in New Zealand. This control may be suitable for retrofit to existing catchpits on a case by case basis. Auckland Council have installed and are trialling a spring bar locking catchpit at two locations in South Auckland (refer Appendix B for details). Subject to a successful trial, Auckland Transport and Auckland Council will need to work closely with suppliers to prepare a suitable specification and update the associate Code of Practice(s). Discussion with suppliers has indicated that replacement of both the catchpit grate and frame would be required.

Priority	Control ID	Proposed Risk Treatment Control	Detail
3	6, 7 & 15	**CATCHPIT UPGRADE** Use more effective catchpits, splaypits or LittaTrap (or similar)	Upgrading existing catchpits represents an opportunity to improve public safety at the same time as achieving other catchment management or road corridor objectives. For example: 1. Upgrade to a Street Catchpit or Megapit to reduce blockage-related risks, likelihood of catchpit damage, flooding and cycle hazard. 2. Upgrade to a Splaypit to eliminate cycle hazards, isolate the public from drowning/falls, and reduce blockage-related risks and flooding. 3. Upgrade existing catchpits to include a LittaTrap to reduce gross pollutants entering streams and bathing beaches, whilst providing a means to capture personal items that may have dropped through the grate. However, this is not recommended as a safety measure in isolation. These controls may be appropriate for use on a case by case basis. A site assessment would be required to demonstrate that the benefits offered outweigh the constraints and potential increased maintenance. Use of splay catchpits at a particular site is sometimes limited as they can take up more space and have the potential to clash with existing utilities exists.
4	18 & 19	**PRACTICE** Refine existing operations and maintenance procedures	This could include: 1. Review and formalise (if necessary) procedures for maintenance contractors to follow in the event they find a missing or damaged catchpit grate. Procedure should be established such that when a missing / damaged catchpit is found by maintenance contractors, the catchpit is made safe prior to moving on with catchpit maintenance. 2. Auckland Council currently maintain a register of reported catchpit faults which are linked to their asset ID in GIS. This data could be used to identify higher priority catchpit hotspots where Additional Controls or proactive maintenance/inspection can be implemented. 3. A quality assurance loop to audit how well Existing Controls are working.

6 Recommendations

6.1 General

The assessment of existing catchpit safety hazards undertaken has identified Existing Controls already being implemented by Auckland Council, Auckland Transport and the relevant maintenance contractors to reduce risk associated with these hazards (refer Section 4). Although not reported here, these Existing Controls significantly reduce the safety risk to the public and operators. Most notably the catchpit grate itself is an Existing Control which helps to isolate the public from drowning and fall hazards. The Existing Controls, coupled with the extremely rare occurrence of serious incidents, mean catchpits are, when used as designed and intended, safe devices.

Despite implementing Existing Controls, due to the inherent nature of risk management it is often not possible to completely remove risks. Further to this, risk can change with time and environment, and controls should be regularly reviewed and updated. This assessment has identified potential Additional Controls which may further reduce residual risks associated with catchpit safety hazards.

This assessment is the first step for Auckland Council and Auckland Transport in further mitigating risk. The outcome of the assessment are the following recommendations. Further work is required by Auckland Council or Auckland Transport to confirm the requirements and their feasibility for implementation.

Recommendations are split into:

1. **Catchpit Drowning Hazard Recommendations** – these directly relate to the tragic incident that occurred on the 3rd June 2017. Some of these recommendations can be implemented to reduce the risk to existing assets. Some are recommendations for new installations – in particular catchpit selection process.

2. **Other Safety Recommendations** – although this assessment has been driven by the risks associated with the public accessing catchpits, a number of other safety recommendations have been identified that could be implemented by Auckland Council or Auckland Transport.

6.2 Catchpit Drowning Hazard Recommendations

6.2.1 Education

Raising awareness, within the community, of hazards associated with stormwater assets represents an easy-to-implement intervention which has the potential to reduce the likelihood of hazards related to drowning or falls. However, this Additional Control does not eliminate risk and should be considered along with more specific controls for higher priority catchpits.

Auckland Council currently have a process in place for members of the public to request retrieval of lost items in a catchpit. However, this service is not explicitly advertised on their website. Additionally, Auckland Council have a web page dedicated to stormwater issues including flooding, blockages and missing / displaced assets (although there is no information relating to general safety issues concerning stormwater assets / catchpits).

