ENVIRO NZ

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Enviro NZ Report

Trial findings of **Visual AI and Worker Engagement Practices** at **dynamic work sites**

ACKNOWLEDGEMENT

A reflection in remembrance

A person lost their life while working. The Enforceable Undertaking between Enviro NZ and WorkSafe exists because of that loss; a loss of a treasured son, friend and colleague.

This report shares what we have done in response. It does not seek to draw a line under what happened, nor speak on behalf of those most affected.

That moment made reflection necessary, and Enviro NZ offers this work to the public in the spirit of being a guardian, not an owner, of the learnings that emerged.

Our intention is to ensure that this work does not fade but becomes part of a longer journey; one committed to creating the conditions for BetterWork, together.

We acknowledge those who contributed their trust, efforts, insights and questions.

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EXECUTIVE SUMMARY

In March 2020, an employee of Enviro NZ never made it home from work. This tragic event has had a lasting effect on the victim's whanau, friends and colleagues.

The Enforceable Undertaking which followed this event was ambitious. It was intended to kick start research and learnings into the management of risk at dynamic work sites, involving the trial of:

1. Visual artificial intelligence (**VAI**) – as both a control to minimise the risk of harm to workers and as an information source capturing the 'Kodak moments' that are the hazardous situations; [1] and
2. Tools for enhanced employee engagement and participation practices in line with the BetterWork principles.

The concept of 'dynamic risk', where the operating environment can shift rapidly, was central to the activities under the Enforceable Undertaking. For work to go well in dynamic environments, workers need the knowledge to be able to reason and analyse those changing situations. Enviro NZ's vision was for the technologies and tools explored under the Enforceable Undertaking, being VAI and worker engagement practices, to support workers to be successful in improving awareness and decision making, and therefore better management of traffic movements at dynamic work sites. To assist in the assessment of this during the trial, a worker competency framework was also developed.

The trial took place between late 2022 – mid 2025 and brought upon a lot of change for the two participating Enviro NZ sites (Hampton Downs Resource and Energy Precinct and Pōkeno fill facilities[2]). There was no shortage of challenges; however, through patience, dedication, trial and error, Enviro NZ has transformed these challenges into valuable learnings and adapted work procedures to reflect outcomes that have real benefit for its workers, the business and the wider industry.

These outcomes do not reflect the destination we had envisaged at the outset of the Enforceable Undertaking. When Enviro NZ started this journey, it had high expectations for the ability of VAI to transform the way organisations manage and / or control dynamic risk. Part of that was realised as VAI technology installed on mobile plant (loaders) proved successful. Operators now value this mobile plant system for its proven ability to reliably detect hazards and verify isolation controls. However, the most influential aspect from the Enforceable Undertaking, leading to emergent trust and a fundamental shift in safety culture at the sites, has been the worker engagement tools.

These tools (including the 4D methodology - Dumb, Dangerous, Difficult, Different - and Learning Teams sessions) helped reshape safety conversations, operational practices and collaboration on our sites, by creating a structured yet flexible approach to understanding dynamic risk. This approach actively encouraged workers to analyse their work environment with curiosity, rather than simply relying on prescribed rules; fostering collective sense-making, deeper risk understanding, and constructive learning. The expansion of the 4D methodology to include the fifth 'D' – Delightful – also allowed workers to discuss and analyse

[1] For more information on the two forms of VAI trialled, refer to Appendix 1, 'Terminology'.

[2] A description of the Hampton Downs Resource and Energy Precinct and Pōkeno Facilities is provided at page 12.

work which was done well and to learn from the positives. Integrating these powerful methodologies into existing site frameworks, including daily Toolbox Talks, Health and Safety Committees and monthly tailgates, has ensured tools were embedded into the culture by utilising existing resources and processes.

Trust has proved a consistent thread throughout the trial, both in terms of worker perception of the role played by the VAI as well as the openness to co-learning through worker engagement. Its absence in some areas has hindered progress, while its presence in others has paved the way for success. Ultimately, we found the worker engagement tools trialled built confidence, with workers reporting feeling safer and managers noting richer dialogue. Sentiment surveys (carried out at the start and end of the project) illustrate this success, with a shift from 66% to 95% positive responses in workers' perception of the organisational response to safety.

For the Enviro NZ team, the Enforceable Undertaking has reinforced that people are the cornerstone of operational, safety, and organisational success. In dynamic environments, this isn't achieved by imposing rules and expecting compliance, but by creating a culture where workers feel safe to engage with management, where workers' curiosity is sought and celebrated, and where workers' critical appraisal and thinking skills are honed. In other words, focussing on 'Work as Done' through doing work *with* workers, not doing work *to* workers. VAI and other technologies can be useful tools, adding another layer of control for the management and verification of risk, but it is the tools which encourage genuine engagement and empowerment of workers that have had the biggest impact. This has collectively and incrementally facilitated the development of a better safety culture.

The transformation at Enviro NZ is still ongoing, as we look to recalibrate and integrate the tools and learnings into broader Enviro NZ operations and health and safety systems. Significant work lies ahead but we are bolstered by the words of support from those who lived the project;

"Would we give it up now? No. Not if we want to keep getting better."

Chris Aughton

Chief Executive Officer, Enviro NZ Services Limited

The Enforceable Undertaking was never just about investigating or trialling tools. It was about expanding our knowledge about how operations and dynamic risks are understood, managed and communicated by workers in everyday work.

As guardians of this knowledge, and the stories, experiences and insights generously shared by our people, we acknowledge that this is not just our story to tell. It is our responsibility to carry it forward with care, integrity and openness.

The purpose of this report is to ensure that knowledge, including our learnings, challenges and successes, is shared with others wishing to do safety differently. Enviro NZ encourages other organisations to contact us if they would like to know more about the trial and findings.

Another part of the Enforceable Undertaking involved an industry innovation project conducted by Learning Teams Inc with three other stakeholders, exploring tools and methodologies to assist both workers and organisations in their critical analysis of dynamic risk. A separate report of this project has been published and is also available if you wish to learn more.

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Part 1: Introduction

PART 1: INTRODUCTION

The fatality in March 2020 which led to the Enforceable Undertaking between WorkSafe and Enviro NZ occurred at a landfill tip head. A loader reversed into a worker who was standing at the back of their truck.

Landfill tip heads are dynamic work sites that need to adapt to the changing hazards and risks influenced by a broad range of both internal and external factors: including vehicle types, vehicle numbers, waste types, site configuration, personnel and environmental conditions.

WorkSafe guidance for Managing Work Site Traffic states that "*if your work site or work activities change, you need to check that your existing control measures are still the most appropriate ones to use*" but does not describe any ways or means of practicably achieving this in the context of dynamic work site. This presented an opportunity for research and learning to better understand dynamic work sites and potential systems to improve worker safety.

Dynamic Work Sites

The concept of a 'dynamic work site', where the operating environment can shift rapidly, was central to the Enforceable Undertaking.

For work to go well in dynamic environments, workers need the knowledge to be able to reason and analyse those changing situations. This is in addition to other risk management procedures (including isolation or engineering controls which need to be workable in the changing environment) and safe systems of work (including rules to guide and support workers in problem-solving in a changing environment).

Enviro NZ's vision was for the technologies explored under the Enforceable Undertaking, being the VAI and worker engagement tools and methodologies, to support workers to be successful in improving awareness and decision making, and therefore better management of traffic movements at dynamic work sites.

The Enforceable Undertaking sought to explore the opportunity for learning and improvement through trialling three types of tools:

- **VAI technology:** Visual Artificial Intelligence (**VAI**) technology uses cameras installed on mobile equipment and fixed (static) points to monitor spatial relationships, detect proximities within defined parameters and trigger alerts. The VAI was trialled with a view to support risk-based decisions of the points persons involving mobile plant, people and traffic on the tip head. [3]
- **Worker engagement tool:** A worker engagement tool (including the 4D methodology - Dumb, Dangerous, Difficult, Different - and Learning Teams sessions) implemented with workers at the Hampton Downs Facility as well as the Pōkeno Facility, with a view to identifying weak signals between how Enviro NZ believed its controls were managing risk, and how workers were adapting to the dynamic work environment.
- **Worker competency framework:** A risk-based competency framework and assessment tool to assess the current state of knowledge and evaluation of competency amongst tip head workers at both Hampton Downs and Pōkeno Facilities over the period of the VAI trial.

VAI was intentionally only installed at one site (the main tip head area of the Hampton Downs Facility), but not the other (Pōkeno Facility), to allow a comparative analysis of its effectiveness. The purpose of this was to assess whether VAI could support better worker engagement and safety practices. It was also to assess the value of VAI as an information source about workers' everyday work.

Enviro NZ's goal of this innovation project was to move safety beyond compliance, driven by a commitment to use the WorkSafe BetterWork principles to understand, and help to bridge, the gap between 'Work as Done' vs 'Work as Imagined'. In order to do this, the trial used cutting-edge technology as well as a human-centric approach, recognising that safety thrives when built on trust, dialogue, and continuous learning from the frontline.

[3] *Refer to Appendix 1 'Terminology' for further information on the role of the points person.*

What Is BetterWork and Why Does It Matter?

BetterWork recognises that, in real life, especially in dynamic work sites like waste and traffic management, that work doesn't always follow the script. People adapt, respond to unexpected conditions, make trade-offs, and use their judgement to keep things going. These adaptations are not the problem, they are often the reason the system works.

BetterWork invites organisations to:

- Learn from how work really happens, not just how it's imagined in policies and plans
- See workers as problem-solvers, not just rule-followers
- Focus on understanding and enabling adaptation, not just preventing deviation
- Create feedback loops that allow risks, insights, and improvements to emerge from the front line

This doesn't mean organisations should be abandoning structure, ignoring risk or disregarding rules. It means understanding that systems are dynamic, and people are central to effective, ongoing safety culture and outcomes. This recognises that safety is not achieved by the absence of accidents alone (as dynamic environments will result in change), but by the presence of an environment where people are central and good work is supported.

The **BetterWork** approach influenced every part of this project. From the selection and design of the tools we used, to how we gathered feedback, to the way we interpreted what was working (and what was not). It shaped how we listened to workers, what questions we asked, and how we made sense of what we found. Understanding this shift is critical. It helps explain why the findings in this report go beyond compliance checklists and instead focus on capability, culture, and the everyday decisions that shape managing risk and performance.

At the time of the fatality and entry into the Enforceable Undertaking, the risk of impact between a loader and a person was primarily managed through application of exclusion zone rules.[4] Vehicles (trucks) would enter an Enviro NZ fill site and dispose their load at a designated tipping area (tip head) at the direction of a points person. The exclusion zone rules were in effect a minimum distance between vehicles/plant and people, allowing time to respond safely in the event of an unplanned or unintended movement. The role of the points person was to control traffic management on the tip head and assist in management of the exclusion zone rules, which requires a high degree of critical thinking and risk-based decision making.

It was these risk-based decisions at a dynamic work site which the VAI and worker engagement tools were intended to control and support, and which the worker competency framework was intended to assess.

Ultimately though, the Enforceable Undertaking was never just about trialling and investigating tools. It was about expanding Enviro NZ's knowledge about how our operations and dynamic risks were understood, owned and improved by those who handle those risks every day. Through the Enforceable Undertaking, Enviro NZ sought to build a learning-capable system that supports workers and leaders to see, discuss and improve work.

This report details Enviro NZ's two-year journey of learning.

[4] *Various other controls were also in place to provide additional layers of protection (including reversing cameras and squawkers on loaders, points person and traffic management procedures).*

THE SITES

The work in the innovation project was undertaken at two of Enviro NZ sites: the Hampton Downs Facility and the Pōkeno Fill Facility. To provide context to the challenges, learnings and outcomes achieved by Enviro NZ in this project, an overview of these sites, the work performed there and aspects that characterise or contribute to their dynamic nature is set out below.

HAMPTON DOWNS FACILITY

The Hampton Downs Resource and Energy Precinct ("**Hampton Downs Facility**") is one of New Zealand's largest and most advanced waste disposal and resource recovery facilities. It is situated on a 360-hectare site in North Waikato and is owned and operated by Enviro NZ. Strategically located to serve the Auckland, Waikato, Bay of Plenty and Coromandel regions, Hampton Downs Facility plays a crucial role in managing the regions' waste disposal needs while prioritising resource recovery and environmental protection.

The Hampton Downs Facility is the site at which the VAI was developed and implemented. Specifically, VAI was installed the main disposal tip head of the Hampton Downs Facility where the fatality occurred in 2020.

Operations within the Hampton Downs Facility

The Hampton Downs Facility comprises three key areas with variable operational activities and interface:

- Fill Facility: accepting various types of waste for disposal at multiple waste stream-specific tip head locations within the site;
- Compost Facility: accepting green waste and food waste for aerobic composting to produce an organic growing media; and
- Landfill Gas to Energy Facility: landfill gas is collected from the Fill Facility and fed to seven 1 MWe engines where it is utilised to generate electricity.

These facilities are supported by an array of ancillary activities that include, but are not limited to:

- Day-to-day management of traffic, fill and cover activities;
- Gas capture and management;
- Leachate, groundwater and stormwater management;
- Forward planning for infrastructure design, engineering and construction activities.
- Implementing health, safety and environmental management systems and sustainability and community initiatives that support good outcomes for people, the environment and wider community both now and into the future.

Hampton Downs Facility as a dynamic environment

The Hampton Downs Facility, in particular the refuse tip head, is a dynamic site with a wide range of work activities and associated hazards. The tasks undertaken and work environment change in response to a broad range of both internal and external factors. These changes are frequent and present in many ways, including:

- **Evolving landfill footprint:** The Hampton Downs Facility footprint is planned for development over numerous stages, enabling continuous expansion to meet future waste management needs. This staged approach involves the construction of multiple refuse tip heads as filling progresses, which necessitates changes to access, egress, and traffic management. The workplace may also change on a daily basis as material is tipped, compacted and covered into the 'active' disposal area of the landfill.
- **Truck movements and configuration:** Hampton Downs processes over 150 truck movements daily over four disposal facility locations, introducing variability in on-site congestion levels. Further, these trucks vary in type and configuration (for example, truck, truck & trailer, semi-trailer, gantry, hook, front load, rear load) and truck tipping methodology (for example, walking floor, tipping, ejector). Depending on configuration, there can be multiple trucks tipping on the refuse tip head at the same time.
- **Material types:** There is a large variation in the types of material being disposed of (for example, refuse, construction and demolition, soil, green waste, offal, sludge). Different types of material have different characteristics that necessitate specific handling requirements at the tip head (for example, sticky waste or free flowing, overweight loads, entangled waste).
- **Persons on site:** Whilst the site is closed to the public, the high number of truck movements mean there are a large number of people on site, being a mix of Enviro NZ and third-party workers and vehicles. Interactions and tasks required of site operators and Points People can vary based on driver attitude and behaviour (impatient, aggressive, calm, pleasant), driver knowledge and experience, driver understanding of English based communications / instructions, and driver competency and capability.
- **Environmental conditions:** As the site is located outdoors, the workplace is inherently susceptible to changes in weather and environmental conditions that impact visibility, tip head stability, operations and working conditions (for example, rain, fog, sleet, wind, dust, light and temperature fluctuations).

PŌKENO FACILITY

The Pōkeno Resource Recovery Centre ("**Pōkeno Facility**"), like the Hampton Downs Facility, plays an important role in regional waste management infrastructure. It is located on a 250-hectare site owned and operated by Enviro NZ. Functioning as a Cleanfill facility (Class 5) as well as a Managed Fill facility (Class 3), the Pōkeno Facility receives a substantial volume of excavated material and other construction related material.

For the purposes of the Enforceable Undertaking, the Pōkeno Facility did not have VAI installed. This allowed the comparative study with the Hampton Downs Facility to occur.

