Pattle Delamore Partners Limited

TECHNICAL MEMORANDUM **PRIVILEGED AND CONFIDENTIAL**

INVESTIGATION	Remedial Action Plan – Initial Concepts	**PROJECT**	Horncastle Arena Diesel Spill
CLIENT	**Vbase**	**PROJECT NO**	CJ747100
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DATE	12 October 2018	**SIGNATURE**	

Introduction

This memo has been prepared to outline the current remedial approach for the diesel spill at Horncastle Arena. Investigation works are continuing to define the full extent of the impacts and as such the remedial approach may vary from this in the future, however, on the basis of the information we have obtained to date, the following remedial approach is being undertaken.

Background Information

Diesel was identified within Jacksons Creek and was traced back by Environment Canterbury (ECan) to the Addington Raceway area where a diesel odour was noted within drainage sumps on the northern side of the arena carpark. Subsequent to that an odour was noted in the retention swale to the east of the arena. As a result of these observations Vbase decided to investigate the integrity of the underground diesel fuel lines that supply Horncastle Arena. On 11 July 2018 Petrotec Services were engaged to pressure test the underground fuel lines on the northern side of the arena and found no evidence of any leakage. This was proven by isolating the supply and return lines between the 10,000 L above ground fuel tank and plantroom 'day tanks'. The lines were pressure tested to 50 PSI (due to being fibreglass) and held for a minimum of 1 hour. This process was repeated on the southern fuel lines on 19 July which identified a breach in the integrity of the supply line. The test process was repeated, which confirmed the failure and this was then reported to Vbase.

On 20 July Petrotec commenced excavation works to find the source of the breach in the fuel line. The breach was found approximately 30 m into the dig from the most eastern plant room in the arena. The cause of the leak was attributed to a waratah damaging the fibreglass fuel line (supply line). The placement of this waratah suggests it likely to have been used to stake boxing for the construction of a footpath associated with the temporary building erected in late 2011. This could indicate a leakage period of up to 7 years. The actual volume of diesel released into the ground is unknown.

The diesel line was repaired on 23 July so the source of the diesel entering the ground has been stopped. As part of this work some petroleum hydrocarbon impacted soil from around the lines was removed and taken away from appropriate disposal. Cleaning of the stormwater sumps and manholes were also undertaken by Chemwaste.

Pattle Delamore Partners Limited (PDP) was subsequently engaged to assist with delineating the extent of the impacts to ground and any associated remedial works. Initial site investigations have involved the installation of a number of monitoring wells to delineate the extent of the plume and to try to understand the mechanisms that resulted in the discharge from the site and also assess the risks to human health and the environment associated with the released diesel in the subsurface environment. As part of these investigations initial recovery of diesel on the groundwater surface has also been undertaken.

A summary of the key findings is as follows (refer site plan for locations of key items discussed below):

- The released diesel has migrated vertically to the water table and then migrated horizontally with groundwater flow to the south-east. The flow direction appears to be influenced by groundwater

seepages into underground services (i.e. groundwater entering deeper service lines) as well as soak pits discharging roof water/hardstand runoff into the ground into the area (soak pits defined as SW5 and SW4 on the plan). Subsurface geological conditions may also be influencing the flow direction (i.e. former river channels). This is still being investigated.

- The soil profile comprises near surface silty soils underlain by sandy gravels. The water table is present within the sandy gravel layer so service line trenches do not appear to be acting as preferential pathways (exception being any shallow services in the silty soils around the release point).
- The groundwater level has been measured at depths between 1.2 and 1.8 m below ground level (bgl) depending on the well location and timing. The apparent thickness of diesel varies, but has been measured up to 1 m thick (MW9). Most wells however show an apparent thickness of 0.2 – 0.3 m. Note that diesel will float on the water surface but due to its weight will also depress the water table (i.e. floats like an ice berg).
- The extent of the separate phase plume is shown on the attached plan (based on wells showing separate phase diesel on the water surface). The extent of the dissolved phase plume is yet to be determined, but will be larger than the separate phase plume.
- Up until the diesel was recently identified in Jacksons Creek the presence of the diesel leak was relatively unknown as there was no sign of the leak from the ground surface, and on the basis that there were no previous complaints of diesel in Jacksons Creek it is possible that there may have been no previous discharges of diesel from the site in the stormwater system. The fact that diesel showed up in the creek at this time indicates that a certain condition resulted in the discharge occurring. This could either be the plume reached a certain point enabling discharge or an environmental condition enabled the discharge to occur (i.e. water table increase). Since the original discharge, there have been no other confirmed diesel discharges from the site.
- The most plausible entry point of diesel into the stormwater system is via the stormwater manhole on Jack Hinton Drive (shown as SW3 on the plan). The invert level to the base of this manhole is 1.5 m bgl and the location of this manhole is around the approximate edge of the separate phase diesel plume. The triggering point could either be the separate phase plume reached this point as the plume was advancing or that the water table has risen allowing the floating diesel to touch the base of the manhole and entering through cracks in the base (the integrity of the base has not been assessed, but this is a typical assumption that some cracks may exist).
- Diesel has been identified within the base of the lift shaft within the NZ Racing Board building to the south. The lift is currently switched off until the diesel entering the lift well has been resolved.
- Stormwater sumps and manholes in the vicinity of the site were cleaned out (vacuum extraction) as part of the initial response to the original event.
- Inspection of the manholes during dry conditions showed no discharges of diesel. This however will be dependent on the groundwater level at the time.