Auckland Transport currently have a process in place for members of the public to report missing catchpits. These reports are treated as an emergency incident and responded to within 1 hour.

Recommendation 1: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes.

This could include:

1. Improved advertising of the service to retrieve lost items in catchpits and reporting missing/damaged catchpits.
2. Communicating hazards – website, schools, Our Auckland magazine, events, Council organisation staff and contractors, etc.

The scope of this plan could be expanded to cover other hazards in the road corridor.

6.2.2 Prioritisation and Feasibility Assessment

It will be necessary for Auckland Council and Auckland Transport to understand which catchpits may need further interventions. Auckland Council have previously developed a safety assessment tool to assess the relative safety risks associated with manholes, culverts, open channels and ponds/wetlands.

Recommendation 2: It is recommended that Auckland Council consider updating their existing safety assessment tool to identify if there are any catchpits where there is a higher risk to the public. This can then be used to enable prioritisation and undertake a feasibility assessment of retrofitting interventions.

6.2.3 Grate Design Improvement

Options to mitigate against unauthorised access to catchpits have been evaluated as part of this assessment. In assessing these options, emphasis has been made on ensuring any potential Additional Controls implemented would not create new hazards, or disproportionately increase the risk of other existing hazards.

Subject to the outcome of the prioritisation and feasibility assessments outlined above, making catchpits only accessible with a special tool, such as a spring bar or similar mechanism, may be suitable for new catchpit designs, retrofitting exiting catchpits if any catchpits are identified as having a higher risk to the public or maintenance contractors and as part Auckland Transport and Auckland Council renewals programmes. . These types of mechanisms can prevent unauthorised access to catchpit units. It is expected this will have negligible effect on the health and safety risk to maintenance contractors. Although products do exist using this type of mechanism, no product currently exists on the market for standard catchpits and would therefore require further design and development.

Recommendation 3: Auckland Transport and Auckland Council Healthy Waters department work with suppliers to develop a design standard and specification for lockable catchpit grates and consider updating the Code of Practice accordingly.

Recommendation 4: Subject to the outcome of the prioritisation and feasibility assessments outlined above, Auckland Council and Auckland Transport consider developing a programme to retrofit the specified lockable catchpit grate to existing catchpits where there is deemed a higher risk of public attempting to access a catchpit (refer Recommendation 2).

In development of any new catchpit design, Safety in Design (as required by the Health and Safety at Work Act 2015) should consider any hazards through the full lifecycle of the product, including fabrication, installation, use (ability to convey flows), maintenance and decommissioning. In particular, maintaining ready access to the catchpit sump for maintenance workers, without increasing risks associated with repetitive strain or time spent in live road corridors would be necessary. Requirement for adoption of lockable catchpits in the Code of Practice should be reviewed based on the outcome of initial trials.

6.2.4 New Catchpit Installations - Code of Practice

The outcome of the Stage 1 catchpit safety review found that Auckland Council and Auckland Transport are managing safety around catchpits in a similar manner relative to other local authorities around New Zealand, and internationally. Catchpit risks to the public, whether from access, blockage or cycling, could be kept as low as reasonably practicable at the design stage through application of Safety in Design.

Recommendation 5: Highlight in the Auckland Transport Code of Practice the need to assess public and operator safety in catchpit/surface drainage design, in accordance with the Health and Safety at Work Act 2015 and Auckland Transport's Safety in Design requirements.

Austroads acknowledges proprietary continuous capture inletting devices such as KerbDrain provide a solution in locations where flat crossfall and road gradients result in the wide spread of gutter flow or where constrained by other utilities. These devices can significantly reduce, if not eliminate, a number of catchpit safety risks

including unauthorised access to sumps by members of the public. However, Austroads advises consideration needs to made regarding the potential for increased maintenance requirements.

Recommendation 6: Auckland Transport to identify where 'continuous capture inletting' could be appropriate as an alternative to new conventional kerbs and channel and update the Code of Practice accordingly.

6.2.5 Maintenance Operation Practices

Managing risk assumes Existing Controls are applied and operating effectively. Without them risk would be significantly higher.

Recommendation 7: In light of the increased awareness of safety at catchpits, it is recommended health and safety procedures in relation to catchpit maintenance are reviewed for opportunities to reduce the health and safety risk to the public and maintenance contractors.