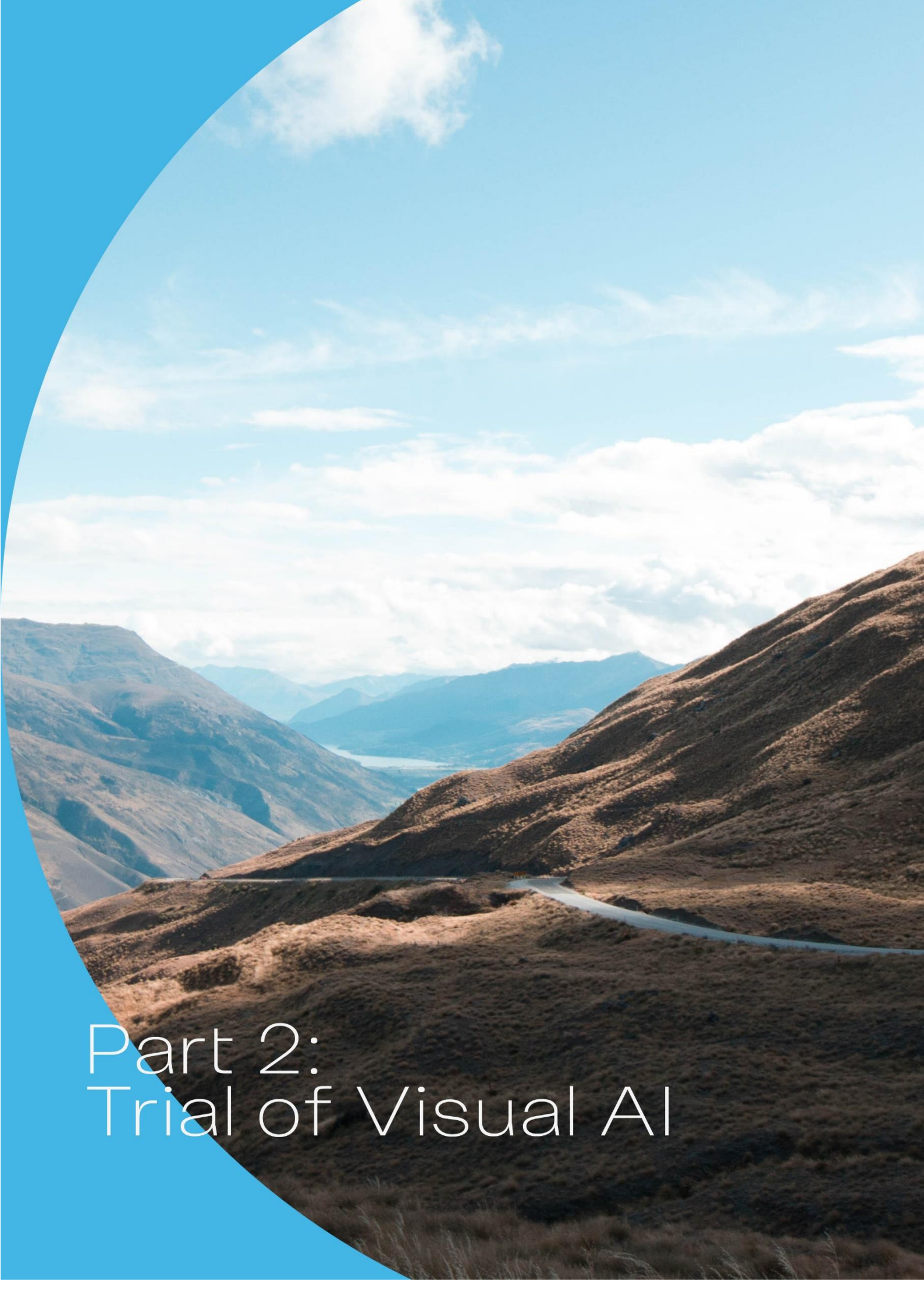
Operations within the Pōkeno Facility

In addition to operating as the abovementioned fill facilities, accepting different types of material for disposal at different tip head locations across the site, the Pōkeno Facility also includes resource recovery facilities where products are processed and diverted from fill. This includes areas for the processing of wood waste for biofuel, gypsum from waste GIB board, and waste concrete into aggregate.

Pōkeno Facility as a dynamic environment

For similar reasons as the Hampton Downs Facility, the Pōkeno Facility is also a dynamic site. Change to the work environment occurs in many ways, including:

- The evolving fill footprint and physical dimensions of the workplace;
- Truck movements (up to 600 per day), types and configurations;
- Persons on site (both Enviro NZ and third party workers and vehicles);
- Environmental conditions; and
- Material types.



Part 2: Trial of Visual AI

PART 2: TRIAL OF VISUAL ARTIFICIAL INTELLIGENCE (VAI)

Enviro NZ developed and installed VAI technology at the main tip head of the Hampton Downs Facility, with a view to supporting points persons and loader operators in their risk-based decision making of separating mobile plant and people on the tip head.

Two distinct types of VAI technology were trialled by Enviro NZ:

- **Mobile VAI** which utilises cameras mounted to mobile plant, equipment or vehicles, to monitor and evaluate the spatial relationships between the object the camera is mounted to and people and objects within the camera's field of view; and
- **Static (or fixed) VAI** which utilises cameras mounted at a fixed location, to monitor and evaluate the spatial relationships between various people and objects that may be moving dynamically within the camera's field of view.

The way in which these VAI systems would provide support to points persons and loader operators was trialled in two ways:

- **Control for risk management:** The trial explored the use of VAI to initiate lower order controls (i.e. warnings of potential hazardous events) as well as higher order controls (i.e. isolation or engineering to prevent or respond to potential hazardous events, such as automatically stopping vehicle movements) at the Hampton Downs Facility; and
- **Information source:** The trial also explored the use of VAI as an information source and tool for worker engagement, to improve awareness and support points people and loader operators in their risk-based decision-making.

At the time of publication of this report, Artificial Intelligence ("**AI**") is considered a commonly known technology. Most businesses have incorporated AI, or are looking to incorporate AI, into their daily work and systems; and there are many options of products and services available across a wide range of applications. That was less the case in 2022 when Enviro NZ began its trial of VAI. The potential of VAI was considered significant, but options for delivery and suppliers at this time were limited.

Enviro NZ was unable to identify technology with proven application in a dynamic landfill operating environment. Typically, VAI options referenced case studies undertaken at manufacturing or warehouse-type premises that feature more visually uniform surfaces, fixed surroundings and reasonably consistent environmental conditions. By comparison, a landfill environment is challenging. Loaders operate outdoors in a variety of weather and environmental conditions, and in areas where surfaces and surroundings may feature broad diversity of objects, shapes, colours and textures. Whilst these challenges were anticipated by Enviro NZ from the outset, it became increasingly evident that having a system with the ability to operate effectively in a landfill environment would be pivotal to the viability of any trial.

Ultimately, for the duration of the trial, Enviro NZ's efforts were focussed on development of a system to a level of accuracy and reliability that the organisation, and its workers, could be confident in. This was not an off-the-shelf product; but a bespoke system trained and improved over time to suit the dynamic environment of the Hampton Downs landfill.

Loader Isolation Policy

At the time of entering the Enforceable Undertaking, the risk of impact between a loader and a person at the Hampton Downs Facility was primarily managed through application of exclusion zone rules. The exclusion zone rules were in effect a minimum distance between plant and people, allowing time to respond safely in the event of an unplanned or unintended movement. Various other controls were also in place to provide additional layers of protection (including reversing cameras and squawkers on loaders, points person and traffic management procedures).

However, during the period of the Enforceable Undertaking, Enviro NZ revised its traffic management system and implemented additional controls with a focus of isolating loaders at the tip head. This isolation control requires that when the loader is in use on the tip head there are no vehicles or pedestrians in the operational area of the tip head and the inlet access road barrier arm is in a lowered position.

This change to include a further higher-order control on the tip head has meant that, should the isolation control be working effectively, the likelihood of a loader becoming proximate to trucks, other moving plant or, most importantly, people is greatly diminished.

In the context of the Enforceable Undertaking, the isolation of loaders has meant that numerous controls need to have failed before the occurrence of a hazard that the VAI is programmed to detect (e.g. close proximity of loader and person). This has affected the role played by the VAI in the trial. In effect, it made use of VAI fundamentally different to how it was envisaged at the start of the Enforceable Undertaking. It's use as a control is now limited.

MOBILE VAI TRIAL

What was the Mobile VAI system?

Enviro NZ installed a camera system with VAI application on the rear of a loader at Hampton Downs Facility in 2022. The camera tracked the loader's travel path, and the VAI was programmed to detect people (pedestrians) and a range of pre-selected objects, such as vehicles (cars, utility vehicles, trucks), mobile equipment (loaders, forklifts, bulldozers, articulated dump trucks, excavators), stops signs and pedestrian signs within a configurable detection zone. The VAI was in addition to other controls, including mirrors, reversing squawkers and reversing flashing lights.

Upon detection, the VAI triggered the in-cab warning system, which used visual and audible controls to alert the operator. The visual control was in the form of an alert (yellow) or warning (red) light, depending on the proximity of the detection, which flashed in the cab of the loader. The audible control was in the form of a beeping sound.

Photo: The camera installed on the rear of a Volvo L120 loader at Hampton Downs Landfill.

The VAI system later featured visual display units which were installed into the cab of the loader to provide the operator with a visual 'picture' of what the camera had detected. Modems were also installed in the loader to improve information connectivity and data transfer, given the remote location of the Hampton Downs Facility tip head.

Photo: What an operator would see from the VDU. This shows a person in the 'alert' zone (shaded yellow), detected with 83% confidence.

Perhaps most significantly, considering the remote location of the landfill environment, the VAI system had a web interface which supported wireless cloud uploading of photos and data and allowed remote viewing of detection events. While this was not a 'live feed', the system could connect to the cloud when the loader key was activated and upload parcels of detection data throughout the day. Easy access to the footage of events detected was a key aspect of the trial, as it would enable Enviro NZ to share information generated by the VAI cameras for use in worker engagement (discussed at Part Three of this report). This development came later in the trial; for majority of the period, access to data required a manual download at the loader.

How was the Mobile VAI system developed?

At the beginning of the trial, the number of false detections was high as the VAI system had to learn the operating environment. A 'false detection' refers to the triggering of a control by the VAI in a scenario which does not represent a hazard or risk. For example, the VAI may interpret an image of a tyre on the tip head as a person or piece of equipment. A false detection is a failure in the safety control system and posed an issue for Enviro NZ. First, false detections meant controls (audible and visual) would be triggered on a frequent basis causing alert fatigue and operator desensitisation to controls for 'true' detections. Second, the controls triggered by false detections posed a distraction for the operator in the work environment, and in this sense risked introducing new hazards instead of managing existing hazards.

The high number of false detections manifested in frustration and distrust in the Mobile VAI system among workers. During this time, the Mobile VAI system was making their work harder and was not contributing to a better learning environment, as had been conveyed when the project was introduced.

Photo: Example of a false detection.

To reduce the number of false detections, data and photos of detection events were regularly downloaded and provided to the VAI supplier for analysis and algorithm refinement. Tens of thousands of photos were supplied for these 'training' purposes. Firmware updates were then made as the VAI algorithm was improved, which increased the accuracy of future detections.

As the trial progressed, the number of false detections decreased to a level that gave Enviro NZ management and workers confidence that the introduction of a further control was appropriate. A seat shaker was installed to the loader, which was triggered on a detection and caused the operator's seat to shake (in addition to the audible and visual alarms described above) to alert the driver to the potential hazard.

Current Status of the Mobile VAI Trial

The Mobile VAI has improved significantly in accuracy, reliability and effectiveness throughout the trial, to a point where it is working well with low incidence of false detections and good connectivity. Feedback from operators is that they value the additional protection and increased level of vision provided by the Mobile VAI system. One worker described it as "*brilliant*!". This confidence and trust in the system by the workers represents a large shift in perspective from the beginning of the trial. Enviro NZ considers this a significant achievement of the trial. System training for the environment took considerably longer than anticipated, but perseverance proved worthwhile.

Due to the amount of time it has taken for Enviro NZ to get to this stage of confidence in the mobile VAI, the volume of 'good' data (in the sense that it is not a false detection, and is reflective of the actual risks and hazards existing within the work environment) sustained over a long period of time has been low. This has made it difficult to locate and analyse patterns and trends in the information generated by the mobile VAI.

The low number of positive detections from the Mobile VAI system also suggests that existing controls (in particular the isolation of loaders as explained earlier) are working as planned. In this sense, the Mobile VAI is functioning both as a complementary control in its own right, but also as a tool to verify other, higher-level controls.

Enviro NZ will continue to explore further improvement of the Mobile VAI system, including potential connection to higher-order controls, generation and analysis of trend data and integration into existing safety systems.

STATIC OR FIXED VAI

The Static VAI system implemented by Enviro NZ involved two (2) CCTV cameras installed on poles at the main tip head of the Hampton Downs Facility. The cameras sent data to a cloud-based system on which the VAI software was installed. The VAI software would then scan the camera data and detect a range of pre-programmed events:

- A person behind reversing heavy vehicle (at any distance)
- A person near moving mobile machinery (within 4 metres of moving machinery)
- A person near moving vehicle (within 4 metres of moving truck)
- A person near raised tipping truck (the exclusion zone targeted was twice the height at all stages of tipping and at least 4 metres in front of the truck)

Photo: 22/04/2024 17:40 Person Near Raised Tipping Truck

Conclusion: False detection. Points person is standing in a safe position in front of the tipping truck.

Detections were captured initially as photographs and logged within an online portal featuring a real-time camera feed and detection event register. However, installation of a local server increased the speed of transmission and made it possible to retrieve video snippets instead of still images. Access to video snippets significantly improved context of the detection events and assessment of the hazard (i.e. whether it was a 'false' or 'true' detection).

Selecting the location of the Static VAI system was challenging, requiring trial and error. The dynamic nature of the tip head meant the cameras needed to withstand the elements of an outdoor environment (wind, rain, fog), be readily moveable and not obstructive to the tip head operations. Initially, the Static VAI system was installed with two (2) cameras on poles at a height of five (5) metres at the back of the tip head looking down towards the tip face.

Image: Aerial view of Hampton Downs Facility refuse tip head as at February 2025.

Photo: The camera on a wooden pole looking down the tip head (initial installation set up).

How has the Static VAI System developed?

Similar to the Mobile VAI system, the accuracy of detections was paramount to the effectiveness of the Static VAI system. The Static VAI system needed to function from significant distances, evaluate a wide range of variables, including over 18 different types of vehicle combinations and their movements, while disregarding non-hazards caused by stationary vehicles, rubbish and debris. Perhaps due to this complexity, the number of false detections has remained high throughout the trial of the Static VAI system. Results of the detections for the first four months of operation showed 343 detection events, of which 342 (i.e. all but one) were considered to be false detections.

Enviro NZ's review of false detections frequently identified issues in perspective. For example, the VAI software interpreted data as showing a person in close proximity to a truck, when in reality the person was located at a safe distance in front of the truck.

18/04/2024 08:30 Person Near Raised Tipping Truck

Conclusion: *False detection as the points person is standing safely in front of the tipping truck.*

22/04/2024 16:28 Person Near Raised Tipping Truck

Conclusion: *False detection. The truck is not a tipping truck, but a walking floor truck. The system was confused by the nets raised.*

To improve perspective of the cameras and therefore accuracy of detections, Enviro NZ reviewed the location of the cameras during the trial. When the tip head moved, Enviro NZ took the opportunity to trial a different installation set up. At the new tip head, the cameras were installed on eight (8) metre-high relocatable poles (rather than five (5) metres), with engineered cement bases. One of the cameras was positioned on a hillside platform

perpendicular to the tip face and approximately 10-12 metres above the tip head, and the other camera was installed at the back of the tip head looking down towards the tip face.

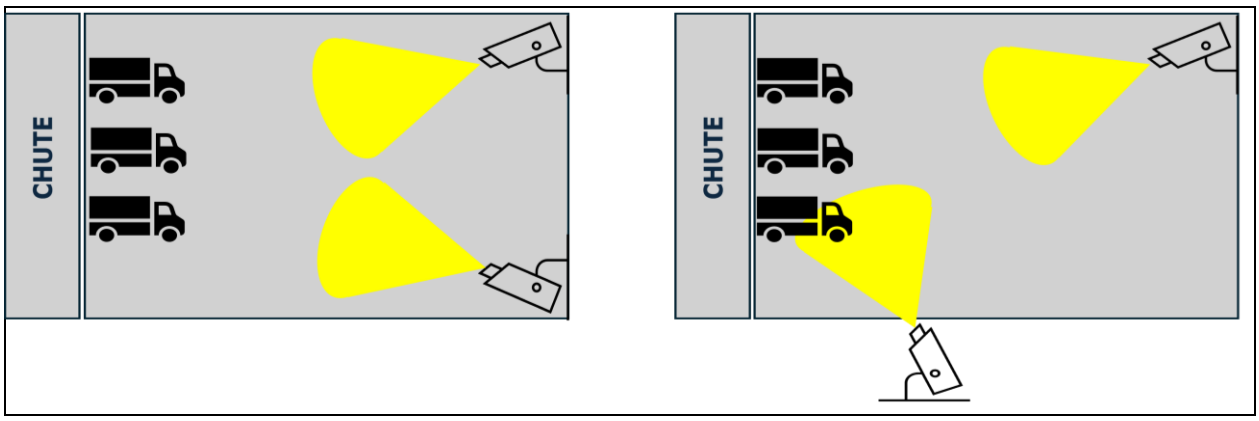


Image: showing the different installation locations trialled by Enviro NZ: initial (left) and current (right).

Enviro NZ expected the additional height of the cameras to enable more of a bird's eye view and therefore improve the VAI software's ability to accurately measure distance and minimise the false detections. The perpendicular layout was also expected to provide better points of view, improved ability to detect depth and, when coupled with a higher point of view, more accurate detections.

Photos: Camera system installed on 8m high poles (current installation set up).

The dynamic nature of Hampton Downs Landfill has tested the Static VAI system's ability to discern genuine safety risks from innocuous occurrences, and the challenge presented by false detections has been a constant issue throughout the trial.

When the Static VAI system was first implemented, there was concern from some of the workers that it would be used for performance surveillance and disciplinary purposes (i.e. 'big brother'). Some workers also felt that their judgment on the tip head (for example, distance

between points persons and tipping trucks) would be brought into question by the VAI, and had doubts the footage would accurately depict all circumstances of everyday work affecting their decision-making skills. This created distrust amongst the workers in the Static VAI system. Similar to the Mobile VAI system, this perception of the Static VAI system was an obstacle to worker buy-in and was not assisted by the lack of meaningful insight presented through high numbers of false detections. Whilst workers now largely accept the Static VAI as being part of the current fabric of controls on site, work continues at the site to build trust between workers and the technology.

