BEGINNING WITH THE END IN MIND: OPERATOR CENTRIC SPS RENEWALS

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ABSTRACT

The City of Logan is experiencing significant growth with greenfield expansion and brownfield gentrification straining existing assets for Logan Water. This has necessitated numerous renewals projects. Typical renewals projects are often perceived as being required for one of two reasons, either: equivalent replacement of an element at the end of it's design life; or an upgrade to increase capacity. However, we must not neglect the opportunity renewals projects present to reassess the site circumstances to incorporate safety, operability, and accessibility improvements.

We've challenged the status quo of the conventional renewal design process by emphasizing beginning with the end in mind. Engagement with local operations and maintenance colleagues is the catalyst to understanding what's important during routine and emergent maintenance activities and subsequently where to target design effort. The insight of operators allows for smart and safer solutions that directly addresses concerns of the end user.

This case study highlights operator centric functional improvements delivered at recent wastewater pump station renewals sites including:

- Pump replacement to minimise blockages, inefficiencies and callouts.
- Improved accessibility to pump station components through considered lifting and cover openings.
- Consideration of asset placement due to climate change flood levels.
- Review of redundancy measures including bypass operations.
- Improved cable routing.
- Self-cleansing overflow screens.

1.0 INTRODUCTION

Beginning with the end in mind is key to any asset improvement we do. We must ask, how is the asset expected to function, what are the operator's requirements, and how can we incorporate this?

Logan City is one of the fastest growing regions in Australia. Greenfield residential development projects are the principal reason for the population to grow from about 350,000 currently to more than 500,000 people in the next 15 years. Coupled with this, like many utilities, Logan Water has an aging asset base, stemming from Australia's development boom between the 1960s and 1980s – known as the infrastructure cliff. To cater for growth and renewal requirements of Logan's water infrastructure, the purpose-built Logan Water Partnership, (a partnership between Logan Water, WSP, Downer and Stantec) was established.

Working closely with the Logan Water personnel has established a collaborative environment where traditional silos previously existed. The collaborative environment has enabled open dialogue with local operations and maintenance staff to ensure the root cause of a problem is understood and addressed, not just the effect or symptom. Understanding daily and emergent work procedures has enabled the status quo for renewals processes to be challenged, to put operators at the focal point of renewal projects. The simple introduction of scoping workshops and site visits with the operators to explore workflow practices has facilitated targeted design development.

This paper presents a case study of an upgrade to the Spanns Road Sewage Pump Station (SPS) - 14.2m deep, 9.5m diameter wet well, with an ultimate capacity of 380L/s and constructed in 2007 (refer to Figure 1). The key to success was insight from the operators and maintainers on deficiencies and requirements at an early stage.

Figure 1: ***Spanns Road Pump Station layout***

2.0 DISCUSSION

2.1 Background

The Spanns Road SPS is a terminal sewage pump station that was (initially) within the Beenleigh wastewater catchment, conveying flows directly to the Beenleigh Wastewater Treatment Plant (WWTP). Capacity issues at the Beenleigh WWTP meant that a new transfer strategy was derived which would require Spanns Road SPS flows to be redirected to the Loganholme WWTP for a centralised treatment solution for a large majority of Logan's sewerage catchment loads.

As part of the transfer strategy, a renewals-based study was conducted to determine the work required to facilitate the redirection of loads to the Loganholme WWTP. Further to this, we tailored the design to ensure that those at the operational coal face gained true benefits. Due to the collaborative partnership between Logan Water design, delivery, and operations and maintenance team members, we were able to efficiently include additional operator centric scope to the renewal project.

Key infrastructure requirements associated with the Spanns Road SPS upgrade included the following items:

- Pump upgrade and switchboard replacement, and generator connection.
- Ancillary cable routing improvements with a local termination point.
- Improved hydraulic inlet design.
- Access cover replacement.
- Crane replacement.
- Improved wet well bypass functionality.
- Flowmeter at the wet well.
- Relocated emergency overflow relief structure, with a self-cleansing design.

