# SEWER PUMP STATION FALL PREVENTION SYSTEM

***Paper Presented by :***


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## ABSTRACT

Occupational Health and Safety Regulations (Prevention of Falls) 2003 have highlighted the need for the water industry to alter the way it carries out works at heights, which in this industry predominantly exist in sewer pump stations.

East Gippsland Water (EGW) in conjunction with a private contractor have designed, tested and manufactured a system centred around operator safety to meet the requirements of the regulations, and ease of use. The system consists of a removable grate, which is held in place by multi-functional corner brackets, all aluminium in construction. Within the corner brackets is provision for portable barricading specifically designed for this application to be installed.

The primary function of the grate is to offer fall protection when accessing the wet well, allowing the operator to visually check the well without the risk of falling. The secondary function of the grate is to be completely removable once the barricading is in place, allowing relatively unrestricted access to the pump well and all of its components.

The principle behind the barricading is very similar to an everyday scaffold, the posts are specially designed in aluminium to fit into the corner brackets. The rails are telescopic and have quick action claspers to allow their fitting to a wide range of well sizes and ease of use.

This system has been rated by a structural engineer and is a practical alternative to permanent barricading around wells or the use of fall arrest systems. The grate and brackets are totally hidden below the well lid and the barricading is completely removable, allowing for areas where aesthetics are important.

This paper will cover all stages of development and use of the system and the benefits it has for the water industry.

## KEY WORDS

Aluminium Grate, Confined Space, Corner Brackets, Ergonomics, Fall Prevention, Handrail System, Personal Protective Equipment.

## 1.0 INTRODUCTION

Throughout Australia, and indeed the world, the need for efficient sewer pumping station facilities is more important than ever. Without these facilities and the components associated with them, the world would be in a constant health crisis, and we would probably all be wading around in what the general public would like to forget ever happened, after they've flushed their toilets.

However unfortunate it may be, some of us have taken to the disposal of wastewater like the friendly pelicans have taken to the basins at my local treatment plant. The satisfaction we take in offering this special customer service often comes at a greater cost to the operator. Every year, the risks involved in the transfer and treatment of waste water are proven by the number of reported workplace injuries and health related issues.

These incidents range from things as small as infection from airborne contaminants and direct skin exposure to effluent, to more serious things such as deaths in confined spaces and falls from heights. The vast majority of these risks can be, and are being controlled by things as simple as Personal Protective Equipment, safe working procedures and monitoring equipment. However, the more serious risks are more difficult and more expensive to eliminate or engineer out. Falls from heights have always been an inherent risk when working around sewer pump stations, especially during confined space entries, station inspections and pump station maintenance.

For decades the risks associated with confined space entries have been assessed and controlled. Fall arrest devices, gas detection equipment, stringent training and comprehensive procedures have significantly reduced the accidents relating from this hazard. However, after all these years of risk control, it is only now that the standby person, the person standing atop a drop of over 2 metres monitoring those below is accounted for in the risk assessment. Although the standby person will not be entering the pumping station wet well, he or she faces the enormous risk of falling into a well filled with dangerous and infection covered components.

This is part of the reason why Worksafe Victoria has introduced its new regulations outlining the obligations employers have in providing employees safe workplaces around fall hazards. Although we are not the only industry affected by these regulations, we, like the other industries need to act swiftly to avoid litigation and any further workplace accidents relating to these hazards.

## 2.0 DISCUSSION

East Gippsland Water, in collaboration with Kennedy's Aluminium Pty Ltd has researched and developed a system designed to eliminate the risks associated with working at heights around sewer pump stations.

The system was designed to a set of very specific criteria. It had to meet the Occupational Health and Safety Regulations (Prevention of Falls) 2003, be constructed in conformance with strict construction and strength guidelines, Australian Standards 1657:1002. Most importantly it had to be safe and relatively easy to retrofit to existing stations, and from an operations point of view, be straightforward and effortless to use.

### 2.1 Establishing a Working Relationship with the Manufacturer

The idea behind the system evolved from a strong relationship established between EGW and our core aluminium fabricator, Kennedy's Aluminium. This relationship was based on a mutual trust, through an informal partnership between the two parties.

Although each party in the relationship has had its own problems throughout the process, good communications ensured that the final result is more efficient, cost effective and user friendly. The greatest way for this effective relationship to be illustrated is by demonstrating the quality of the final product.

### 2.2 Developing the Prototype

Sewer pump stations within East Gippsland Water have been designed quite differently as the years have passed.

As unique as they all may be, there is a set of similarities we were able to use to map out the design for the prototype. The similarities were that the stations were all over 2 metres deep, which means that they needed some type of fall protection system incorporated into their structure. The second similarity was that the vast majority of them have access hatches varying from 0.90 – 3.4 metres in length and 0.56 – 1.2 metres in width. All stations are fitted with hinged aluminium lids, some modified from their original design where square gatic lids were once fitted.

The basic concept of the prototype design was to install a grate directly beneath the hinged aluminium lid. The grate had to be lightweight, to avoid manual handling problems, completely removable and be constructed out of mesh to allow visual inspection of the station components located below. The prototype design also had to incorporate a bracket to hold the grate in place and include a sleeve to insert the handrail system into. The final part of the design was the posts and handrails; they had to be lightweight, quick and easy to assemble and readily stored. Finally they all needed to meet the Australian Standards and be approved by a structural engineer.

Stage one of the manufacture of the prototype was the corner brackets. These needed to be able to be fitted into the corners of the floating slab beneath the access hatch. They are fixed at a set depth below the lid, and restrained by two 12mm true bolts into the reinforced concrete slab. The total length of each side of a standard bracket is 200 millimetres with a depth of 150 millimetres. The entire bracket is constructed of high-grade aluminium (figure 1).