As mentioned above, the trial did not just explore Static VAI as an information source using data (pictures and videos) detected and generated by the camara; it was also trialled as a control for risk management. The VAI software was able to be integrated with other software, hardware and systems, such that detection events would trigger alerts or other controls such as sirens or lights at the tip head. Due to the high number of false detections, Enviro NZ's implementation strategy involved a careful, staged approach. Enviro NZ first installing an application on a mobile phone which triggered notifications (noise or vibration, setting dependent) upon a detection. This mobile phone was monitored off-site so as to not risk introducing another hazard. As false detections remained at high levels, Enviro NZ did not advance its trial of these controls.

Had the technology been proven, Enviro NZ planned to consider alternative alert devices, such as smart watches or wristbands, with vibration and audible functions, instead of having workers carry phones. This is due to the potential distraction posed by phones, and a result of worker feedback on the worker engagement tool (discussed at Part Three of this report).

Current status of the Static VAI trial

Enviro NZ's trial of a Static VAI system has encountered numerous challenges; more so than the Mobile VAI system. Despite efforts to 'train' the Static VAI system, software updates and location changes, false detections still remain at a high level.

Challenges around trust, functionality and accuracy of the Static VAI system remain ongoing, and ultimately have hindered Enviro NZ's progress towards implementation of the Static VAI system to function as an effective and reliable control and information source.

> The human eye's ability to accurately perceive distance and spatial relationships is something which we have not yet seen matched by VAI.

Given more time and development, it is possible that the number of false detections will reduce so that the potential of the Static VAI system to add value is realised. However, as at the conclusion of the trial period, the Static VAI system has not progressed to the same degree of improvement and functionality that we were able to achieve with the Mobile VAI system.

Whilst false detections were considered an *incorrect* function of the VAI, they ironically showed a *correct* function of existing controls (for example, the administrative control of the exclusion zone between a worker and a tipping truck). Whilst an unintended part and outcome of the trial, this has shown the value of static VAI as a control verification tool.

There is potential to explore the Static VAI system in other ways that focus detections on more simple aspects of work as done, rather than detailed measurement of multiple interactions over a large area, for example:

- **Verification of the isolation control:** If working, this control aims to ensure no other vehicles or persons are on the tip head and the inlet access road barrier arm is down whilst the loader is in use on the tip head; or
- **Busy, different or difficult work conditions:** If there are three or more trucks unloading at the tip head, difficult conditions or unusual trucks or loads to discharge video footage can be captured and used later to prompt discussion with workers on their everyday work.

FINDINGS OF THE MOBILE AND STATIC VAI TRIAL

Enviro NZ believes VAI offers a lot of promise to help eliminate and manage risk. It is a powerful tool with marked advantages; an 'ever-vigilant' system and source of objective insights, potentially otherwise unknown. However, with that comes its own unique set of challenges, some easier than others to overcome.

Below is a summary of some of the overarching learnings from the Enviro NZ VAI trial:

- **VAI as an additional layer:** Mobile VAI proved itself as an effective and reliable technology option for complementary controls at dynamic work sites. However, in dynamic work site environments, VAI should act as an additional layer of control only, and not as a substitute for other controls. Technology has not yet advanced to a point at which the involvement of people to facilitate landfill tip head operations can be eliminated. For critical risks in particular, such as the risk of a person being struck by a loader, VAI is just one control which works alongside other controls within multiple layers of defence.
- **Value as a verification tool:** Static VAI has proven a useful tool, not through its role as a complementary control to prevent or minimise hazards, but through the role of VAI data in the verification of existing controls. As organisations strive to identify and narrow the difference between 'Work as Imagined' and 'Work as Done', VAI data insights hold value.
- **Difficulty in dynamic environments:** It takes a lot of time and effort to train VAI systems to function in dynamic environments. This process of trial and error and generation of false detections, as well as their review, can be disruptive to the workplace and resource demanding. Patience, continual 'training' of the VAI and engagement with workers is essential. As the technology improves this learning will become less relevant, but it has been an important one for Enviro NZ.
- **Hierarchy of controls:** Using VAI to help remove the need for workers to be exposed to the hazard, rather than managing the risk associated with workers being in the same area as the hazard, will have a greater positive impact on safety outcomes. If controls further up the hierarchy of controls can be applied (VAI or otherwise), then these will be applied by Enviro NZ in the first instance. For example, the tip head isolation control which has had a marked effect on reducing the risk of people and loader collision.
- **Conservatism in High-Risk Areas:** Dynamic work environments carrying a high risk of harm warrant a level of conservatism when implementing VAI solutions. Enviro NZ would

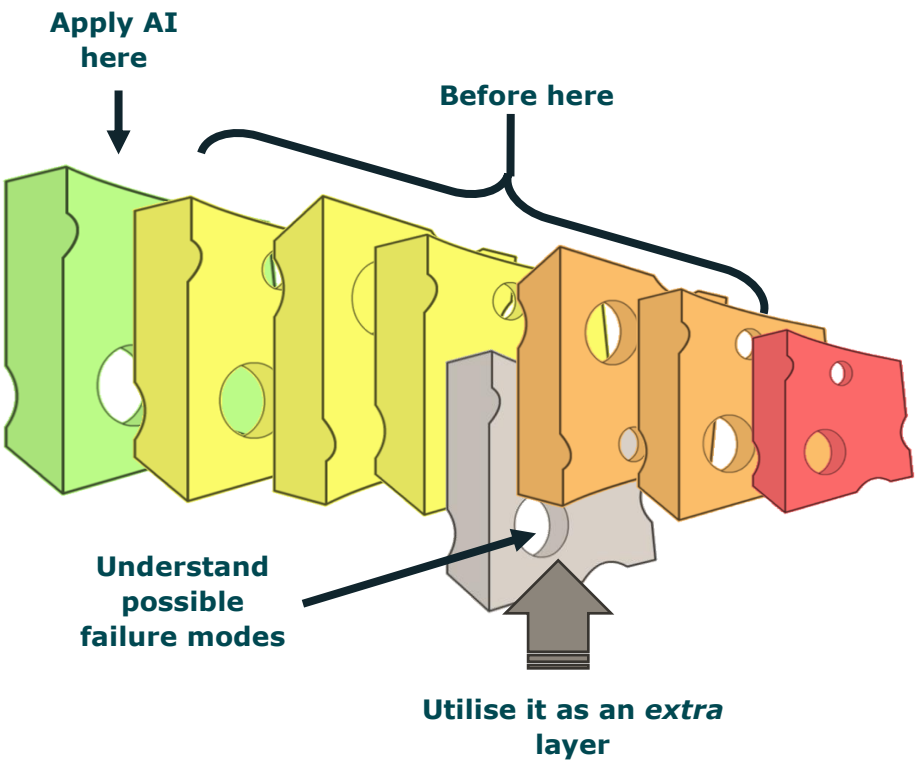
prefer a few false alarms, instead of missing a high-risk situation, but the right balance must be found to avoid possible unintended consequences.

- **Better understanding of worker behaviour:** VAI detects and captures situations ('Kodak moments') that provide opportunities to gather insights from workers around their experiences. Snapshots of a detection (whether false or positive) have provided greater context to everyday work and hazards, helping Enviro NZ to have richer, more informed engagement with workers to understand how hazards arise. The snapshots have also prompted discussions around aspects of work that it would not have previously anticipated, which allowed management and workers to then develop better outcomes for work task and work environment planning, ultimately leading to safer outcomes.

  This is one of the areas that the trial aimed to explore – whether information from VAI systems can help Enviro NZ to better understand everyday work and hazards in a dynamic environment. The published report for section 3.3.4 provides more information about these findings of the comparative study.

- **Planning for Failure:** VAI controls have different unique modes of failure that must be considered, such as the complexity of the technology which present more components/ opportunities to fail, and vulnerability to cyber security risks. This can be mitigated through robust processes for identifying these modes of failure and implementing additional layers of control to fall back on. It is necessary to understand the data demands of the project and the privacy / security requirements associated with that data.

- **Worker engagement for management of change:** It is essential to ensure workers understand the purpose and role of the VAI cameras. Workers had concerns about the cameras acting as 'Big Brother' and management's use of footage for disciplinary reasons. This effected trust in the VAI system and required time and discussion for worker 'buy in' – which is essential to the success of any safety control and engagement tool.



VAI as an additional layer of protection

The Enforceable Undertaking involved a trial of VAI. In 2022, expectations for outcomes and results were high, but the path of the journey and destination was unknown. Enviro NZ is proud of how it committed to that journey, yet in 2025 has found itself at a different end point. Enviro NZ's vision of the VAI technology was for it to act as a primary control to detect and manage hazardous situations and provide 'big data' on everyday work and hazards. Instead, due to the complexity of the VAI technology and challenges presented by the dynamic nature of the site, as well as the fundamental shift in traffic management controls, only the mobile VAI has proved beneficial as a complementary control yet both VAI systems' have value as a verification tool for *other* controls and a data source for worker engagement.

Overall, there were significant learnings from both mobile and static VAI systems and Enviro NZ intends to keep investing in this technology as it advances.

Enviro NZ hopes that other organisations can learn from its lessons and benefit from the VAI trial carried out by Enviro NZ during the Enforceable Undertaking. Below are key "tips" for industry from Enviro NZ's trial.

Tips for using Visual Artificial Intelligence (VAI) to manage dynamic risk

1. **Purchase proven technology off the shelf:** Choose a supplier that can show you, ideally through case studies, the "VAI systems off the shelf" working in your specific industry and in your specific application. If you cannot buy a proven VAI technology off the shelf, choose a supplier that has already developed a similar technology that can be applied to your industry and operating environment, to minimise system learning and development.
2. **Be very clear on how you will use VAI**: Focus on using VAI to learn and understand more about how work is done. Understand its place with the system of controls.
3. **Build trust early in the project:** Before you install the VAI system engage with your workers, communicate clearly with them on the purpose, function, objectives and likely journey of the VAI system. Establish a co-design team that involves workers and management. Avoid "big brother watching" concerns. There should be check-ins and updates with the whole team (including workers) on a continuous basis.
4. **There may not be autonomous learning**: You will likely have to train the system to understand your specific application. This takes time, energy, patience and investment.
5. **Resource for change management:** As with all new technology and systems, ensure sufficient resourcing and training of personnel.
6. **Understand your data management and connectivity needs:** That is - quantity, type, networks, processing speed, security, privacy, server isolation.
7. **Plan for the environment the cameras will be working in:** If located outdoors, is all equipment adequately resistant to the weather and other moisture/dust sources, do you require low light capability (night, fog)? If you're relying on solar power, how will you ensure battery back-up and management?
8. **Mount cameras on structures that are easily accessed or portable**: Avoid work at heights for camera maintenance. Understand vibration, wind-stability impacts on camera operation. Portability increases system flexibility. Remember retraining of the VAI might be required if the cameras are relocated.
9. **Plan for failure**: VAI has many modes of failure and cannot be relied upon as a solitary control.
10. **Conservatism is key**: Make sure your VAI system is conservatively geared to avoid missing important detections.

Part 3: Worker engagement tools

PART 3: WORKER ENGAGEMENT: THE POWER OF HUMAN-CENTRIC APPROACHES

Simultaneous to the trial of VAI technology at the Hampton Downs Facility, Enviro NZ developed and implemented worker engagement tools at two sites: one with VAI (Hampton Downs Facility) and one without VAI (Pōkeno Facility).

This project focussed on two worker engagement tools:

- **4D Methodology:** The 4D methodology involves simple questions and conversations focussed on what is Dumb, Dangerous, Difficult and Different about work.
- **Learning Team Sessions:** Learning Team sessions involve facilitated conversations and provide a platform for workers to provide valuable insights into how work is done.

The aim was to use information gathered from the worker engagement tools to better identify 'weak signals' between how Enviro NZ believed its controls were managing risk and how workers were adapting to the dynamic work environment. Enviro NZ would then explore whether the worker engagement tools, and the weak signals they identified, could be used to evaluate the effectiveness of controls and support workers' knowledge, competency and skills in dynamic environments.

The purpose of implementing worker engagement tools across two sites (one with VAI and one without VAI) was to assess the value of VAI data to worker engagement. Could VAI inform better worker engagement? What was the value of gathering and making use of information about workers' everyday work? Enviro NZ sought to explore these questions through the comparative study.

What began as a standalone change with a handheld device, evolved into a more holistic and comprehensive framework of employee engagement integrated across multiple operational forums.

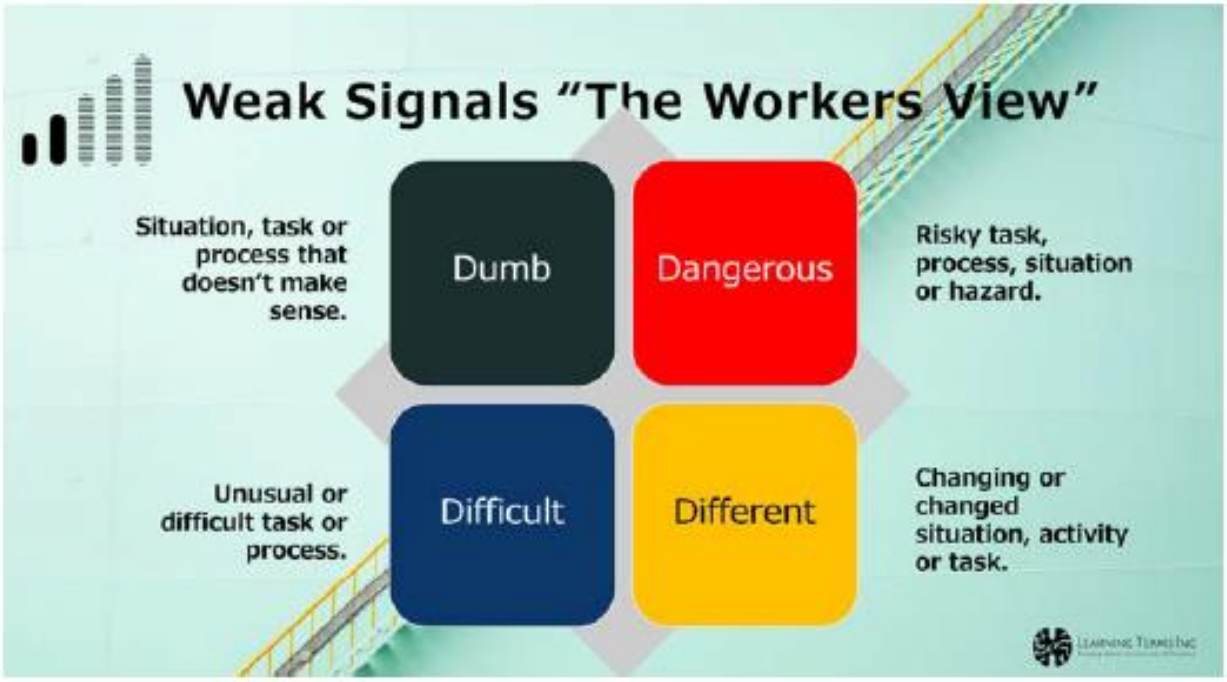
What is a 'weak signal'?

A weak signal is the first indicator of a change or an emerging issue that may not currently seem significant, but which may become so in the future. Weak signals can be identified by 'scanning' the operational environment. They may supplement trend analysis and be used to detect emergent risk.

4D METHODOLOGY

The 4D methodology is a simple way for workers to evaluate a work environment. Through four simple questions and conversation prompts, the 4D methodology applies enquiry and curiosity to seek understanding and learning:

- **DUMB:** What does not make sense or frustrates you about the work?
- **DANGEROUS:** What is risky or challenging about the work?
- **DIFFICULT:** What makes the work difficult or demanding?
- **DIFFERENT:** What is changing or surprising about the work?



DUMB

The word 'dumb' initiates a thought-process and conversations about things that make sense, things that do not, and what frustrates people in work. Understanding why choices make sense to people at the time based on their cues and their interpretation of the circumstances can be an important preventative learning.

Making enquiries into how workers make sense of things can demonstrate that the worker's interpretation of the work environment matters.

DANGEROUS

Discussing hazard and risk perception can identify which hazards workers care about and how they deal with them. Keeping an open dialogue about hazards and risk (and therefore what is perceived to be dangerous and what is not) lowers the perceived threshold of risks worth talking about.

DIFFICULT

When a work task is difficult or demanding on workers, many may simply just 'soldier on' and 'make do,' possibly assuming that is just the nature of the task. However, task difficulty can be an important sign that the task is being done incorrectly, or that something is amiss elsewhere in the system.

Weak signals can be identified from creating an open dialogue about the difficulty of work and lowering the threshold on what is perceived as worth discussion.

DIFFERENT

Tasks or situations identified as different are particularly relevant in a dynamic environment, where hazards and risks constantly change.

Conversations about tasks that have changed or work environments that are different, whether due to location, material, environmental context or otherwise, can assist in the detection of weak signals.

Enviro NZ's initial use of the 4D methodology

Initially Enviro NZ chose to use a digital method of interface between workers and the 4D methodology, by giving workers at the Hampton Downs and Pōkeno Facilities designated work smart phones with links to a 4D website. Workers would talk into the phones to recount their observations and thoughts about the work environment in real-time using the 4D methodology. AI technology would then anonymise the received content, remove any personal identifiers and analyse key themes and weak signals.