2.2 Operational Resilience

The following improvements were recognised to drive operational resilience and improve reliability, following site visits and workshops with the operators and maintainers.

Inlet hydraulics:
The previous inlet structure was designed with an encased dropper pipe, leading to a central hollow column, which discharged the flow out each side in a direction parallel to the pump line (refer to Figure 2). This arrangement did not promote a smooth flow profile to the cycling duty pump, which increased the chance of air entrainment, poor performance and blockages. These risks were all exacerbated as it is a terminal pump station receiving a high level of grit and rags.

As such, the inlet was redesigned with a stereotypical inlet dropper pipe which could direct flows axially to the pumps. Computational Fluid Dynamics (CFD) modelling and a review of operating levels was employed to reduce the intrinsic risks of a drop structure inlet at a sewage pump station (such as odour).

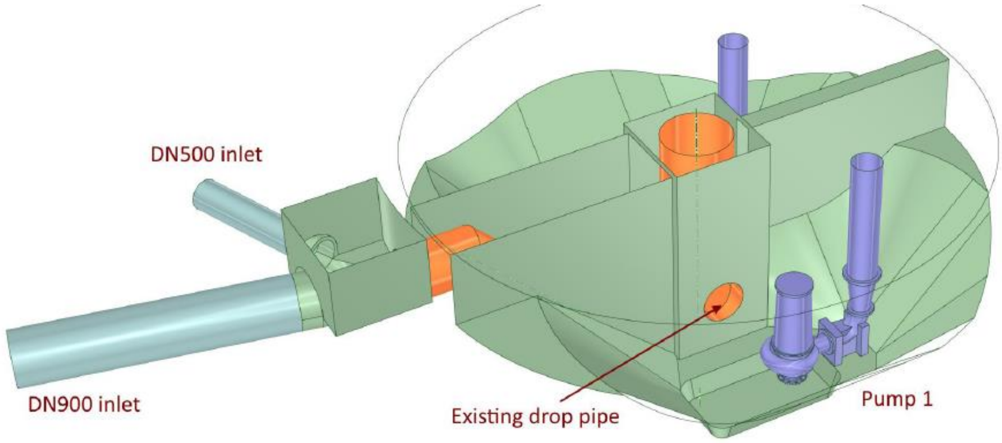

Figure 2: ***Spanns Road Pump Station Inlet - Existing***

Flow balancing:
As a function of the flow diversion, with multiple pumps now pumping to a common inlet at the WWTP, a single flowmeter at the discharge was no longer feasible. The previous methodology involved cross checking the exiting flowmeter at the discharge end against the wet well levels and pump operation in SCADA – this introduces unnecessary risks. As a result a new flowmeter was installed at the pump station, providing the ability for instantaneous flow balancing and flow pacing to optimise system wide pumping.

Bypassing and Isolation:

The existing pumpstation setup had an emergency bypass connection point, however it required confined space entry inside the valve chamber for operation and connection. It also warranted a significant length of pipework, as it was not near the nominated bypass pump setup position.

Through collaboration with Logan Water's operations and maintenance team, contingency planning was undertaken, to develop a preferred bypass strategy. As a result, the proposed solution was to cut in a new bypass connection to the rising main downstream of the valve chamber, with a buried bypass line back to where the bypass pumps would be set up. The new bypass connection point provided safe access for operators at ground level and removed any requirement for confined space entry when bypassing.

To isolate the pump station, the two incoming gravity mains needed to be isolated. As there were no upstream isolation valves, multiple plugs were required. To allow for future operational flexibility, the inclusion of a knife gate on the inlet of the pump station was designed to allow for isolation.

2.3 Maintainability and Accessibility

To operate an asset safely and efficiently, suitable access is required for maintainability.