**Figure 1:** ***Aluminium Corner Bracket***

Stage two was the manufacture of the grate. These were measured from the distance between the corner brackets, allowing clearance for the sleeve incorporated in the bracket for the handrail system. It was then simple to install atop the four corner brackets. The grate has a total depth of 50 millimetres, maximum weight of 20Kg (two-person lift), varying length and width measurements, and is constructed of high-grade aluminium, (figure 2). It combined with the corner brackets is rated at 5 kPa (500Kg live weight per square metre).

**Figure 2:** ***Aluminium Grate***

Stage three was the manufacture of the handrail system. The posts are comprised of a straight length of aluminium tube with four lugs to allow the handrails to be attached. The handrails are self-retracting telescopic tubes. They also include quick action claspers at each end for attachment to the lugs on the posts, and weigh less than 1.5Kg per item. The Handrails length varies telescopically from 0.56m to 3.4m depending on the application. The Posts are 1 metre in height and weigh less than 1.5Kg per item. All components are constructed of high-grade aluminium except the locating pins on the claspers (figure 3).

**Figure 3:** ***Handrail System – Complete with Posts, Rails and Grate Hook***

## 2.3 Working with the Completed Product

With the prototype installed and proven operationally, it was then time to begin the task of installing the system in as many stations as possible. A bulk amount of corner brackets were ordered, and then installed. During the installation stage of the brackets, harnesses and retractable lanyards were used for fall protection.

Once the brackets were installed at a station, the grate size was measured. The measurements were then forwarded to the manufacturer for construction, and finally the completed grate was installed under the station lid atop the preinstalled corner brackets. Total time for the installation of the brackets and measuring of the grate averaged 2 hours per station. Following this, installation of the grate took a further 30 minutes per station, which included modifications to lid handles and other well components.

**Figure 4:** ***Fully Installed Handrail System with Grate Removed***

The handrail system was the final component of the project, and from an operational point of view, the most important. This component was designed to allow operators to work at heights around sewer pump stations without risk of falling. The initial concept of the system was simple; however the design was made more difficult due to the difference in size of the access hatches. The final solution was to make the handrails telescopic, and to incorporate a stopping mechanism to keep structural strength within the handrails. The entire system consists of three sets of four different length handrails (12 in total), and four posts.

The portable handrail system is stored in a specially made drawer on EGW's maintenance truck, and takes approximately 90 seconds for two people to erect, and 60 seconds to disassemble. Installation of the handrail system is very similar to erecting a scaffold. The posts are slipped into the sleeves located in the corner brackets. The handrails are then clipped onto the lugs located on the outside of the posts (figure 4 and 5). Finally, if there is need for somebody or something to enter or exit the erected system, partial removal of one or more of the handrails (figure 6) allows this to occur, with no risk to the operator.

**Figure 5:** ***Handrail System – Quick Action Clasper Attached to Post***

**Figure 6:** ***Practical Use of the Handrail System – Removing Pump***

Once the initial work on the installation of the brackets and grates was complete, the final stage was the testing and modification of the prototype design. The key criterion for this system is to allow access to sewer pump station wells, either for inspection or maintenance, with no risk of fall to the operator. For this criterion to be reached, works instructions and procedures needed to be written to ensure the safe use of the system. Other areas also needed to be assessed, which included the way the grate was lifted out of the erected handrail system, as this produced some manual handling risks. Another problem found with the prototype design was the potential for the grate to fall, if improper removal practices were undertaken.

The introduction of an aluminium hook for removing the grate out helped with the bad ergonomics previously encountered and removed any manual handling risks associated with the task. This allowed the grate to be lifted to one end and then removed by two people from outside of the erected handrails. A snap lock hook, attached to a length of stainless steel cable, and incorporated into a corner bracket is now attached to every grate. This is manufactured at a length of 0.70 metres and designed to allow the grate to fall a short distance without damaging essential electrical components located inside the well.

## 4.4 Cost Analysis

**Table 1:** ***Individual unit cost analysis***

| Item | Cost of Item | Total cost of Item including installation and materials |
|---|---|---|
| Corner Bracket | $380.00 | $500.00 |
| Average Sized Grate | $962.00 | $1017.00 |
| Handrail System | $2850.00 | N/A |

The cost to research and develop the system, including the manufacture and installation of the Prototype was estimated at $14,000. EGW has budgeted $190,000 over three years to manufacture and install the system in up to 90 stations, which equates to around $2,100 per station.

The Handrail System is portable, meaning that there is only need for two sets per Depot at EGW. Of the two sets, one is carried on a maintenance truck and the other is kept as a standby set. This means that there could be hundreds of sewer pump stations operated by a depot and there would still only be the need for two sets, unless of course there was more than one maintenance truck.

## 5.0 CONCLUSION

The Fall Prevention System has been very successful so far at East Gippsland Water. All new stations will have the system included at the design stage. Thus far in the Bairnsdale region alone, we have been able to successfully install the complete system in 68% of our sewer pump stations. Of the remaining stations, 15% have had a secondary system installed. This system reuses the Handrail System designed in the Prototype stage. It involves a similar concept to the Fall Prevention System; however it does not include the Corner Brackets or the Grate. The remaining 17% have had permanent handrails installed. These stations were located in areas where aesthetics were not an issue, or, where none of the other two options were practicable.

The effectiveness that this system has had for EGW in reducing the risk of falls around sewer pump stations far surpasses any other alternative proposals. Worksafe Victoria has approved the system as a fall prevention risk control and credited East Gippsland Water for its innovation in risk management.

## 6.0 ACKNOWLEDGEMENTS

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## 7.0 REFERENCES

Worksafe Victoria, 2003 - *Occupational Health and Safety Regulations (Prevention of Falls)*