Photo: The 4D website shown on a phone

The use of mobile phones as a collection tool for the 4Ds however was not well received or adopted. Workers were reluctant to engage with the technology and the phones sat unused in the smoko rooms and designated areas. Operators shared honest feedback about why they weren't using the phones: they felt silly talking into devices in public spaces; it was "*just another thing*" to remember to do during their already busy workday; they valued their breaks as actual breaks; and they doubted whether their recorded concerns would ever lead to meaningful action. As one manager reflected:

> *"One of the early hurdles we faced was the introduction of the 4D phone. The operators were unwilling to engage with the technology, and it quickly became clear that language barriers, generational gaps, and a lack of on-the-ground champions were significant factors in its failure. Despite my deep understanding of the operational side of the business, my efforts to integrate technology into our daily practices felt disconnected from the reality of the operators' needs."*

Rather than forcing the technology approach, Enviro NZ found that two changes to workers' interaction with this methodology had a positive effect on its implementation and effectiveness at the Hampton Downs Facility:

- **Fifth "D" – Delightful:** Whilst the 4D methodology was positive in intent, it carried inherently, negative connotations. Workers wanted to celebrate, and learn from, successes. As a result, a fifth "D" was added. This included innovations that improved safety, near misses caught before becoming incidents, and things that made work better.

  "No stuck loads, that's a delightful day"

- **Embed in existing forums:** Teams at Hampton Downs sites moved to incorporate the 4D methodology into existing, familiar forums including morning Toolbox Talks. This initiative was driven through a Learning Team session, where a key insight emerged: "*[A Toolbox Talk] wasn't the start of work; this was part of an ongoing operation. Work didn't stop and restart with a form. It carried through, with insights, risks, and workarounds handed down from one shift to the next*." Recognising that often handovers were informal and valuable information was lost, the team explored how Toolbox Talks could capture more than just compliance. What if, as they questioned, *'they made space for learning? What if they helped the team think together?*' Embedding the 4D methodology (and 5th D: 'Delightful') into the Toolbox Talk form and conversation helped to facilitate this transformation.

Conversely, the team at the Pōkeno Facility had a slightly different approach. Workers moved away from the 4D methodology and instead incorporated curious questions from the HOP Nerd resource during Toolbox Talks. This highlighted the flexibility in worker engagement tools needed to resonate with different teams.

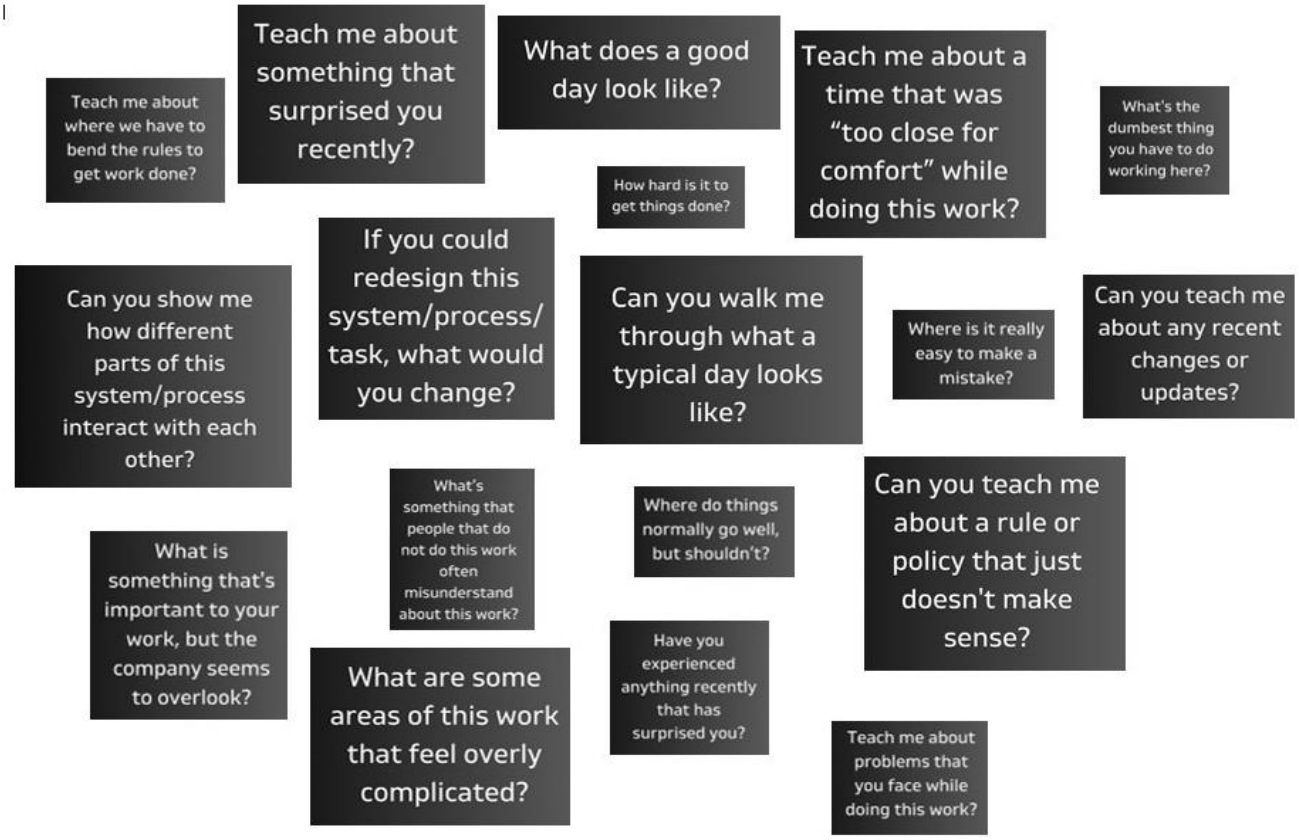


Image: Curious Questions

Ultimately, whilst the device did not prove successful, Enviro NZ found that the 4D methodology provided a simple language that enabled teams to build confidence in discussing issues openly, creating richer and more meaningful safety dialogues.

At Pōkeno, one worker stated:

> *"We used to just go in do the meeting and then go out and get started. Now…it makes me think…I go out…I stop, look at the site, check things, see what's different, what might be hard…it's been really good to start my day."*

LEARNING TEAMS

Introducing Learning Teams and its initial challenges

Worker engagement sessions, referred to as "Learning Teams", were established at the Hampton Down and Pōkeno Facilities and formed the backbone of Enviro NZ's worker engagement approach during the Enforceable Undertaking period.

Initially managed by an external facilitator, the monthly Learning Team sessions involved workers (primarily points persons, tip head machine operators and Health and Safety representatives) discussing how work was actually performed on the ground and "deep dives" into particular topics. The 4D methodology was also used in Learning Teams to reinforce its use in Toolbox Talks and consistency in safety discussions.

The purpose of Learning Teams sessions was to have a high level of worker input to help Enviro NZ understand how work really gets done. To facilitate this input, an early objective of the Learning Teams sessions was to foster the psychological safety of the operators involved in the sessions. In a psychologically safe environment, workers feel comfortable and are more willing to share their knowledge, experiences, and insights with others, supporting the process of continuous learning and improvement. To achieve this, management were excluded from the Learning Team sessions. While this helped foster a safe space for workers to talk freely, it also had several unintended consequences. Excluding management from the early sessions created a "*them and us*" divide between operators and management. In addition to this, management lacked context for the Learning Team discussions and outputs that flowed from these sessions. Without this context and not wanting to inhibit the Learning Team process, management often felt unable to follow up on or act on some of the aspects being discussed, thus creating a barrier to the development of the crucial feedback loops required to complete the learning process. Without these feedback loops between workers and management, the workers reported that despite now having a forum for speaking up, that they were still not being heard. From the workers' perspective, they were raising concerns but seeing limited or no action; from managements' perspective, they had limited understanding of the discussions taking place and so struggled to take meaningful action.

Management also felt conflicted with what seemed like mixed messages about the purpose of Learning Teams. Early in the project, teams were told by third party facilitators the focus was on the learning and not about fixes and that fixes can inhibit learning; that being, our natural tendency is to rush to a solution when an issue is raised, instead of taking the time to be curious and learn first to really understand all the factors at play. This communication of the principles and theories behind Learning Team sessions had unintended consequences with managers experiencing a sense of frustration and paralysis, being that they felt damned if they fixed items raised in Learning Teams and damned if they didn't. As one Manager reflected:

> *"[Facilitators] while knowledgeable, sometimes communicated in ways that felt out of touch with the practical needs of the team. The use of overly technical*

language or vague concepts often created confusion instead of clarity. It became clear that having a meeting to gather feedback without an intention for resolution was not productive."

Despite these challenges, both sites were committed to the Learning Team process. Workers and management sought to obtain further value from the sessions and address the incomplete feedback loops that the workers were reporting during the project.

EVOLUTION OF THE LEARNING TEAM SESSIONS

To solve the issues above, the facilitation of Learning Teams sessions transitioned inhouse, led by the site Health and Safety Representative and Health and Safety Advisor. Alongside this change, the sites reflected on the Learning Team process further and initiated a new clear structure to enable learning, curiosity, understanding and improvement. The adopted structure follows:

- **LEARN**: Explore issues in depth with those closest to the work.
- **SOAK**: Structured period of 24 to 72 hrs to process and reflect on what has been learnt.
- **SOLVE**: Develop practical actions to address identified issues.

The introduction of a SOLVE session involving management was a pivotal point and has been fundamental to the success of Learning Teams at Enviro NZ. Not only has this provided management with direct context and understanding of the perspectives of workers, but it has provided space for the collaborative development of improvements – proving purpose and value in the time and viewpoint of workers. This structure has helped to resolve earlier frustrations in the absence of feedback loops, felt by both workers and management. This is illustrated in two examples below.

LEARN > SOAK > SOLVE

Example 1

At the Pōkeno Facility, hung loads due to sticky material[5] emerged as a recurring issue in toolbox meetings with the change of season bringing wet weather conditions. Hung loads can occur when the material inside a truck gets stuck and does not dislodge when tipped at the tip head. This causes the suspended load to become unstable and can lead to trucks falling sideways, creating a hazard to those in the trucks cabin and nearby. The Safety Committee identified this as a pattern of conversations in minutes from the morning Toolbox Talk meetings and voted to do a Learning Team session on this topic.

- **LEARN:** The Health and Safety Advisor facilitated a discussion with three workers, using curious questions to uncover the realities of managing hung loads. This session revealed variations in communication methods, permission processes for scraping out hung loads, and issues with equipment.
- **SOAK:** A period of reflection and deeper thought.
- **SOLVE:** This session included the site Operations and Branch Managers to develop improvements with the workers based on their insights. These actions were loaded into

[5] *Refer to Appendix 1 'Terminology' for a description of 'hung' / 'sticky' loads.*

the site's incident reporting system and assigned to nominated individuals to complete. Finally, the learnings and actions out of these Learning Team sessions were shared with all site workers at the monthly Tailgate meeting.

Example 2

Similarly, in a Learning Team session at Hampton Downs Facility, the Health and Safety Representative identified winter preparation and low visibility as timely topics needing further exploration.

- **LEARN:** A session with several points persons, a supervisor, and the Health and Safety Advisor examined normal processes, challenging conditions, and resource needs.
- **SOAK:** A period of reflection and deeper thought.
- **SOLVE:** The follow up session developed action plans including a PPE evaluation project and standardisation of light wands across the site. Again, these learnings were shared at the Tailgate meeting, completing the feedback loop.

Building a Comprehensive Framework: Connecting the Dots

Through the two-year journey of trial, error, adaptation and evolution over the course of the Enforceable Undertaking, Enviro NZ gradually developed a worker engagement framework (figure 1 and 2 below) that connected Enviro NZ's various worker engagement initiatives into a more cohesive whole.

An important part of this is the Safety Committee, which had been established during the initial phase of the Enforceable Undertaking at both sites. The Safety Committee included worker representatives, management, Health and Safety Representatives, and the site Health and Safety Advisor, with Terms of Reference in place clearly outlining that worker representatives were never to be outnumbered by management. As Enviro NZ's understanding of effective worker management deepened, the structure of these Safety Committees evolved to better serve each site's specific needs and the worker engagement tool framework. Safety Committees still retain their compliance focus, but the meetings have adapted to act as dynamic platforms for reviewing and assessing frontline insights and trends. This helps to direct resource toward areas with the greatest potential for learning and improvement.

At Hampton Downs Facility, both management and the Health and Safety Representatives felt that the Safety Committee forum could be further enhanced to facilitate more stories and feedback from operators. Building on the principle of establishing psychological safety that the site had learnt from the Learning Team sessions, the site moved to an operator-only Safety Committee, chaired by the site two Health and Safety Representatives. This change enhanced the sharing of work stories and leveraged the relationships that Health and Safety Representatives had built with the workforce. The Health and Safety Representatives then actively communicated outcomes to management, creating a bridge between frontline perspectives and leadership decisions, and ensuring feedback loops were maintained. This change of structure enabled the Health and Safety Representatives to clearly identify safety themes to feed into the monthly Learning Team sessions for a deeper dive.

In contrast the Pōkeno Facility site maintained their original committee structure (described in the diagram below) but adapted its purpose. Rather than using the 4D methodology to capture stories from members during the Safety Committee meeting, the Safety Committee

began reviewing stories generated at the morning Toolbox Talk sessions and voting on issues which merited deeper exploration in the monthly Learning Team sessions, along with determining who should be involved in those discussions.

As a result of this framework, Enviro NZ have been able to embed worker engagement tools and adapt existing systems to maximise worker engagement results. This connection of morning toolbox meetings, Safety Committees, Learning Team sessions and monthly tailgates in a structured way ensures findings from one forum informs actions in another and improves safety and operational efficiency. This framework enables issues to be identified, explored in depth, addressed through practical solutions, and then communicated back to the wider workforce; creating the cycle of learning and improvement.

Hampton Downs Facility Framework

Figure 1: Hampton Downs Facility Framework: Evolved to an operator-only Safety Committee chaired by Health and Safety Representatives, enhancing psychological safety while maintaining management feedback loops through the Health and Safety Representatives.

Pōkeno Facility Framework

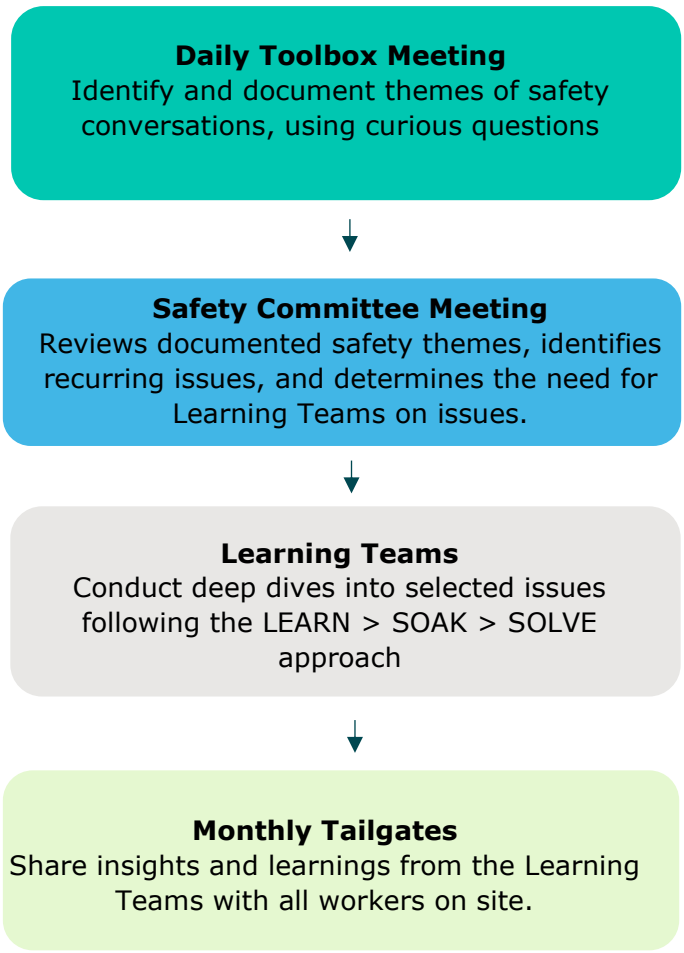


Figure 2: Pōkeno Facility Framework: The Pōkeno team maintained the original committee structure but changed its purpose to review toolbox generated stories and vote on issues meriting deeper Learning Team exploration.

Cultural Shift at Enviro NZ

The implementation of worker engagement tools by Enviro NZ as part of the Enforceable Undertaking have contributed to a cultural shift at the two sites. The focus on learning has changed workers' perspectives from simply getting on with the job to a more proactive safety-conscious approach. Workers have reported that they feel more confident communicating with supervisors, addressing problems openly, and exploring different solutions. Of most significance is that workers have reported they feel safer on site.

This new framework and focus on the 4D methodology for worker engagement has also improved morale among workers, who report feeling their contributions are more valued and suggestions they make are actioned. In one worker's words:

> *"We now feel they [management] have our back, before we were just told what to do".*

This is mirrored in feedback from managers who state there is a lot more engagement and conversation in the toolbox and other worker engagement sessions.