Remedial Approach

The full extent of the diesel impacts (separate and dissolved phases) is yet to be determined, but covers a significant area and has migrated beneath internal site roads and underground infrastructure and migrated beneath neighbouring commercial and residential properties. The nature of petroleum hydrocarbons in the subsurface soils means that removal of all of the released diesel is extremely difficult (if not impossible) as it becomes trapped in the soil pore spaces and will remain as residual (i.e. immobile). This residual will continue to produce a dissolve phase plume until it completely degrades. Excavation and removal of impacted soils is often used in small scale spills, however, given the extent of impacted soils this is not practical at this site. The risk drivers (once managed) also don't warrant the complete excavation and removal of all impacted soils.

The primary remedial goals are to:

- Remove as much of the mobile diesel in the subsurface and stabilise the plume
- Avoid any further discharges of separate phase diesel to Jacksons Creek

- Manage/monitor/mitigate any identified complete pathways and receptor links that indicate a potential risk to human health or the environment
- Allow natural attenuation processes to remediate the remaining residues in the ground. This will take a number of years to complete, however, once the risks have been managed/mitigated this is the most appropriate long term remedial approach for remaining residues

The potentially complete key exposure pathways include:

- Discharge of separate or dissolved phase diesel into the stormwater system (Jacksons Creek)
- Permeation of diesel into the reticulated water supply pipelines
- Abstraction wells drawing shallow groundwater or insecure well heads
- Vapour entering underground service lines/manholes
- Vapour intrusion into nearby buildings (residential and commercial)
- Separate phase diesel entering basement/subsurface structure (i.e. lift shaft)
- Maintenance excavation workers undertaken deep excavation work that could intercept residual impacts and or dissolved or separate phase plumes

The remedial approach to reach these goals is being undertaken in stages as follows:

Initial stage (underway)

1. Investigation of the separate phase plume extent and mechanisms for discharge/exposure to receptors
2. Recovery of as much of the mobile diesel as possible whilst it is still relatively mobile. With time as the plumes spreads out it becomes less mobile and harder to recover
3. Identify and manage the pathways for diesel to discharge from the site (stormwater system) or direct exposure (lift shaft)
4. Stabilise the advancing plume to halt any further migration
5. Develop conceptual site model (CSM) of key pathways and receptors

Secondary stage (only recently commenced)

1. Investigation of the dissolved phase plume extent
2. Investigate complete pathway/receptor linkages and assess risk level. Depending on the outcomes of these investigations additional remedial/mitigation measures may need to be adopted
3. Continue to monitor the plume to show that natural attenuation processes are occurring and the plume is stabilising and eventually reducing in size.

In order to undertake the remedial/investigation work consents/permits from CCC and ECan will be required, including but not limited to a tradewaste discharge permit (CCC) and dewatering and passive discharge consents (ECan). Discussions will be made with the respective councils to obtain the appropriate permits/consents, however we would like to discuss getting temporary permission to undertake initial trials to aid with the initial stage of the remedial works when we have the best opportunity to recover as much of the mobile phase diesel as possible.

Remedial Works

The following is a summary of the remedial works already undertaken, currently underway or planned to be undertaken in the coming weeks. This will continue to be developed as additional information is obtained.

1. Three shallow product recovery wells (150 mm dia) have been installed (MW1, MW2 and MW3) and to date approximately 22,000 L of diesel has been removed using vacuum extraction (Chemwaste). A range of recovery techniques/devices were used to improve the efficiency of removal with recovery percentages ranging between 3% and 49%. Product recovery efficiencies in these wells started to reduce with time indicating we had removed a large percentage of the mobile fraction in the area of influence of each well. These wells were only installed via hydro-excavation so were not deep enough