This could include:

1. Review and formalising procedures for maintenance contractors to follow in the event they find a missing or damaged catchpit grate. Procedure should be established such that when a missing / damaged catchpit is found by maintenance contractors, the catchpit is made safe prior to moving on with catchpit maintenance.

2. Auckland Council currently maintain a register of reported catchpit faults which are linked to their asset ID in GIS. This data could be used to identify high priority catchpit hotspots where Additional Controls or proactive maintenance/inspection can be implemented.

3. A quality assurance loop to audit how well Existing Controls are working.

6.3 Other Safety Recommendations

The current standard catchpit design has a minimum 50mm back entry inlet, however this narrows significantly below the grate frame.

Recommendation 8: Auckland Transport work with suppliers to identify how the back entry on the standard catchpit could be improved to reduce the safety risks associated with surface water (e.g. blockage).

Although removal and replacement of all deciduous street trees that result in catchpit blockage is not considered practicable, the following update to the **Auckland Transport Vegetation in Road Corridor Guidelines** is recommended to reduce the likelihood of blockage over time or damage from root systems:

Recommendation 9: Auckland Council and Auckland Transport include a requirement to consider selection of tree species that practically minimise damage from root systems or leaf fall in order to reduce the risk of blockage and surface water hazards.

There is ambiguity within the Auckland Transport Code of Practice on when cycle-friendly catchpit grates are to be used. Section 13.5.7 specifies cycle-friendly grates are *to be installed in all new road construction*. Section 17.8.5 states cycle-friendly grates are required *where cyclists may travel close to the drainage channel*.

Recommendation 10: Auckland Transport clarify in the updated Auckland Transport Code of Practice where cycle-friendly catchpit grates are to be used.

Stage 1 of this study identified there are a large variety of 'standard' catchpits used across New Zealand.

Recommendation 11: Auckland Council communicate the findings of this report to other local authorities, who could consider how the risk profile may change with their 'standard' catchpit.

7 References

1. Opus International Consultants (2017). *Royalpark Place Catchpit Safety Review: Stage 1*.
2. Auckland Transport (2013). *Auckland Transport Code of Practice*. https://at.govt.nz/about-us/auckland-transport-code-of-practice [downloaded: 30th October 2017].
3. Auckland Council. Risk Management Framework (provided September 2017).

Appendix A
Catchpit Health and Safety Risk Register

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RISK ASSESSMENT PROFORMA – 'STANDARD' 675MM X 450MM CATCHPIT
31st October 2017
Version 1.0

Ref ID #	Hazard Description	Impact	Existing Controls[1]	Likelihood	Consequence	Residual Risk Rating (RAG)	Possible Additional Controls[4]	Risk Treatment Plan Summary for existing catchpits[2]	Review Date
1	**Public Hazards**								
1.1	Child trapped on catchpit inlet during storm event	Could lead to injury	Catchpits cleaned twice per year, or on public call out to minimise risk of blockage. Requirements for spacing of new catchpits within Code of Practice (Auckland Transport, 2013).	1	3	Low	3. Improve public education on advising of catchpit issues / dangers 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots.	**Education -** Recommendation 1 / Controls 3 & 4: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes.	31/10/2017
1.2	Person tries to open and / or remove catchpit grate	Could lead to injury	Heavy catchpit grates used to mitigate against unauthorised access, makes opening difficult. Some catchpit grates are lockable.	3	3	Moderate	1. DANGER warning on catchpit back entry 2.Contact number for retrieving items stamped on catchpit back entry 3. Improve public education on advising of catchpit issues / dangers 4. Improve public communication on advising AT/AC of missing catchpits / contamination risk 7. Use splay catchpits instead of standard catchpit 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 12. Install bolts on all catchpit grates 13. Install bolts on high risk catchpit grates only 14. Make catchpits only openable with special tool (like manholes) 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots. 19. Implement formal process for maintenance contractors to report and manage missing / damaged grates, accompanied by training.	**Education -** Recommendation 1 / Controls 3 & 4: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes. **Grate Design Improvement -** Recommendation 3 / Control 14: Make catchpits only openable with special tool **Catchpit Upgrade -** Recommendations 7 / Controls 6, 7 & 15: Use high capacity inlet catchpits, splaypits or LittaTrap (or similar) **Practice -** Recommendation 6 / 18 & 19: Refine existing operations and maintenance procedures	31/10/2017
1.3a	Person attempts to retrieve dropped item without becoming stuck	Could lead to injury	Heavy catchpit grate makes opening difficult. Existing system in place to enable public to contact Auckland Council and have item retrieved by maintenance personnel.	5	1	Moderate			31/10/2017
1.3b	Person attempts to retrieve dropped item and becomes stuck	Could lead to death/injury via drowning or lack of oxygen		1	5	Moderate			31/10/2017
1.4	Contact with contaminated water in catchpit sump	Could lead to illness/disease	Public isolated from sump by catchpit grate. Half syphon used on catchpits in combined sewer areas to minimise backflow of sewage into catchpits.	1	2	Low			31/10/2017
1.5	Person falls into open/missing catchpit grate	Could lead to injury	Catchpits inspected times per year depending upon road service level. Catchpits cleaned twice per year, or on public call out. AC/AT emergency response procedure to replace grate on public notification.	1	3	Low	3. Improve public education on advising of catchpit issues / dangers 4. Improve public communication on advising AT/AC of missing catchpits / contamination risk 7. Use splay catchpits instead of standard catchpit 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 12. Install bolts on all catchpit grates 13. Install bolts on high risk catchpit grates only 14. Make catchpits only openable with special tool (like manholes) 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots. 19. Implement formal process for maintenance contractors to report and manage missing / damaged grates, accompanied by training.		31/10/2017