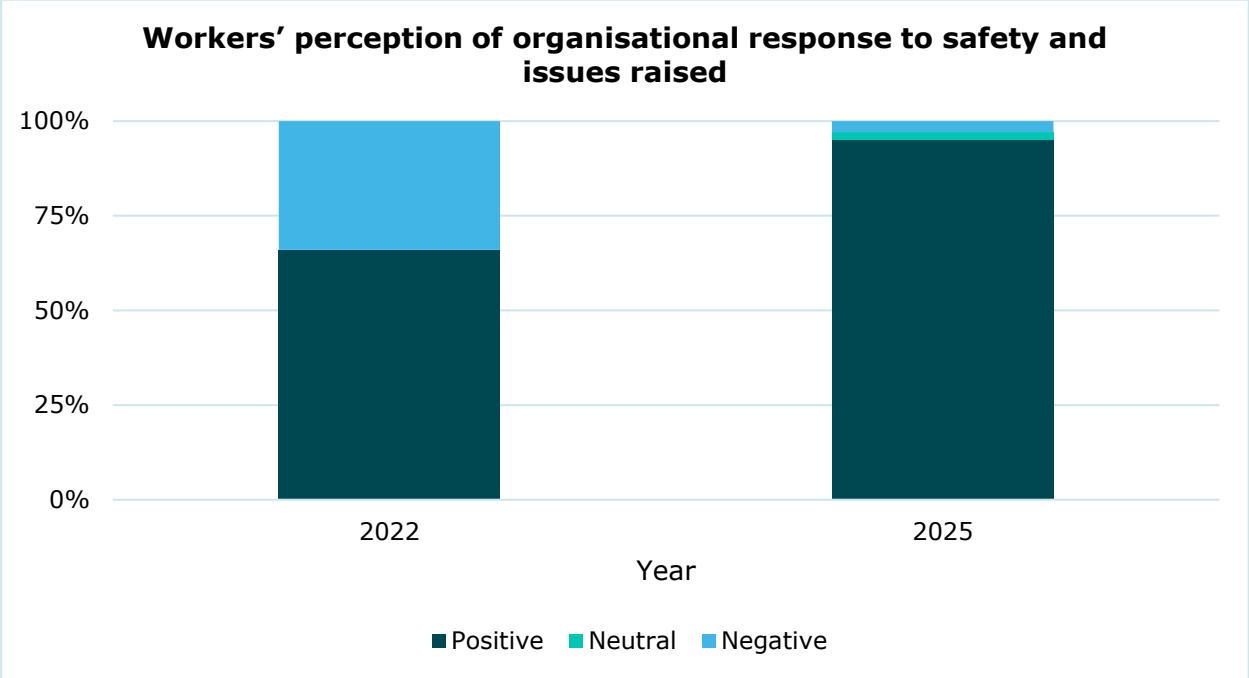
> *"I'm much more confident that if there is an issue that they're dealing with on a day-to-day basis, or there's some issue sitting out there that's potentially going to hurt someone that would actually be raised, and then it's the forums for doing that, there's the Learning Teams, there's the safety committee, there's the daily Toolbox meetings." – Management*

The case studies set out Appendix 2 are powerful examples of this cultural shift.

Another example came from a discussion about chain of command and communication. Workers identified that while they were expected to generally follow a chain of command upward through the foremen to the operations manager, when raising issues on site, that same chain of command was not being used for communication back down to the workers. Workers identified that their site foremen often had the context as to why the workers were doing things a certain way and a closer working relationship with individuals.

Communication back down through the foreman therefore enabled the workers to just focus on their work and be sheltered from some of the noise that could be dealt with by the foreman. This insight acknowledged the natural power imbalance that can prevent workers from fully expressing themselves when approached directly by senior management. It also recognised the workers and supervisor's roles enabling greater delegated responsibility, improving on the job decision making and dynamic risk analysis.

The results of an employee survey conducted in 2022 and again in 2025 at the two sites helps to demonstrate this cultural shift. This survey looked at workers' perceptions of organisational response to safety and issues raised. Positive responses increased from 66% to 95% and negative responses decreased from 34% to 3%. While there have been changes at the sites outside of the Enforceable Undertaking, including new management and leadership structure, the improvement in associations with engagement, learning and empowerment, and reduction of associations with blame, correlate to the core principles of effective worker engagement.



Graph: Results of survey looking at workers' perception of organisational response to safety and issues raised

Summary: Enviro NZ's Learnings

Throughout the period of the Enforceable Undertaking, there have been many learnings for Enviro NZ which we believe will be of great benefit to other organisations reassessing their method of worker engagement and assessment and verification of risk in a dynamic environment. These are summarised below:

- **Trust and Resourcing for Change Management:** Implementing worker engagement tools explored under the Enforceable Undertaking required a significant cultural shift and foundation of trust. This took time and resource. In hindsight, Enviro NZ may have had a better and quicker outcome had we approached the introduction of worker engagement tools in a similar way to implementing a new IT system, with a clear assessment of the starting point, appropriate resourcing and support, and a clear communication strategy. For example, Enviro NZ learned that the introduction of methodologies and tools, without adequately explaining the context, meant that workers knew the 4D terms but an understanding of the powerful themes and questions they represented was lacking. As one Manager put it:

  > *"To communicate the importance of the project, we approached the operator team and explained why this was happening. We emphasized its significance but quickly realised that explaining the 4D and Learning Team process was challenging. The messaging was unclear, with new jargon, acronyms, and power phrases being thrown around."*

  Having a 'champion' to assist in change management and instil belief in the purpose and value of the tools will assist implementation.

- **Conditions of Worker Engagement:** We have learned that worker engagement is most effective in conditions where workers feel valued and heard, where their expertise is

recognised, and where their insights drive meaningful change. The tools trialled (4Ds, curious questions and Learning Team sessions) have played a key part in this fundamental shift in approach. The importance of psychological safety may be the most valuable outcome of our two-year journey and is one which Enviro NZ continues to work to improve.

- **Adaptability:** We have learned that the approach to worker engagement needs openness and flexibility to adapt to the culture and needs of individual work sites, and it should not be assumed that one method works for all sites (even those with similarities in operations). Whilst consistency is important, organisations have limited resources and must focus on adding value with simple and practical systems that work for each team. It is critical that tools and implementation strategies are catered to the starting point.
- **Upskilling of workers and leaders:** When introducing a new process, especially one involving new technologies, theories and high levels of interaction, it is essential to ensure those participating (i.e. the workers) have a clear understanding of it and those leading (i.e. management) are provided with necessary training, resources and support to run effective sessions. Similarly, concepts discussed should have clear practical application and not exist only in theory. The role of facilitator in Learning Teams is an important one, and support from the organisation is necessary to ensure they have the necessary skills to draw out meaningful stories and prompt reflection and deeper thinking when met with silence. To embed tools and ensure continuity of benefit, knowledge also needs to be shared by many and passed on.
- **Importance of a feedback loop:** To give purpose and productivity to worker engagement, there needs to be a feedback loop which is not delayed (such that issues become forgotten or irrelevant, or discussions are repeated). The pre-planning of the SOLVE component of Learning Teams sessions facilitated this feedback loop. There remains room for improvement here; on-site teams are considering introducing an additional session for reflection on progress and case studies.
- **Celebrating success:** One of the key learnings is that workers want to celebrate positive outcomes and learn from success, not just focus on failures or breaches. By balancing problem solving with success sharing, there is a potential for organisations to create more engaging, productive, and ultimately safer work environments. This approach helps to bridge the gap between how work is imagined by management and how it is actually performed by frontline workers, creating a foundation for continuous improvement and enhanced safety outcomes.
- **Growth of competence and mindset:** Learning Teams sessions, through their focus on learning and improvement in a no blame environment, helped workers to foster deeper learnings and management to appreciate worker knowledge, perspectives and competence on site. Openness of mind – and having a culture that allows it – were prioritised and valued. People with natural tendencies for leadership, empathy and problem solving were provided with an environment to flourish.

Collectively, these challenges served as a powerful reminder: implementing new safety paradigms is not simply about introducing tools or technologies. It's about navigating human dynamics, fostering trust, adapting methodologies, and creating responsive organisational systems that genuinely value and act upon the insights of those closest to the work.

Conclusion

The development and implementation of worker engagement tools has been a journey of continuous learning and adaptation, but ultimately one of success.

While Enviro NZ's initial technology-based approach using mobile phones was not embraced by the workers, the integration of the 4D methodology (and later 5D) into existing operational forums proved effective as a tool. The addition of the positive 'Delightful' dimension, use of curious questions and the structured LEARN > SOAK > SOLVE Learning Team sessions have helped to reframe risk, evolve language and elevate worker stories so that their knowledge and experience contribute to the safety journey. This has strengthened Enviro NZ's overall approach to worker engagement.

This worker engagement framework has enhanced the safety culture at the Enviro NZ sites by creating spaces for open communication about operational challenges, building internal capability to facilitate meaningful conversations, and improving feedback loops to ensure worker concerns are addressed and weak signals don't go unnoticed. This has helped Enviro NZ to take worker engagement beyond a place of compliance and shift towards co-learning and a culture of doing work *with* workers not *to* workers.

These tools provide a replicable framework for other organisations seeking to improve their safety culture; however, implementation requires careful socialisation and management of change. If trust, purpose and relevance are not clearly framed, even the most sophisticated technology will be resisted. Future projects should build readiness first, engaging to ensure people understand not just what is being introduced, but why.

Would we give it up now?

What began as a project-imposed toolset gradually became something more. Workers (both management and front-line) who were initially cautious, even dismissive, of the learning tools began to ask questions, offer stories and reflect together in ways that hadn't occurred before. The turning point wasn't a single moment, it was the accumulations of small insights being heard and acted on.

"It felt like a tick-box at first. But once we saw things changing, it became our place."

"It helped us talk through stuff, not just report it."

"I wouldn't want to lose it now. It's been good to step back and actually say what's going on."

These sentiments reveal something deeper: when engagement tools are done with workers, not to them, they become part of the system, not just a feature of a project.

As one participant put it bluntly:

"Would we give it up now? No. Not if we want to keep getting better."

Part 4: Worker competency

PART 4: WORKER COMPETENCY FRAMEWORK

As has been explained in the earlier parts of this report, the concept of 'dynamic risk', where the operating environment can shift rapidly, was central to the activities under the Enforceable Undertaking. For work to go well in dynamic environments, workers need the knowledge to be able to reason and analyse those changing situations.

Worker competency, including risk awareness and decision making, is therefore a critical aspect of managing dynamic risk and an important measure of the effectiveness of the VAI and worker engagement practices being trialled under the Enforceable Undertaking.

To assist in the understanding and assessment of worker competency in the role of the points person during the trial, a worker competency framework was developed. This framework was intended to help workers and supervisors understand the nature of risk involved in the role of the points person and evaluate skill levels and decision-making.

DEVELOPING A COMPETENCY FRAMEWORK AND ASSESSMENT TOOL

The establishment of a baseline in March 2023 was necessary to help map and understand the nature of dynamic risk that workers had to work with when successfully performing their role. This baseline, or competency framework, was inspired by the Fisher Improvement Technologies model (tailored for dynamic, high-risk environments). The selected model was based on the Occupation, Job, Task, and Action (OJTA) approach, and was designed to address:

- Performance modes (skill-based, rule-based, knowledge-based)
- Error traps (conditions or factors that make work challenging)
- Operational context and environmental variability (performance hazards)
- Human nature and individual capabilities
- Decision-making under uncertainty

When developing the baseline, Enviro NZ undertook a review of existing tools, roles and workplace conditions. In addition to discussions with management and workers about their everyday work, organisational documentation related to the points persons role at the Hampton Downs Facility (including polices, work instructions, Standard Operating Procedures, Traffic Management Plans, and machine training records) were also reviewed. This documentation provided the foundation for understanding the formal expectations of the role, as it was described on paper.

From this framework, an assessment tool was developed which could be used to assess workers' competence against the framework.

This assessment tool evaluated the workers' understanding of written rules and procedures, as well as their critical thinking about hazards, team dynamics, equipment operation, and performance under pressure. Literacy and numeracy testing was also undertaken to assess level of understanding of written materials and numerical literacy.

These assessments identified gaps between written procedures ('Work as Imagined') and actual field practices ('Work as Done'). This indicated that workers were finding their own ways to deal with these gaps. Some of these workarounds added new, hidden risks, while others showed off truly clever and effective ways to solve problems.

(A copy of the worker competency framework and assessment tool is enclosed at Appendix 3).

FURTHER ANALYSIS OF THE POINTS PERSON ROLE

During the course of the Enforceable Undertaking, Enviro NZ's view of the points person role has changed. The abovementioned assessment and ongoing employee engagement practices through Learning Team sessions over the past two years have highlighted complexities in the points person role that were previously underestimated. For example, the employee engagement work uncovered difficult situations in daily operations that written procedures did not fully capture.

Enviro NZ recognised that a large number of tasks required the points person to engage in key decision-making steps in order to do the job successfully. In order to do this the points person needs to have a level of skill and knowledge which is often developed over time through experience. This highlighted the value of knowledge, decision making abilities and experience, especially in the use of heavy machinery.

It also became evident that the role encompassed psychosocial risks arising from the specific pressures a points person face. One example of this is difficult interactions with truck drivers who are under pressure to empty their loads before their driving time is up. This led to the implementation of better work design, through improving interactions with truck drivers and enhancing queue control. The site introduced a separate truck area away from the tip head and out of sight of the points person. This has reduced driver aggression by providing a person (the queue traffic controller) who is "*trying to look after [drivers] from the point that they arrive at the queue area*" and allowing a driver to take a break then rejoin the front of the queue without losing their slot. Further, by removing the source of perceived stress (trucks queuing at the tip head), the points person is in control of managing the traffic onto, and safety at the tip head, more effectively.

The points person role is now viewed by Enviro NZ as a role requiring greater skill and responsibility for traffic management. This recognition, and changes in the points person role (including the loader isolation policy and tip head queue management), has meant the previous competency framework required review.

REDEFINING COMPETENCE

In May 2025, Enviro NZ re-mapped the competency requirements for the points person role. A copy of the tool is enclosed at Appendix 4.

In this process, Enviro NZ found that management and workers, working together to co-complete the tool, can both deepen their learning about the dynamic nature of work.

The tool highlighted the critical steps involved in the points person work, the worker performance modes required to undertake the work (skill mode, rule mode and knowledge mode) and the high level of competency required to perform the job. Enviro NZ has used this tool and information to inform recruitment selection criteria for the role and is currently working on training programmes and performance assessment criteria for three levels of capability: competent, advanced and expert.

This new framework enables gradual learning and development for non-machine operating tasks. It reflects a structured training process, where a small percentage (approximately 10%) occurs in the classroom, but the majority of learning is through a 'buddy system' where

the new worker learns from 'work as done', including the dynamic nature of the workplace and management of those risks. The points person role gradually takes on more responsibility, with a focus on gaining knowledge and making decisions; firstly, as observers, then under supervision, and gradually by themselves. This practical, experience-based learning is crucial for developing the good knowledge, decision making and spatial awareness that drives effective, safe performance. Trainees will also participate in Learning Team sessions, enhancing their learning about 'work as done'. The new framework will provide a formal set of requirements, ensuring a standardised level of competence that reflects the role's true complexity in a dynamic risk environment. Competency is assessed against objective criteria by both site management and the senior points persons.

It is envisaged that this will be an ongoing process as the role of points person evolves with the enhancements of technology and improved work practices and changes on the site(s).

PROGRESSION OF COMPETENCE IN THE VAI TRIAL

One of the areas which Enviro NZ sought to explore in the VAI trial was the potential of VAI to build worker competency at dynamic risk sites and provide data to better inform decision-making across workers.

As a result of the loader isolation project (which reduced the occurrence of positive detections and therefore data regarding everyday work and hazards), and the high number of false detections generated by the VAI systems (in particular the static VAI system), information from the VAI systems has not been a key input in the assessment or progression of competency of workers over the duration of the VAI trial. Changes to the points person role (as described above) have also made such an assessment difficult.

Instead, worker engagement tools and activity have been most influential in improving worker competence and decision making. Higher levels of involvement with frontline staff have led to a greater procedural understanding of work as done, and workers have reported greater confidence in discussing operational challenges; a direct result of improved psychological safety within our teams. Managers have also reported an increase in competence of workers as a result of the critical thinking and deep dive assessment of everyday work through the Learning Team sessions. Open dialogue through worker engagement tools have revealed invaluable insights about worker competence and capability that might otherwise have remained hidden.

By engaging directly with frontline workers, Enviro NZ has moved beyond the initial benchmark to a more dynamic, model of competence that has evolved with understanding and insight. This ongoing framework of worker engagement ensures that as the operational environment changes, the skills and understanding of the workforce will continue to adapt, leading to enhanced safety, improved operational effectiveness, and a more confident, capable team.

Part 5: Comparative study

PART 5: WORKER COMPETENCY STUDY

As part of the trial of the effectiveness of the VAI systems, a comparative analysis between a site 'with VAI' and one 'without' was carried out. The purpose was to determine whether VAI technology could deliver a better understanding of work. As explained earlier in this report, both Pōkeno and Hampton Downs embraced worker engagement and participated in the risk-based competency assessment, but only the Hampton Downs Facility trialled VAI technology. Therefore, the Pōkeno Facility represented the control site 'without VAI' against which the comparative analysis activity was undertaken.

For the purposes of comparison, both the Hampton Downs Facility and Pōkeno Facility are dynamic work sites undertaking a range of activities and feature an array of associated hazards. Whilst fill methodologies, waste types, truck volumes and configurations vary, there are commonalities across both sites. Hazardous situations involving persons and vehicles/ plant can arise at both sites as a result of tasks undertaken at the tip head, and work environment change in response to a broad range of internal and external factors.

In essence, both sites offer a constantly shifting landscape where operators must make real-time, adaptive decisions to maintain safety and efficiency.