Flood levels:

Midway through the project, updated flood models were adopted by Council, incorporating climate change. This necessitated a review of the site infrastructure requirements. Contingency operational scenarios were workshopped, and a practical approach was recognised with regards to redundancy measures and placement of infrastructure. The benefit that this pump station had was that the wet well top slab was still above the 1% Annual Exceedance Probability (AEP) level. The switchboard placement was revised, and as a result an isolation termination box for the cumbersome pump cables was required adjacent to the wet well. This simple addition significantly lowers the risk of manual handling injury while attempting to pull cables through conduits during pump removal.

Emergency overflow relief:

The historical emergency overflow relief screening structure for this catchment was within a Queensland Rail controlled rail corridor, distant to the pump station facility. Strict access conditions were in place, and immediate entry was prohibited. To eliminate this risk, a screening device, with suitable access road was included in the design at the pump station.

A typical emergency overflow relief chamber employs a static screen to limit the solids discharging to the environment. After such events occur, operators are required to remove and wash down the screens to relieve them of any ragging material. To relieve operators of this unpleasant and labour-intensive task, a self-cleansing screen was installed. The WATSOL Sewer Comb (refer to Figure 3), is a self-cleansing overflow screening device, that was retrofit within a nearby upstream existing maintenance hole. Using no mechanical parts, this technology utilises a series of static combs, within a baffle frame, and a hydrostatically-actuated ball valve to screen and capture the solids. Once the overflow event recedes the solids are then returned and conveyed to the centralised collection point at the inlet screens of the WWTP.

Figure 3: ***Schematic of WATSOL Sewer Comb section view*** *(source: www.drapperconsultants.com/watsol-sewer-comb.html)*

Lifting:
The existing monorail crane was at the end of it's design life, and did not have the lifting capacity to cater for the new ultimate sized pumps. Rather than a like for like replacement, a new jib crane was installed. During the investigation process we reviewed the lift plans with the operators and maintainers, and concluded that it was feasible to incorporate the additional lifting capability for the isolation valve, valve chamber and flow meter pit.

The existing monorail crane setup relied on a two-stage lifting process to take the duty/standby pumps to the workshop for maintenance. Initially, the pumps were lifted to the existing wet well roof, prior to a crane truck loading them onto the operations vehicle. Using the new jib crane this can be achieved by a single lift, which is a much safer and efficient alternative.

Access covers:
The original access cover setup relied on rope netting as fall from heights risk mitigation. This was a significant deficiency which was addressed with modernised replacements.

The access covers were further optimised to reduce manual handling risk. The existing covers and opening of the wet well and chambers were designed to cater for a four-pump solution. Following a review of the future hydraulic requirements, two pumps were adequate in a duty/standby configuration, meaning the openings were effectively oversized. We worked with a local supplier to develop a tailored solution to minimise the size of the opening using fixed panels to minimise the size of the hinged opening to reduce manual handling and fall from heights risk exposure. Pump cable hooks were also relocated to the suitably design frame based on operator pump lifting procedures.

Operator and Public Safety:
The Spanns Road SPS is situated in open parkland, adjacent to residences (refer to Figure 4). To provide a safe working environment and reduce public exposure to site risks the pump station was provided with site fencing and programmable smart locks.

<u>Figure 4:</u> ***SPS proximity to nearby residents.***

3.0 CONCLUSION

Renewals based projects typically improve asset performance through implementing a like for like replacement. Employing that typical methodology can create a disconnect between the supposed ideal design (based purely on meeting performance objectives) and what is truly required to operate a safe, reliable and resilient asset. The ideology of an operator centric design is engaging with the operators to ensure their knowledge and expertise is captured at an early stage in the projects design lifecycle with the aim of continuing improvements.

By including those who control the infrastructure, ensures the efficient delivery of improvements that not only meet serviceability requirements but can resolve operability issues and safety concerns of the end user. Common areas of focus as highlighted through this case study include improving:

- access conditions
- lifting arrangements
- automating manual tasks, an example of which is self-cleansing overflow structures
- enhancing redundancy measures.

Logan Water's operator centric approach has been used widely, ensuring a sustainable renewals program for both water and wastewater infrastructure can continue to be delivered.

4.0 ACKNOWLEDGEMENTS

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5.0 REFERENCES

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