1.6a	Person <u>falls into open/missing</u> catchpit grate when it is obscured and full of water during or immediately after a storm event.	Could lead to death (child)/injury	Catchpits inspected times per year depending upon road service level. AC/AT emergency response procedure to replace grate on public notification	1	5	Moderate	3. Improve public education on advising of catchpit issues / dangers 4. Improve public communication on advising AT/AC of missing catchpits / contamination risk 5. Remove/replace deciduous street trees that increase blockage risk 6. Use high capacity inlet catchpits instead of standard catchpits 7. Use splay catchpits instead of standard catchpit 8. Improve backentry design to reduce ponding 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 12. Install bolts on all catchpit grates 13. Install bolts on high risk catchpit grates only 14. Make catchpits only openable with special tool (like manholes) 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots. 19. Implement formal process for maintenance contractors to report and manage missing / damaged grates, accompanied by training.	**Education -** Recommendation 1 / Controls 3 & 4: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes. **Grate Design Improvement -** Recommendation 3 / Control 14: Make catchpits only openable with special tool **Catchpit Upgrade -** Recommendations 7 / Controls 6, 7 & 15: Use high capacity inlet catchpits, splaypits or LittaTrap (or similar) **Practice -** Recommendation 6 / 18 & 19: Refine existing operations and maintenance procedures	31/10/2017
1.6b	Person <u>trips on dislodged/damaged</u> catchpit grate when it is obscured and full of water during or immediately after a storm event.	Could lead to injury		1	3	Low			31/10/2017
1.7	Blocked catchpit grate/back entry leads to water depth hazard on ground surface	Could lead to death/injury/illness (e.g. for child)	Catchpits inspected times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out.	1	5	Moderate	5. Remove/replace deciduous street trees that increase blockage risk 6. Use high capacity inlet catchpits instead of standard catchpits 8. Improve backentry design to reduce ponding 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots.	**Catchpit Upgrade -** Recommendations 7 / Controls 6, 7 & 15: Use high capacity inlet catchpits, splaypits or LittaTrap (or similar) **Practice -** Recommendation 6 / 18 & 19: Refine existing operations and maintenance procedures	31/10/2017
1.8a	Blocked catchpit inlet reduces performance of drainage network increasing the likelihood of flooding <u>on road other than high speed road (>50km/h)</u> leads to loss of control of vehicle or accident as a result of evasive action from driver	Could lead to injury[3]	Catchpits inspected 6-52 times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out.	1	3	Low			31/10/2017
1.8b	Blocked catchpit inlet <u>on high speed road (>50km/h)</u> leads to loss of control of vehicle or accident as a result of evasive action from driver	Could lead to injury[3]		1	3	Low			31/10/2017
1.9a	Cyclist accident <u>due to open / missing / dislodged / damaged</u> catchpit grate	Could lead to injury[3]	Catchpits inspected 6-52 times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out. AC/AT emergency response procedure to replace grate on public notification.	1	3	Low	3. Improve public education on advising of catchpit issues / dangers 4. Improve public communication on advising AT/AC of missing catchpits / contamination risk 7. Use splay catchpits instead of standard catchpit 9. Avoid catchpits in cycle lanes/high cycle areas 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 12. Install bolts on all catchpit grates 13. Install bolts on high risk catchpit grates only 14. Make catchpits only openable with special tool (like manholes) 17. Safety in Design applied to the location and type of catchpits/drainage 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots. 19. Implement formal process for maintenance contractors to report and manage missing / damaged grates, accompanied by training.	**Education -** Recommendation 1 / Controls 3 & 4: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes. **Grate Design Improvement -** Recommendation 3 / Control 14: Make catchpits only openable with special tool **Catchpit Upgrade -** Recommendations 7 / Controls 6, 7 & 15: Use high capacity inlet catchpits, splaypits or LittaTrap (or similar) Practice - Recommendation 6 / 18 & 19: Refine existing operations and maintenance procedures	31/10/2017