Comparative Themes: Unpacking the Differences and Commonalities

The side-by-side analysis of the Hampton Downs and Pōkeno Facilities' parallel journeys in the Enforceable Undertaking revealed themes common to both sites, and from which safety improvements could be drawn. These themes, explored in earlier sections of the report, were punctuated by a range of notable differences.

The differences identified did not collectively result in a finding that the use of VAI technology systems trialled (Mobile VAI or Static VAI) were wholly beneficial or detrimental to a site. Ultimately, VAI is just another tool acting as a layer of control to reduce risk, and as with any control its interaction with other controls and site-specific nuances must be considered. The key findings of the comparative analysis were more akin to lessons, in that they provided fresh insight into the ways in which the presence or absence of such technology can influence what may otherwise have appeared as unrelated workplace dynamics. Some of these findings are explored further below:

Learning more about the work, our workers and our work environment

- Visual outputs from both VAI systems were able to prompt memories and trigger workers to share insights into the 'Kodak moment' that had been captured; their reflection of 'what was going on, and why?'. Use of the imagery to prompt discussion in Learning Teams environments, worker engagement sessions, and tip head catch ups allowed previously unidentified factors around the work and the work environment to be revealed. How the situations underlying the 'Kodak moment' were handled through adaptation by workers provided new insight into the types of competencies necessary to undertake the role. A greater understanding of the increased complexity and layered characteristics of the role emerged and offered a glimpse of the powerful potential that the intersections of technology, collaboration, and operational learning can offer. An example of this was the collaborative work undertaken across several sites on 'hung loads' triggered by a single still image from VAI installed at the Hampton Downs Facility. An image that prompted wider discussion and a refining of the system by identifying the weaknesses and aspects

around the management of tiphead activities not previously considered, and an outcome less likely to be gained from a site without VAI.

AI - the unbiased conversation starter

- At the Hampton Downs Facility both the Static VAI and Mobile VAI technologies were able to provide imagery that could be utilised to initiate conversations with workers without introduction of any actual or perceived bias. In both cases, the ability to utilise visual outputs from the VAI technology made it possible for these conversations to occur free from the subjectivity that could typically be influenced by a person's recollection or opinion. The Pōkeno Facility, without the VAI technology, on the other hand relied on more traditional lines of reporting such as formally reported hazards/incidents, worker feedback or recent events to generate discussion points and foster conversation. This situation allowed for more subjectivity which, in itself, could have unintended consequences.

Trust in the system...what is it being used for?

- A direct benefit of the Mobile VAI trial was the increased oversight for operators in situations where they had influence or control. The Mobile VAI trial allowed Hampton Downs loader operators to receive real-time feedback from the system via a screen in the cab as they undertook their work, and alert them to any unexpected situations. The system was able to record alerts and the parameters against which they occurred, giving operators the confidence to undertake their work without fearing claims of 'rule breaking behaviours'. Operators at the Pōkeno Facility without VAI technology installed were not supported by a system providing real-time feedback; any feedback was driven by the perceptions of 'compliance' from others present in or around the work area who may be observing the work, thereby impacting their confidence. The Mobile VAI is now considered an additional layer of protection for workers, not only at the Hampton Downs Facility, but at other Enviro NZ sites with dynamic risk, such as transfer stations where Mobile VAI has been installed following the successful trial at the Hampton Downs Facility.
- Conversely, the Static VAI trial did not offer real time feedback or have any in-cab interface, invoking a level of anxiety and reportedly making operators "*feel like Big Brother was watching*". The perception that the Static VAI technology would be used to focus on identifying mistakes and as a disciplinary tool, rather than understanding the decisions being made from the viewpoint of the worker (as the Mobile VAI technology offered), was an enduring theme. The system is now largely accepted by operators as part of the current fabric of controls on site and has never been used for that purpose. In comparison, the absence of Static VAI at the Pōkeno Facility meant the complexities of distrust were not introduced to the site and worker relationships.

Undisputable direct benefits – use as a complementary control

- Whilst initially the level of false detections experienced from the Mobile VAI trial was high, by the middle of the trial the technology was able to reliably detect a range of potentially hazardous situations relating to proximity between vehicles and plant and people. The system was recently described by one worker as "*brilliant*", acknowledging that the Mobile VAI system had succeeded as a reliable control. The Mobile VAI now provides workers with a second set of eyes to support workers on site to conduct work safely. Enviro NZ is mindful that such success may introduce a risk of worker complacency, potentially reducing the competency of workers through reliance on technology to manage detection

of particular hazards. This will be monitored, however to date, the trial has not provided evidence of complacency having arisen.

- Given this success, operators without Mobile VAI technology in their machines would appear to be at a disadvantage in dynamic worksites; however, that is not to say that operations are less safe where Mobile VAI is not utilised. At both the Hampton Downs and Pōkeno Facilities, Enviro NZ relies on other risk minimisation control measures which have a greater effect on reducing the likelihood of a hazard arising. The Mobile VAI at the Hampton Downs Facility is instead utilised at the lower end of the hierarchy of controls and as a layer against residual risk arising from other layers' weaknesses or failures. Therefore, whilst there is clear benefit in VAI as a safety net, the extent of benefits to safety compared to sites without VAI may be greater if VAI is applied further up the hierarchy of controls.

Reimagined purpose of VAI - a shift towards verifications of other controls

- As both VAI trials progressed, they moved from being used directly to detect potentially hazardous situations, to a position of verifying that other controls implemented in parallel were effective in reducing risk. As already discussed in this report, strengthened isolation controls were adopted at tip heads at both sites in parallel to the Enforceable Undertaking project. This meant that over the course of the Enforceable Undertaking, the opportunity for detection of potentially hazardous situations increasingly diminished from levels initially experienced at the onset of the VAI trials earlier in the Enforceable Undertaking journey. The presence of VAI technology provided important insight into the effectiveness of the isolation controls via objective data capture on the frequency at which potentially hazardous situations occurred. For example, the frequency of detections from a VAI technology system (or preferably, the absence of detections) provided valuable assurance that isolation controls were effective any time the machine was working. This has provided comfort to management that the gap between 'work as imagined' and 'work as done' is being constantly monitored and, whilst always present – especially in dynamic sites, can be better understood with worker insight when it arises. In essence, the VAI was able to provide verifiable, empirical data relating to potentially hazardous situations occurring on the tip head. At the Pōkeno Facility, the assurance around the effectiveness of isolation controls was subjective and reliant on traditional reporting lines and observation to identify any deviations from 'safety' (with a strong culture of psychological safety being required to gain assurance around effectiveness).

CONCLUSION

In comparing the two sites, Enviro NZ gained valuable insight into how interfaces between technology, operational context, leadership, culture, and existing systems can shape worker engagement, operational learning, safety, and adaptation.

The comparative review reinforced a powerful overarching takeaway – controls to reduce safety risk are rarely effective in isolation and the combination through which they are applied to achieve good outcomes may need to be as dynamic as the worksite itself.

By the end of the trial, Mobile VAI's direct benefits were proven via its reliable identification of potentially hazardous situations. Additionally, both forms of VAI were able to foster unbiased conversations to reveal previously untapped, yet very powerful, learnings and showed potential to be further developed to offer validation and assurance for other controls that were not previously considered or unrelated to the trial. It was also evident at the end

of the trial that in certain environments, or in workers with a more fragile sense of psychological safety, the implementation of VAI technology could elicit some tension or anxiety around being 'watched'– for example workers were hesitant around the reality of the tool being used as a learning tool rather than a disciplinary one. This highlighted a need to be mindful of the psychological aspects that could be introduced when implementing this technology. However, these potential outcomes and any site-specific nuances must be considered just as they would be when implementing any other control, as highlighted above.

The comparison highlighted that the combination of tools proven to be effective at one worksite may not be as effective at another, but through a purposeful curiosity to reflect, share experiences, and adapt, authentic learning can occur on any site and lead to better outcomes. In time, this learning will result in the creation of effective 'work as done' practices; an outcome that epitomises the BetterWork ethos.

Essentially, the enduring success of the Enforceable Undertaking trial will not hinge on the utilisation of any *single* innovation, strategy, tool, or ethos. Instead, enduring safety outcomes will be driven by a combination of a desire for continual improvement, the layering of *multiple* effective health and safety practices and controls, and fundamentally a genuine desire to really understand our work, our workplace, and our workers.

Part 6: Key learnings

PART 6: KEY LEARNINGS AND POTENTIAL APPLICATIONS

The two-year journey of Enviro NZ in the Enforceable Undertaking represents a shift in safety culture and operational practices. This project illustrates how empowering the frontline workforce can reshape an organisation's approach to safety, leading to tangible improvements in operational excellence and efficiency, worker competency and capability as well as safety outcomes and a more engaged, resilient workforce. It also demonstrated that current advances in VAI technology can play a part in keeping workers safe and informing engagement, albeit with an acknowledgment that results may not be instant and will still require the application of existing controls to work together to manage risk on dynamic work sites.

Beyond Compliance to Proactive Engagement

The most striking success of this journey is the shift in cultural mindset. Workers reported a newfound confidence in addressing problems and communicating openly with supervisors, shedding the previous approach of just "*getting on with the job*". The adoption of frameworks like the curious questions and the 5D's (including the crucial 'Delightful') provided an objective, shared language that moved conversations from blame to inquiry, fostering a proactive and safety-conscious approach. This was reciprocated by management, with workers expressing a powerful sense of support:

> *"We now feel they [management] have our back, before we were just told what to do."*

Managers, in turn, observed an uplift in the quality of engagement, with toolbox sessions evolving into rich, meaningful dialogues focused on real work challenges. This collaborative transparency helped to unearth gaps between 'Work as Imagined' (how management perceived work to be done) and 'Work as Done' (the realities of frontline operations) and better assist with an understand of why they occur and how improvements can be made.

Change Management Cannot be Underestimated

As this was a trial, the worker engagement tools were introduced to operational practices at the two sites only. The broader operational and health and safety policies, procedures and frameworks at other sites and across the wider business continued to apply. Whilst worker engagement is an important part of existing health and safety practice at Enviro NZ, and indeed a necessary feature for compliance of all organisations, the principles of BetterWork (upon which the worker engagement tools are founded) are not thoroughly embedded. At times, others within the organisation that had not been closely involved in the Enforceable Undertaking struggled to understand these principles and tools. Acknowledging this, Enviro NZ will be running Learning Teams education and facilitation workshops to ensure change management is supported through a foundation of knowledge and resource.

The tools introduced by the Enforceable Undertaking also arrived ahead of the culture required to support its use which meant that, at the early stages, there were times when the activities felt *done to* each site rather than *with them*.

Despite the above, a fundamental element in the success of the employee engagement approach was the efforts of the people involved at the two sites. Facing early difficulties

understanding the concepts and trying to make them work, they persevered and adapted the tools and methodologies to their work environments and cultures. They also took the lead; taking the initiative to learn more about the methodologies and concepts from HOP Nerd website and 4D Books. This tenacity and perseverance was instrumental in building the foundations for success.

A thoroughly considered change management approach to the project may have helped to alleviate some of these challenges. Further, as not all sites are the same, nor are all sites dynamic in nature, the framework for worker engagement may need to differ to ensure it works within the overall system.

Enhanced Safety Outcomes Through Collective Insight

The project's emphasis on stories and learning from 'Work as Done' means that subtle indicators of risk are more likely to be actively and quickly surfaced and addressed. The feedback loops, built during the course of the trial exemplified by the case studies, demonstrate how worker generated insights led directly to actionable solutions, from improved communication protocols to standardised equipment.

Cultivating a Proactive Learning Culture through employee engagement is key

This project has assisted in the progression of a safety culture from a reactive, compliance-driven model to a proactive and learning-oriented one. Several foundational elements were critical to this success:

- **Trust as the precondition for learning:** The project's early challenges of worker perception of VAI and worker engagement initiatives served as a powerful reminder: trust is paramount. Without it, even the most innovative systems will fail. Where strong relationships existed between workers, ideas flowed more freely, and concerns were openly shared. This demonstrates that authentic, human relationships are key to organisational learning.
- **Learning as well as improving:** Whilst a key feature of the Learning Teams is to facilitate open dialogues in a trusted environment where 'work as done' is the focal point for learning, the introduction of LEARN > SOAK > SOLVE allowed workers to see the benefit and outcome of those discussions. This in turn led to more meaningful embracement of the worker engagement tools.
- **Engagement as a continuous system, not a single event:** The consistent nature of the Learning Teams, with 32 sessions across both sites, was an essential element. It established a rhythm of reflection, revision, and open dialogue. Workers moved beyond simply reporting incidents to surfacing their real experiences, and supervisors began asking "*why*" and "*how*" adaptations occurred rather than just "*if*" rules were followed. This persistence and layered unfolding of engagement, where being consistently listened to, having information solicited and reflected back, proved impactful.
- **Reframing risk - From avoidance to understanding:** One of the most promising shifts was how the sites began to reframe risk. It transformed from a static list of hazards to be avoided, into a dynamic series of interactions, situations, and contexts to be understood. The language evolved from "*non-compliance*" to discussions about context, constraints, and adaptive decisions. Workers' insights became sources of system understanding, not evidence of failure. Safety and operations moved to be done *with* workers, not *to* them. This fundamental shift embodies WorkSafe's BetterWork

philosophy, recognising that safety is about enabling capability within workplaces, not just enforcing compliance. For example, the shift of focus in the prestart Toolbox Talk form at Hampton Downs Facility enabled deeper learning and peer connection. The workers owned the change and have made the process work well for them.

- **The power of 'Delightful' - Learning from success:** The worker-driven addition of 'Delightful' to the 4D framework was a pivotal insight. By actively seeking out and celebrating successes, innovations, and positive outcomes, not just focusing on problems or failures. The project cultivated a more engaging, productive, and ultimately safer work environment. This balanced approach resonated deeply with workers and fostered a positive feedback loop. The curious questions used by the Pōkeno Facility team facilitated a similar approach.

Technology's Role: An Additional Layer, not a Panacea

The project's experience with VAI tools provided a crucial reminder: technology is not a shortcut or a standalone solution. That is often the lens it is marketed as, or the "silver bullet" to fix problems and generate efficiencies. The failures of the 4D hardware and the limited initial effectiveness of the Static VAI system were not disappointments, but rather learnings. They underscored that even the most advanced technology might not deliver expected results if the organisational culture isn't ready, or if the technology isn't co-designed and purpose aligned with the needs of the users.

However, the success of the Mobile VAI system, particularly as an additional layer of protection in dynamic environments and verification of effectiveness of other controls, affirmed that technology, when thoughtfully implemented (and adapted to the environment) and integrated into a foundation of trust and engagement, can effectively enhance safety systems.

It is a powerful support, not a replacement for human insight and collaboration, and its application in the hierarchy of controls and safety management systems needs to be approached as any other control.

RECOMMENDATIONS AND APPLICATIONS FOR OTHER BUSINESSES

Enviro NZ's journey offers practical, pragmatic lessons for any organisation within the industry seeking to improve safety culture and worker engagement. These aren't theoretical concepts, but hard-won insights from real-world application.

Change management approach:

As a first step, adopt a change management approach which considers the broader influence of the tools being implemented; then communicate the 'why' clearly. This will help you do the project 'with' the workers, not 'to' the workers.

Actionable Tip: Plan and design the project as you would for a new technology roll-out. Resource the project holistically, even where external facilitators or consultants are involved.

Build trust as your foundation, first and foremost:

Before implementing any new safety programme or technology, invest in building genuine trust and openness. Foster psychological safety where workers feel safe to speak up, challenge, and contribute without fear of reprisal. This may take time and using thinking tools which provide objective frameworks are a powerful way of having discussions about issues and observations in an objective and neutral manner. Being curious, open to understanding and learning is key.

Actionable Tip: Start with informal, open dialogues. Visible, consistent management presence on the ground, actively listening rather than directing, can build trust incrementally.

Empower site ownership and adaptability:

Do not impose rigid, one-size-fits-all solutions. Provide frameworks (like the 4Ds or "curious questions") and empower local teams to adapt them to their specific culture, language, and operational rhythms. When workers take ownership and integrate tools into their routines, we found success follows.

Actionable Tip: Pilot new engagement tools with small teams. Solicit their feedback on how to make the tools work for them, not just for the system. Be prepared to pivot and adjust based on their insights.

Integrate engagement into daily work, don't add it:

Make worker engagement a seamless part of existing daily operations. Weave discussions into toolbox talks, pre-start meetings, and existing safety forums and avoid creating separate, burdensome activities. The project's success soared when the tools became ingrained, and workers owned the initiatives.

Actionable Tip: Identify existing daily meetings. Introduce one new, simple 'curious question' or 4D prompt at the start of each meeting to encourage daily reflection on work realities.

Establish rapid, visible feedback loops:

To give purpose and maintain momentum, ensure insights generated by workers are acted upon swiftly and transparently. The **LEARN > SOAK > SOLVE** model is highly effective. Workers need to see that their contributions lead to meaningful change.

Actionable Tip: After a discussion (e.g., in a Learning Team), assign clear owners and deadlines for proposed solutions. Communicate progress and outcomes back to the originating team, even if it's just a small win.

Embrace learning from success ('Delightful' moments):

Actively encourage and celebrate what goes right, successful adaptations, and 'Delightful' moments. Balancing problem-solving with success sharing creates a more positive, engaging, and ultimately safer environment. It shows that safety is about capability, not just compliance.