1.9b	Cyclist accident on unsafe / slippery catchpit arrangement / grate	Could lead to injury[3]	Auckland Transport Code of Practice specifies cycle friendly grates to be installed in all new road construction and progressively across network (refer Section 13.5.7). Auckland	1	3	Low	3. Improve public education on advising of catchpit issues / dangers 7. Use splay catchpits instead of standard catchpit 9. Avoid catchpits in cycle lanes/high cycle areas 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 17. Safety in Design applied to the location and type of catchpits/drainage 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots.	**Education -** Recommendation 1 / Controls 3 & 4: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes. **Catchpit Upgrade -** Recommendations 7 / Controls 6, 7 & 15: Use high capacity inlet catchpits, splaypits or LittaTrap (or similar) **Practice -** Recommendation 6 / 18 & 19: Refine existing operations and maintenance procedures	31/10/2017
1.10a	Vehicle accident on open/missing/dislodged/damaged catchpit grate – 2 Wheel Vehicle	Could lead to injury[3]	Catchpits inspected 6-52 times per year depending upon road service level. Roads swept a minimum of 3 times per year. Catchpits cleaned twice per year, or on public call out. AC/AT emergency response procedure to replace grate on public notification.	1	3	Low	3. Improve public education on advising of catchpit issues / dangers 4. Improve public communication on advising AT/AC of missing catchpits / contamination risk 7. Use splay catchpits instead of standard catchpit 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 12. Install bolts on all catchpit grates 13. Install bolts on high risk catchpit grates only 14. Make catchpits only openable with special tool (like manholes) 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots. 19. Implement formal process for maintenance contractors to report and manage missing / damaged grates, accompanied by training.	**Education -** Recommendation 1 / Controls 3 & 4: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes. **Grate Design Improvement -** Recommendation 3 / Control 14: Make catchpits only openable with special tool **Catchpit Upgrade -** Recommendations 7 / Controls 6, 7 & 15: Use high capacity inlet catchpits, splaypits or LittaTrap (or similar) **Practice -** Recommendation 6 / 18 & 19: Refine existing operations and maintenance procedures	31/10/2017
1.10b	Vehicle accident on open/missing/dislodged/damaged catchpit grate – 4 Wheel Vehicle or Bus	Could lead to injury/illness	As per 1.10a plus people wear seat belts and cars have safety features.	1	2	Low			31/10/2017
1.11	Damaged cast iron back entry – sharp edges	Could lead to injury	Catchpits inspected 6-52 times per year depending upon road service level.	1	2	Low	3. Improve public education on advising of catchpit issues / dangers 4. Improve public communication on advising AT/AC of missing catchpits / contamination risk 10. Use 'continuous capture inletting' (e.g. KerbDrain) rather than conventional kerbs and channel 11. Use grated channel 18. Use GIS information gathered on requests for service and catchpit fault to identify issue hotspots.	**Education -** Recommendation 1 / Controls 3 & 4: Auckland Council and Auckland Transport prepare a public communication plan that sets out how the organisations intend to improve public awareness of catchpit hazards and Council processes. **Practice -** Recommendation 6 / 18 & 19: Refine existing operations and maintenance procedures	31/10/2017

2	**Operations / Maintenance Hazards**								
2.1a	Contractor hurt trying to open catchpit grate while using t-bar tool	Could lead to injury	Catchpit T-bar tool and correct PPE designed to reduce the chance of injury	1	3	Low	Risks associated with operations and maintenance hazards are considered outside the scope of this assessment. However, these have been considered in the assessment process to determine any impact to the risks associated with these hazards from any additional controls proposed to treat residual public risks.		31/10/2017
2.1b	Contractor hurt trying to open catchpit grate without using t-bar tool	Could lead to injury	Correct PPE designed to reduce the chance of injury	1	3	Low			31/10/2017
2.2	Repetitive strain from opening multiple grates	Could lead to injury	Catchpit T-bar tool designed to reduce the chance of injury. Workload management. Correct PPE designed to reduce the chance of injury. Education of correct lifting technique.	1	3	Low			31/10/2017
2.3a	Maintenance of catchpits requires working in the live road corridor and struck by vehicle	Could lead to injury	Left hand drive vehicle, sucker located on left hand side (i.e. operator excluded from live road corridor). Appropriate traffic management plans for the level of road. All operators trained to a minimum of Level 1 traffic controller. Standard operating procedures.	1	1	Low			31/10/2017
2.3b		Could lead to injury/death	Right hand drive vehicle, sucker located at rear of vehicle. Appropriate traffic management plans for the level of road. All operators trained to a minimum of Level 1 traffic controller. Standard operating procedures.	1	5	Moderate			31/10/2017
2.3c		Could lead to injury/death	Right hand drive vehicle, sucker located on left hand side. Appropriate traffic management plans for the level of road. All operators trained to a minimum of Level 1 traffic controller. Standard operating procedures.	1	5	Moderate			31/10/2017
2.4	Malfunctioning or inappropriate use of catchpit sump cleaning equipment/truck	Could lead to injury/illness	Appropriate training/qualification/certification of personnel prior to use.	1	4	Moderate			31/10/2017
2.5	Confined Space with water hazard	Could lead to injury	Correct application of work procedures and strict adherence to health and safety procedures	1	4	Moderate			31/10/2017
2.6	Contact with contaminated water/debris from catchpit sump	Could lead to illness/disease	Appropriate PPE and training/qualification/certification of personnel prior to use. Mainteance contractors provided with access to first aid equipment, water, sanitiser, etc.	1	3	Low			31/10/2017
2.7	Fall/stuck in open/dislodged/damaged catchpit	Could lead to injury	Correct application of work procedures and strict adherence to health and safety procedures	1	3	Low			31/10/2017
2.8	Contractor damages / breaks grate / lid during catchpit mainteance	Could lead to injury	Contractor educated on correct maintenance procedures. Maintenance requirements considered in catchpit design.	1	4	Moderate			31/10/2017

[1] Refer to Section 2.3 of the Catchpit Safety Review Report - Stage 2 regarding consultation with Auckland Council and Auckland Transport on maintenance and reporting schedules
[2] Refer to Section 5.3 of the Catchpit Safety Review Report - Stage 2 regarding control ref.
[3] Review of data provided from Auckland Transport has shown that no recorded deaths or serious injuries occurred in 2016 as a result of the specific hazard. Therefore, AT consider that a consequence rating of 4 is appropriate. As further data becomes available these risks should be reviewed.
[4] Refer Table 3 of the Catchpit Safety Review Report - Stage to for assessment of Additional Controls

Appendix B
Spring Bar Locking Catchpit Examples

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Date: 19 October 2017
Location: 13 Derrimore Heights, Manukau
Supplier: Pipe and Infrastructure
Description: Prototype stormwater grate with torsion bar mechanism and captive hinge - retrofitted to existing stormwater sump.

Date: 19 October 2017
Location: 13 Derrimore Heights, Manukau
Supplier: Pipe and Infrastructure
Description: Prototype stormwater grate - torsion bar mechanism.