Actionable Tip: Dedicate a few minutes in team meetings for "wins" or "lessons learned from success." Ask: "What went well today, and why?" "What does success look like for you today?"

Invest in leadership training for engagement:

Equip supervisors and managers with the skills to facilitate genuine dialogue, actively listen, and translate frontline insights into action. This means shifting from a 'tell-and-control' mindset to one of 'ask-and-enable'.

Actionable Tip: Provide short, focused training sessions for leaders on active listening, asking open-ended "curious questions," and facilitating problem-solving sessions rather than just delivering instructions. Appreciate that everyone is different, and some people's journey towards BetterWork principles may be different to others.

View technology as a support, not a panacea:

Understand that while VAI and other technologies can be powerful complementary controls (like the Mobile VAI system), they are not standalone solutions. Their success is contingent on existing trust, co-design, cultural readiness, and data security. Don't let technology overshadow the human element.

Actionable Tip: If considering new safety technology, consider how it operates with other safety controls and implement it appropriately within the hierarchy of controls. Pilot it collaboratively with frontline users, focussing on how it can support their work and decision-making. Address concerns about trust proactively and consider its own fragility.

The importance of leaders and champions:

There were several key people who stepped up and took the initiative to drive things forward even when things got stuck down. They persevered and pushed forward trying other things and being curious to why things weren't working. They listened and advocated for changes and different approaches. Without these people our outcome might have been quite different.

Actionable Tip: Understand who are some of your trusted leaders who can help 'champion' the change, even when things are bogged down and get difficult. For project longevity, involve those people in the training of other leaders.

Conclusion

CONCLUSION

Enviro NZ's journey over the past two years is testament to the role all workers play in safety and continuous improvement. What began as a requirement under an Enforceable Undertaking evolved into the foundations for a shift in approach to operations and safety culture on two sites. This trial has been instrumental in revealing the true complexities and critical decision making inherent in the workplace made by employees every day, often carried out unseen and unrecognised in traditional safety systems.

The success of worker engagement initiatives has been the true cornerstone of this transformation, driven significantly by the proactive contributions of the workers themselves. Through tools like the 4Ds (now 5D's) methodology and Learning Teams, the sites are progressing towards an environment of open dialogue and trust. It was the workers' willingness to share their experiences, their ingenious 'workarounds', their concerns and fears as well as their invaluable 'weak signals' from the frontline that allowed for real-world practices to be better understood. It was also site management's willingness to listen, engage constructively and demonstrate faith and patience in the tools which helped to create the necessary environment for the tools' purpose and intent to be realised. Together, these people – not just the tools - have helped Enviro NZ to better understand and bridge the gap between theoretical procedures ('Work as Imagined') and the realities on the ground ('Work as Done'). This evolution to a living, operational safety culture, where employees feel genuinely valued, heard, and empowered to contribute, is a significant achievement of our journey. Their active participation and ownership of these initiatives have been absolutely vital, and they are the heroes, leaders and champions of this project.

The VAI technology, in particular the Mobile VAI system, has shown value as an additional layer of protection and tool for verification of the effectiveness of other controls. However, VAI's limitations were also demonstrated by the Static VAI system. The challenges of accurately perceiving distance and spatial relationships in a highly dynamic landfill environment meant the Static VAI struggled with high levels of false detections. This ultimately hindered its effectiveness as a reliable control and information source and highlights that, while technology offers powerful support, its success is deeply intertwined with the context of its application and ability of people to use it in practical, pragmatic ways.

Enviro NZ's experience offers a powerful lesson for all organisations. Culture cannot be shifted through tools alone. BetterWork is not just about doing different things, rather it is about doing things differently, together. Genuine safety improvement and the creation of a truly resilient safety culture at dynamic work sites are not dependent on the latest technology or significant capital expenditure, nor about the best theoretical tools for worker engagement. Instead, this is fundamentally driven by consistent conversations, openness, and the cultivation of trust with employees.

As we pause here at the end of the Enforceable Undertaking, what has been achieved is real:

- Foundational shifts in how risk is talked about;
- Emergent trust, built through Learning Teams; and
- A growing awareness of the value of worker-led insight.

Enviro NZ now begins the journey of maintaining its successes, continuing to improve in psychological safety and implementing the tools across the broader Enviro NZ business and health and safety system. Significant work lies ahead. We want to ensure that learnings,

insights and opportunities continue to be garnered from everyday work, not just from adverse events. The tools, failings, achievements and learnings of the Enforceable Undertaking equip Enviro NZ to make real progress in this expansion.

APPENDICES

Appendix 1 : Terminology

Term	Description
Tip head	The location where waste will be discharged from a truck.
Loader	A large piece of wheeled plant shown below, used to push materials, e.g. clearing the tip head of fallen debris and waste. Loaders are typically very mobile. 
Points Person	A person who is on-foot and controls and guides traffic movements on the tip head.
Dozer	A large piece of tracked mobile plant as shown below, used to push and track roll materials e.g. refuse, dirt. 
Unload area	The location where trucks unload their contents on the tip head.
'Hung' or 'sticky' load	When a tipping truck's waste contents sticks or hangs-up within the raised unit (be it a trailer or a bin) and does not flow out of the unit on its own.

VAI	Visual Artificial Intelligence. For the purpose of the Enforceable Undertaking, two forms of VAI were trialed: • **Mobile VAI** which utilises cameras mounted to mobile plant, equipment or vehicles, to monitor and evaluate the spatial relationships between the object the camera is mounted to and people and objects within the camera's field of view; and • **Static (or fixed) VAI** which utilises cameras mounted at a fixed location, to monitor and evaluate the spatial relationships between various people and objects that may be moving dynamically within the camera's field of view.
Hampton Downs Resource and Energy Precinct Facility	A waste disposal and resource recovery facility where, for the purpose of the trial, VAI was installed at the main tip head.
Pōkeno Facility	A managed fill and cleanfill facility. For the purpose of the trial, no VAI was installed at this facility.

Appendix 2a: CASE STUDY: From Compliance to BetterWork – Redefining value of Toolbox Talks at Enviro NZ

Pre-start Toolbox Talks had long been a standard part of safety at Enviro NZ. An expected ritual before the workday began. Over time, many workers had come to see it as little more than a checkbox rather than a valuable tool.

Background

Following the death of one of Enviro NZ's workers in an incident involving people and machinery, and the introduction of an Enforceable Undertaking ("**EU**"), Enviro NZ embarked on a journey to transform worker engagement and look deeper, not just at the safety processes, but at the thinking behind these meetings. The EU introduced technology tools, Learning Teams and 4Ds, based on the principles of BetterWork at the Hampton Downs and the Pōkeno landfill worksites. These tools are based on the understanding of workplace risk using a Work-as-Imagined vs Work-as-Done (WAI vs WAD) approach and are designed to amplify worker voices.

The 4D tool

The 4Ds are **Dumb, Dangerous, Difficult, and Different**. These are a set of prompts (Fig 1) for workers to use to help them describe the variability and risk in their daily work environment. The intention was to provide a simple tool in the form of the 4Ds that enabled frontline workers to share contextual stories from day-to-day work. These "weak signals" are often the precursors to incidents or adaptation and are rarely captured in traditional reporting systems.

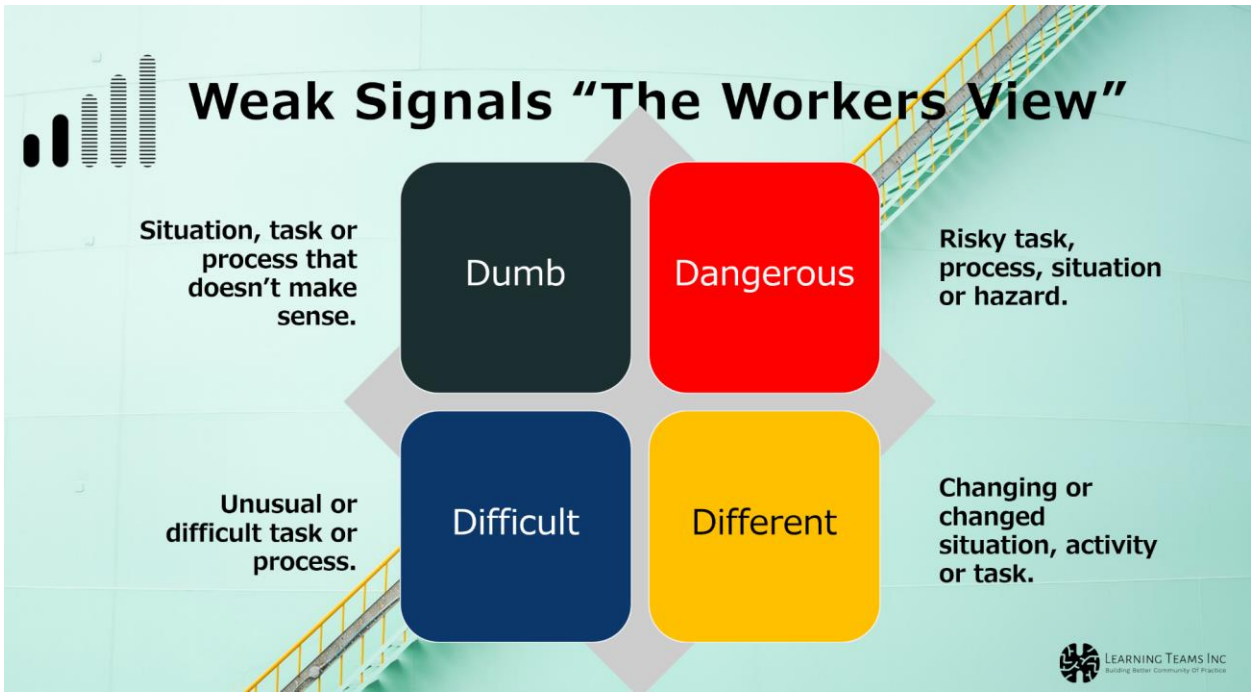


Figure 1: The 4Ds

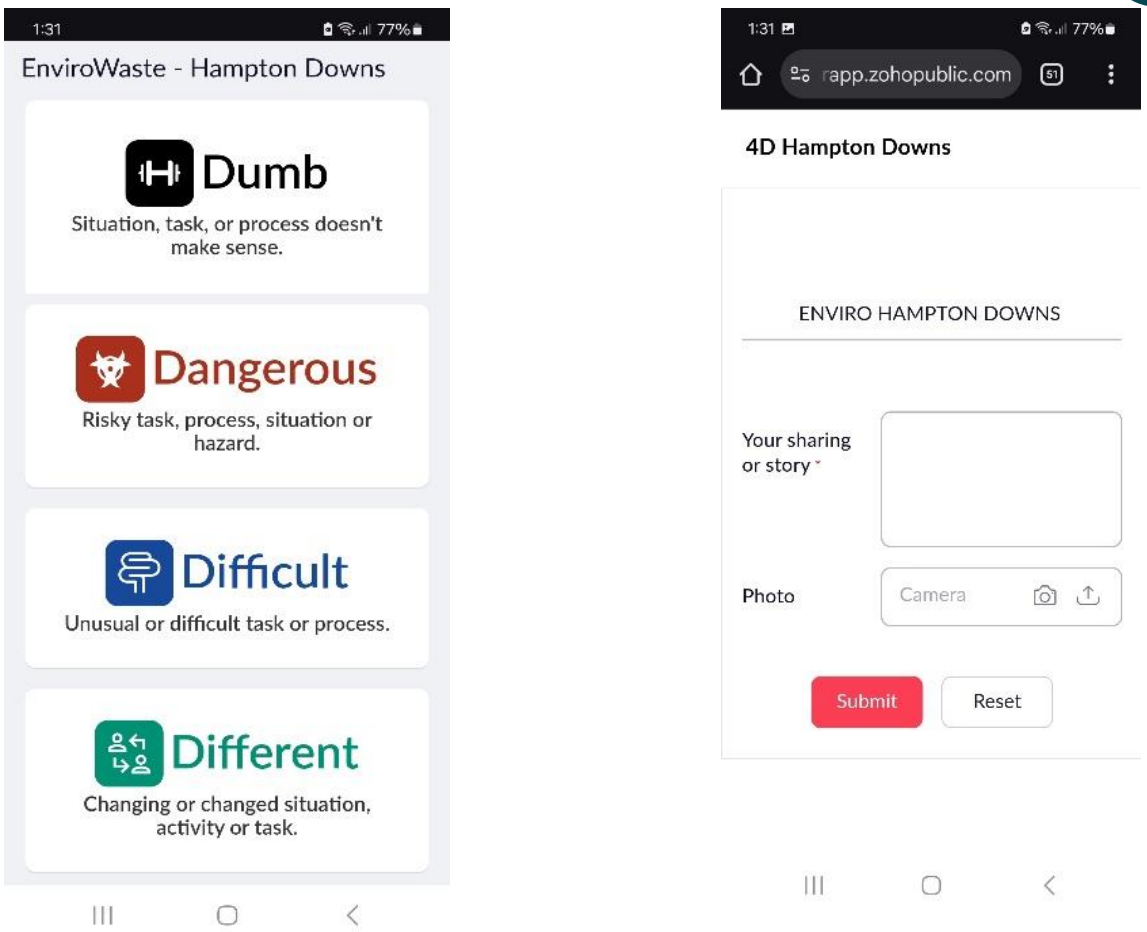


Figure 2. Hardware User Interface of the 4D story collection tool

To support implementation of the 4Ds, a hardware-enabled tool was introduced early in the project. This was initially delivered via a mobile device (smart phone) and Fig 2. shows the user interface screens. The technology was designed to allow workers to log and record a 4D observation during or after a shift, feeding back anonymous stories to be used for learning teams. As the project progressed it became evident the smart phone devices were not being used. Workers didn't like using them and it was just another thing to do in an already busy workday.

Learning Team tool

A Learning Team is a facilitated discussion that brings together individuals in a psychologically safe environment to learn and improve. There are five core principles that apply:

- Understanding Work-As-Imagined (WAI) and Work-As-Done (WAD) gives context
- Groups outperform individuals in problem identification and problem solving
- Workers have the best knowledge and understanding of the problem
- The more effort put into understanding the problem, the better the solution outcomes
- Group problem identification, solving and reflection (soak time) drives learning and improvement.

BetterWork

BetterWork reframes traditional safety thinking. Rather than focusing on events and prevention of reoccurrences, it expands the tools to look at how work happens, how people adapt and succeed, and what systems and people need to support both productive and safe performance. It sees organisations as continuous systems that learn, grow, and evolve. Operational learning tools (Learning Teams and 4Ds) were all part of the EU's requirement. However, their value came to life when the team chose to integrate them, not as extra safety tasks, but to add value to everyday work.

Organisations as machines	Organisations as living systems
– The system is safe	– Safety is created
– Accidents result from unsafe acts, or deviations from plans	– Incidents result from a mismatch between resources and demands
– Variability is a threat	– Variability is inevitable
– Procedural compliance is mandatory	– Better capacity to adapt is needed
– People are a problem to manage	– People are a solution and power to harness
– How can we change people?	– How can people be supported to adapt successfully?
– More motivation is needed	– More knowledge and opportunity to contribute is needed

Figure 3. BetterWork Principles

The potential for change made evident through learning

During one Learning Team session, the group chose to review pre-start Toolbox Talks. A key insight: This wasn't the start of work; this was part of an ongoing operation. Work didn't stop and restart with a form. It carried through, with insights, risks, and workarounds handed down from one shift to the next. Often the hand overs undertaken by the workers were informal, done outside the Toolbox Talks, and valuable insight and information lost, unshared, and unknown to the team and wider site operations.

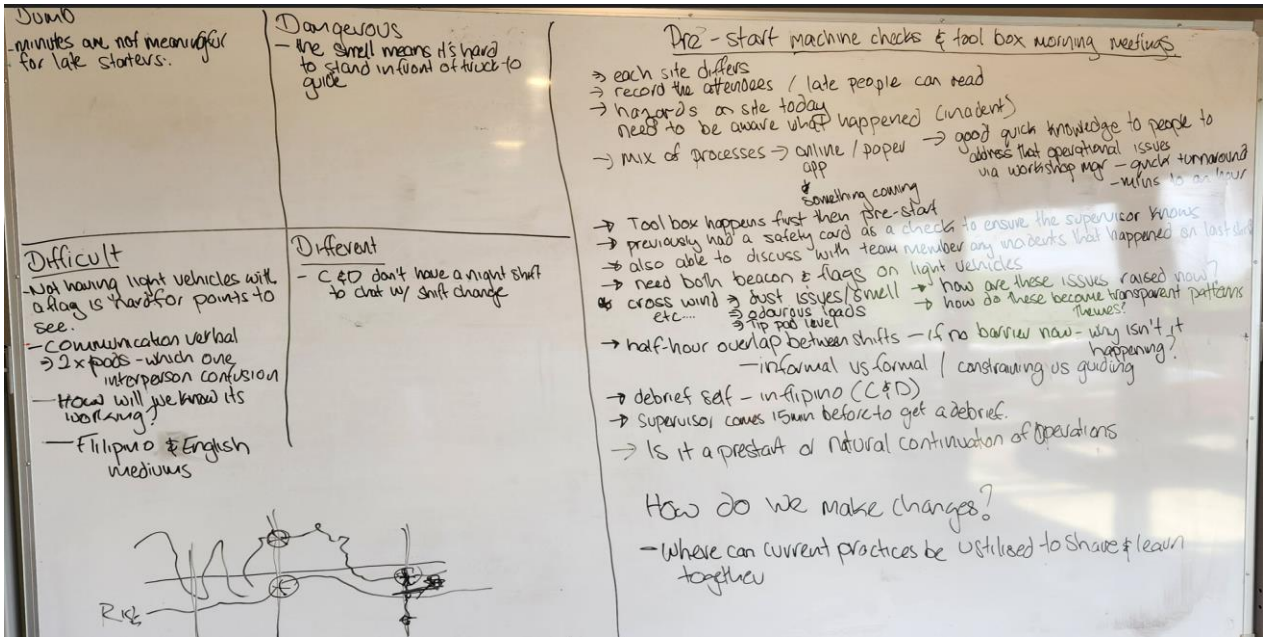


Figure 4. Learning Teams notes on Toolbox Talks

The Learning Team explored what would happen if Toolbox Talks captured more than compliance. What if they made space for learning? What if they helped the team think together? Ownership replaced obligation. Curiosity replaced caution. And learning became part of the culture.