Date: 19 October 2017
Location: 13 Derrimore Heights, Manukau
Supplier: Pipe and Infrastructure
Description: Prototype stormwater grate - release of torsion bar using retrofitted maintenance t-bar

Date: 19 October 2017
Location: 13 Derrimore Heights, Manukau
Supplier: Pipe and Infrastructure
Description: Prototype stormwater grate - release of torsion bar using retrofitted maintenance t-bar


Date: 19 October 2017
Location: 6 Arden Court, Manukau
Supplier: Pipe and Infrastructure
Description: Prototype stormwater grate - retrofitted to existing stormwater sump. installed adjacent to existing standard catchpit

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Plus Grate and Lintel - with torsion mechanism and captive hinges

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Plus Grate and Lintel - with torsion mechanism and captive hinges

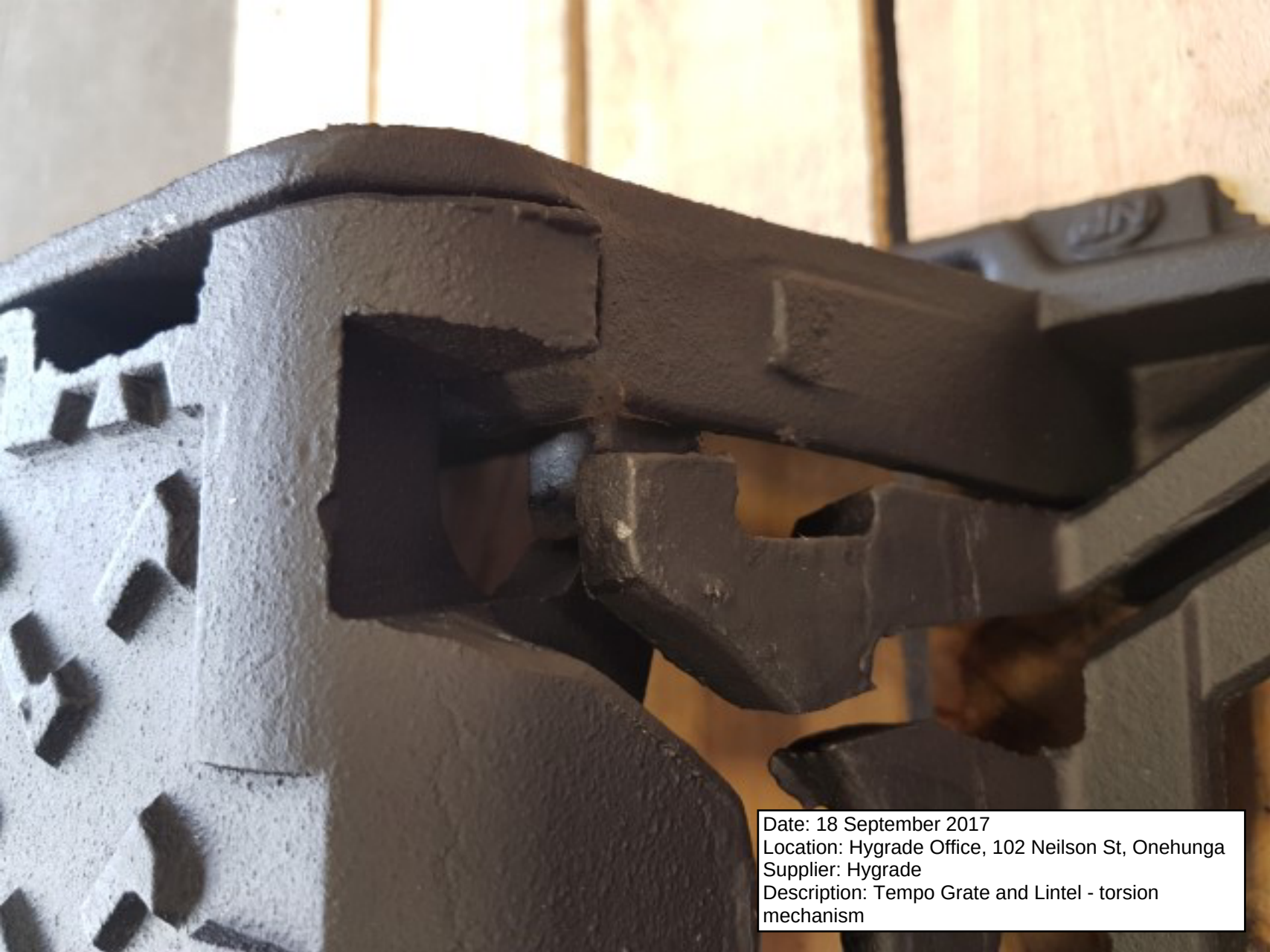
Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Plus Grate and Lintel - with torsion mechanism and captive hinges

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - with torsion mechanism and captive hinges

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - with torsion mechanism and captive hinges