Post the Learning Team, the group reworked the standard pre-start form, from a one-page hazard checklist and compliance record, it became a two-page dialogue tool. They not only embedded the 4Ds they also added a fifth question, one that came from the team themselves:

> *What was delightful about yesterday's work? "No stuck loads, that's a delightful day"*

What was 'delightful' was not about making things fluffy. It was about recognising that safety is not just about preventing harm, it is also understanding *what enables things to go well***.** This small addition changed the tone of the conversation. This addition opened visibility of what supported success: a decision that paid off, a moment of good communication, or a system that worked better than expected. But the biggest shift wasn't just in the form. It was in the flow of learning**.**

> *"I think that's important – reflection on the shift, previous shift"*

> *"There's more of it…, our guys write different things, more detailed than me or whoever, but it relays that message through everyone, everyone gets to see it, speak up when they need to"*

Today, Toolbox Talks are no longer quiet tick-box moments. They're open, thoughtful, connected and worker lead conversations. A space where risks are surfaced early, successes are shared, and decisions are informed by the people who know the work best.

> *"It's gone from a piece of paper saying you're doing this, hazards and controls are already pre-printed, draw a map, circle the hazards… to a full conversation, talking about workshops, what's happening on site, what happened last shift, good, bad ugly, hazards identified"*

A new safe system of work – Toolbox to learning to engagement

Completed Toolbox Talks minutes are not just filed away, they are actively reviewed by a site Health and Safety Representative, who identifies recurrent themes, and issues. The information forms a regular part of a worker-owned, independent Safety Committee meeting. This group facilitates its own operational learning, raising issues, reflecting on themes, and bringing forward insights, which are shared with management. If necessary, a joint Learning Team (with wider inclusion across the site) can be run to dig deeper to learn more, to identify improvements, or what other system issues hinders progress. It's a feedback loop which has trust, transparency, and shared responsibility. It's an example of Worker Engagement, Participation and Representation (WEPR) that isn't mandated, it simply part of how we work.

> *"It's clear in the Toolbox minutes, you could see the change from copy paste to when the new Toolbox was initiated"*

> *"I've gone through the Toolbox minutes and picked out something that keeps coming up, for example – [issue], that was a biggie"*

> *"This is a change we can physically see and feel"*

Operational learning has become continuous, grounded, and local - a new safety system of work at the site**.** It's not something that happens after an incident; it happens through everyday work conversations and includes all site stakeholders. This new system reflects the essence of the BetterWork approach, where workers lead conversations, leaders enable, systems learn and safety is designed with people, not done for, or to them.

> *"I'm much more confident that if there is an issue that they're dealing with on a day-to-day basis, or there's some issue sitting out there that's potentially going to hurt someone that would actually be raised, and then it's the forums for doing that, there's the Learning Teams, there's the safety committee, there's the daily Toolbox meetings" - Management*

Hampton Downs Toolbox Talks evolved from a compliance task to a core part of how the team understands and learns about its risk. Learning about and managing risk is continuous, not event or compliance driven. The frontline workers and management now work together as integral parts of the team and the system.

BetterWork has become embedded in how our people think, reflect, and adapt together. It has not just changed how safety is recorded; it has changed how work is understood.

Key Learnings from Enviro NZ Hampton Downs Toolbox Talk Shift to BetterWork

- **Toolbox Talks are part of continuous operations, not a fresh start** – shift handovers now reflect the continuity of work across shifts, with handover information between and within the teams.
- **Workers want tools that add value** – everyone wanted the Toolbox Talks to be meaningful and valuable about real risks, controls, successes, and the work performed every day.
- **"What makes a good day at work?" is also worth understanding** – Adding "what was Delightful?" encouraged reflection on what works well and why, challenges overcome and conditions that make work good. This shed a light on the innovation and creativity being used to make work successful during the shift.
- **Tools should support sensemaking, not just recording** – Shifting the purpose of the Toolbox Talks minutes form enabled deeper learning and peer connection, the workers owned the change and have made the process work well for them.
- **Learning loops need to be jointly owned, not overseen** – The most effective system change came when workers and management agreed what was needed to make this work and enabled the change to happen.

About the Enforceable Undertaking

This case study is one example of the outcomes of Enviro NZ's Enforceable Undertaking with WorkSafe New Zealand. The EU design supported a shift from traditional compliance-based approaches to a more adaptive, learning-enabled system (WorkSafe NZ's innovation teams' BetterWork principles). It included a wide range of initiatives (mindset to risk, and our safe systems, introduction of novel safety technology, e.g. AI and operational learning, worker-led systems, and shared governance practices).

The overall result has been stronger WEPR across both project sites, integration of tools to improve visibility and understanding of operational risk, and a more risk-capable organisation.

Appendix 2b: CASE STUDY: A Work-as-Done Approach to Safer Traffic Management

Starting Point: A Team-Led Expansion of BetterWork Thinking

At Enviro NZ's Pokeno site, BetterWork principles were introduced as part of an Enforceable Undertaking ("**EU**"), marking a shift in how safety was approached in high-risk operational areas such as landfill tipheads. Key tools – Learning Teams, Work-as-Imagined vs Work-as-Done (WAI vs WAD), and the 4Ds - were introduced and implemented to support this transformation. Over the following 24 months, these tools became embedded in the site's safety practices, fundamentally reshaping how safety is done on site.

While the EU made the use of these tools mandatory in the Pokeno site's tiphead operations, when it came to the Pokeno site's wood processing facility, it was the team that made a conscious decision: they wanted to adopt and utilise the same tools there too. This decision wasn't driven by compliance, but by a confidence in the mindset, methods and the value the tools had already demonstrated on site.

> *"The wood facility had been left out. It was missing from the changes" - Wood Facility Operator*

This choice marked a significant shift. The integration of BetterWork was no longer driven by the requirements of the EU, it was embraced because it had proven value, and the team was motivated to enhance safety across more areas of the site.

Understanding the Reality of Work: Walking with WAD

At the wood processing facility, the main focus was on the risk of people working around mobile plant and machinery**.** At the time, the facility had minimal documentation in place. The Traffic Management Plan (TMP) was a site map with directional arrows, offering little insights into the actual risks on the ground.

The first step was to understand the operations alongside a worker, walking the site together to understand the system from the inside out. This was not a paper-based review. It was a deliberate act of listening to workers and learning WAD.

Our worker didn't want to lead the project; they just wanted to help. Their quiet knowledge was our foundation. They helped us see the system through the operator's lens. Together, we observed:

- Congestion from overlapping truck flows
- Drivers exiting cabs in hazardous zones
- Visibility issues from stockpiles
- Uncoordinated contractor movements
- Pedestrians navigating operational areas to access machines

It was also discovered that the facility's physical design (including shed placement and underground services) was shaping work design and traffic management risks. Looking at WAD revealed how this design created constraints, influencing the decisions workers were making every day in managing risk.

A New Safe System of Work - moving from insight to iteration: building a new TMP through co-design

This understanding of the WAD resulted in the development of simple, visual diagrams of traffic flows to support operator discussions. This supported the principles of adult learning and need of English for Speakers of Other Languages (ESOL). These weren't polished presentations; they were transparency aids to create shared understanding.

A Wood Facility Traffic Management Committee was formed, a cross-functional group comprised of operators, managers, and the H&S advisor. At each meeting, they worked together to:

- Compare the real work (WAD) with WorkSafe's *Good Practice Guidelines*
- Review constraints (shed layout, site access)
- Test options using diagrams and scenario planning
- Make decisions *with* the people doing the work

What changed: design outcomes driven by worker insight

The final redesign of the Wood Facility traffic management was shaped by real constraints and based on worker expertise. Changes included:

- A machine park that removed the need for operators to walk through high-risk zones
- A relocated pedestrian gate aligned with operator movement
- A separate vehicle facility entry and exit**,** reducing congestion
- Barrier arms installed at the entrance controlled by operators
- A truck trailer park that kept drivers separated from machines during detarping
- Clear driver communication with 1-page change handouts provided at the weighbridge

Changes were tested with customer drivers; one even conducted a live drive-through to confirm truck manoeuvrability and visibility. It was a working system, built with everyone in mind**.**

Current

Issues:

- No control on site entry
- One entry/exit all traffic
- No queuing ability
- Visibility -Stockpiles between operators and traffic movement (people on ground)
- Two way traffic flows
- Unloading Trucks – Number movements alone AND next to incoming GBC trucks
- Congestion bottom right – unloading trucks having to wait for GBC trucks to detarp move forward before looping back
- Missing LV parking
- People on ground
  - GBC driver exiting on side with loader

Ideally:

- One way Traffic flows
- Two way traffic – Marked lanes
- Separate exit / entry points
- Minimal reversing
- Facility access controlled (unauthorised persons cant progress to area where at risk of site operations)
- LV parking area
- Clearly id traffic and operational areas

Figure 1: Summary of previous 'Work as Done' at the wood facility

Figure 2: Worker led 'New' traffic management plan

Ongoing Learning: The Loop Continues

After implementation, a further Learning Team was held with Wood Facility operators. More WAI–WAD gaps were identified, including:

- An old pedestrian gate that hadn't been locked
- Light vehicles entering through the facility exit
- Customer drivers walking through the facility to access office amenities

These gaps led to suggested further improvements, such as a barrier arm at the facility exit, and the placement of portable facilities for drivers at a dedicated location on site.

> *"We have facilities in the graveyard [truck park] – are drivers aware?" - Learning Team Conversations*

This process reflects the **Plan, Do, Study, Adjust (PDSA)** approach, which is an evolution of the traditional Plan, Do, Check, Act (PDCA) improvement cycle, prioritising learning and adaptation:

- **Plan** – Walk the site, ask questions, draft diagrams
- **Do** – Trial changes, get feedback
- **Study** – Reflect on what worked and what didn't
- **Adjust** – Refine the approach with everyone's input

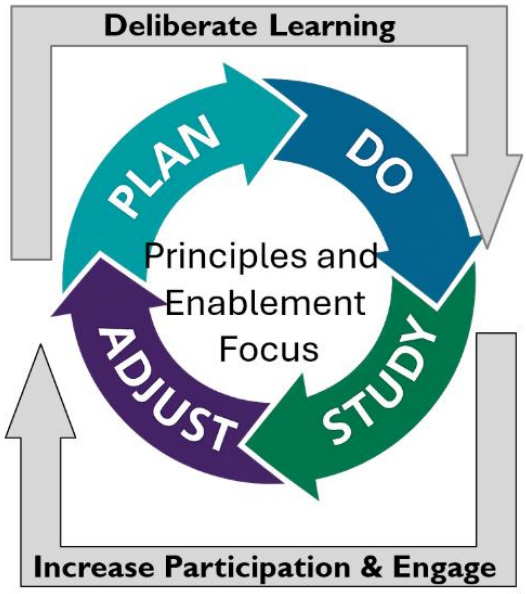


Figure 3: PDSA improvement cycle

The Learning Team process continues to be run monthly and has been modified to ensure faster feedback loops occur. The site now uses Learning Teams as a flexible tool, supported by operators, with outcomes communicated back through monthly Tailgates and Safety Committee meetings. It has fostered a greater openness to learn about WAI vs WAD, ongoing Worker Engagement Participation and Representation (WEPR) and continuous learning.

BetterWork Principles in Action – Wood Facility Case Study

- **Start from WAD, not documents** - Insight came from the front line, not from paper documents.
- **Operators are the experts** - Workers led the thinking and shaped the solutions.
- **Use visual, inclusive communication** - Diagrams bridged understanding, especially across ESOL needs.
- **PDSA works in real time with complexity** – An enabled improvement cycle helped the team continuously learn, adapt, and respond together.
- **Design with people, not for them** - Every improvement was tested and validated by those impacted.
- **Learning continued beyond delivery** - The team continues learning, questioning, and improving.

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Figure 4. BetterWork Principles

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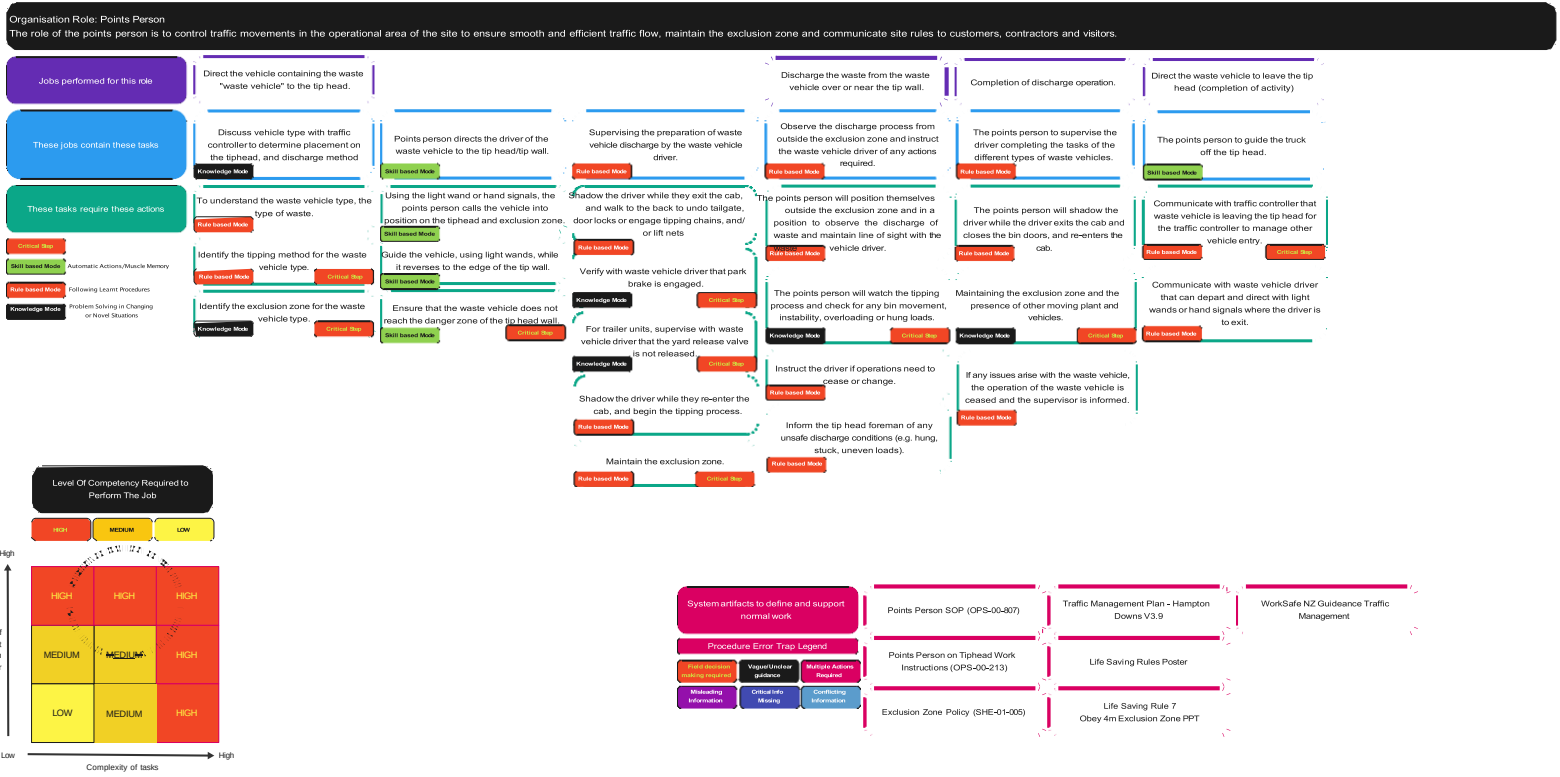
The overall result has been stronger WEPR across both project sites, integration of tools to improve visibility and understanding of operational risk, and a more risk-capable organisation.

Appendix 3: Capability and Capacity Framework

Points Person - Capacity, Capability and Competency Framework Example



Appendix 4: Mapping of Work and Dynamic Risk

Work Activity:

What are the high level activities to complete the work

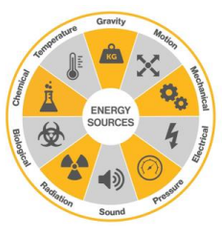
Steps in Activity:

What are the related activities in the order the steps are taken to complete the task

Actions in Step:

What actions are required to complete the steps.

Hazards/ Energy Present:



Hard Controls Present:

Controls Energy without human influence.

Soft Controls Present:

Controls Energy with human influence.

Field Based Decision Making:

Rely on worker decision-making for the control or work to be safe.

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