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - torsion mechanism

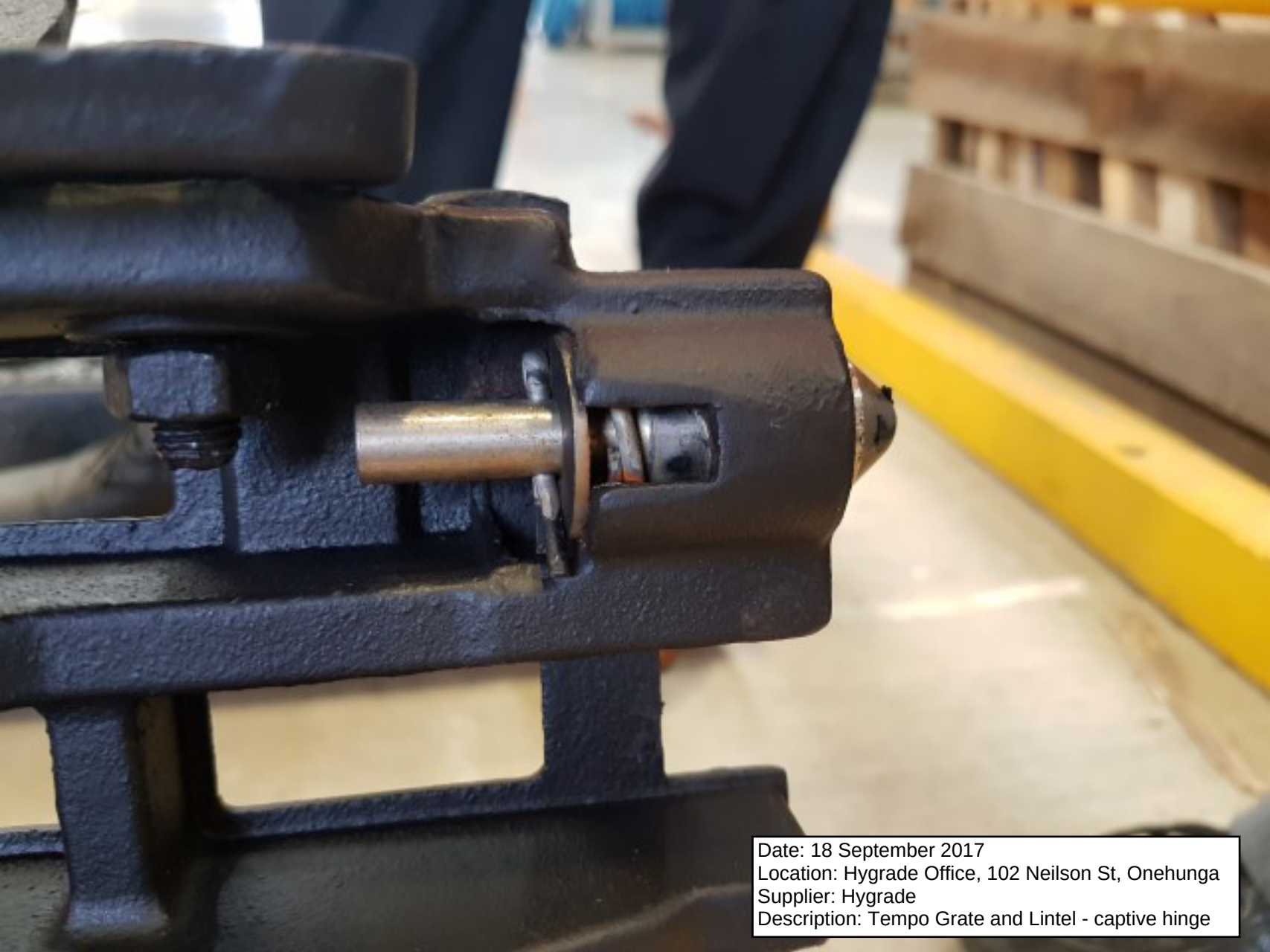
Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - torsion mechanism



Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - torsion mechanism

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - captive hinge

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - captive hinge



Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: Tempo Grate and Lintel - captive hinge

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: V-Grate with torsion mechanism and captive hinges

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: V-Grate with torsion mechanism and captive hinges

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: V-Grate torsion latch

Date: 18 September 2017
Location: Hygrade Office, 102 Neilson St, Onehunga
Supplier: Hygrade
Description: V-Grate torsion latch

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