to create any larger radius of influence. **COMPLETED**

2. Reduce additional stormwater entering the ground which would contribute to the mounding of the water table (i.e. possibly increasing the migration of the plume). The main roof runoff discharge has been plugged from entering the soak pit and diverted to overland flow into the CCC operated stormwater system. **COMPLETED BUT REQUIRES ONGOING MONITORING**
3. Installation of additional groundwater monitoring wells to delineate the separate phase plume (MW4 – MW12). The additional wells installed have defined the approximate extent of the separate phase plume including the installation of key wells such as MW5 between the source and the stormwater retention basin and MW4 in the trench of the sewer line (i.e. whether there is a preferential pathway along the permeable trench bedding material). Wells MW8, MW10, MW11 and MW12 define the approximate extent of the separate phase plume. **COMPLETED**
4. Sampling of reticulated water supply to ensure diesel has not permeated through water lines where diesel has migrated beneath. **FIRST ROUND COMPLETED BY CCC. No traces of diesel in water supply.**
5. Sampling of Jacksons Creek to assess any effects to the stream associated with the original discharge event and also whether any further discharge is occurring during a rainfall event. **INITIAL BASEFLOW SAMPLING COMPLETED BY CCC. AWAITING RESULTS.**
6. A deep recovery well is proposed to be installed (7 m deep and 150 mm dia – refer attached plan) to continue to recover the mobile fraction of diesel in the ground. A trial pump test will be undertaken once installed to determine the drawdown required to create a suitable radius of influence to draw the mobile fraction of diesel towards the well for removal (water abstracted discharged to sewer and vacuum truck to skim any accumulating diesel on the surface). The drawdown created will also ensure that the water table/product levels are maintained below the suspected release point into the stormwater manhole and lift shaft. Once the trial has been completed a semi-permanent system is proposed to be installed. The details of this system will be finalised once the trial has been completed, but will look to achieve the same objective of maintaining a water table depression and skimming of any accumulating diesel on the surface. **DRILLING AND TRIAL TO COMMENCE NEXT WEEK**
7. Undertake an initial groundwater sampling round within those wells that do not contain any separate phase diesel on the water surface (i.e. perimeter wells only) to start to understand the dissolved phase plume and concentrations present in these areas. Includes the collection of a sample from the soak pit to the southwest (beyond the concrete floor pad) to determine whether any dissolved phase is present in this area. A sample was also collected from the piped section of Jacksons Creek where groundwater was observed to be entering the piped system (i.e. representative of groundwater entering the stormwater system at that point). **COMPLETED 10 OCTOBER – AWAITING RESULTS**
8. Drilling of additional monitoring wells to further assess the extent of the dissolved phase plume. This will include wells further downgradient and will be based on the initial results of the groundwater sampling noted in point 7 and the modelling noted in point 14. **STILL TO BE COMPLETED**
9. Inspection of the monitoring wells on the northern side of the building following the reported odour in sumps (John Denton Addington). These wells were installed as part of the previous site investigation works. **COMPLETED 10 OCTOBER – No signs of any diesel on the water surface of these wells.**
10. Completion of a gas survey in the manholes in the vicinity of the arena (stormwater and sewer) using a PID (gas detector) to measure the gas levels present and Landfill Gas Meter to check for other gases. Purpose to ensure there is no explosion risk in the service lines. **COMPLETED 9 OCTOBER – No cause of concern noted. Still to be reported.**
11. Undertake a vapour intrusion survey within nearby downgradient buildings. This is to assess the risk to human health associated with the potential for vapour intrusion into these buildings. This is based on a toxicity risk as opposed to explosive assessment as diesel has a low risk of explosion. **STILL TO BE COMPLETED**
12. Collection of soil samples from the detention basin where diesel odour was noted. Also collection of soil samples from the stormwater basin to the south-west as requested by CCC. **COMPLETED 10 OCTOBER – AWAITING RESULTS**
13. Well survey of groundwater users. ECan database shows no abstraction wells within 300 m downgradient of the site **(COMPLETED)**. Door to door survey to identify any unrecorded groundwater wells in the area (residential area down gradient of the plume). **STILL TO BE COMPLETED**

14. Development of a groundwater model to predict where the plume may be migrating. This will be helpful in the long term to define where the dissolved phase plume has migrated and help direct where future monitoring wells should be installed. **UNDERWAY**
15. Investigation of the effect rainfall events have on groundwater levels. Pressure transducers have been installed within a number of wells and will record water levels every 15 minutes. This will be critical for the possible connection with the base of stormwater manhole SW3. **UNDERWAY**
16. Sampling of the discharge within the stormwater system during and after a rainfall event to ensure no discharge is occurring. Sampling will be undertaken at SW1, which receives the stormwater discharge from manhole SW3. Inspection of SW3 will also be undertaken throughout. **TO BE UNDERTAKEN DURING NEXT SUITABLE RAINFALL EVENT.**
17. Assess the integrity of the stormwater manhole and pipe network around manhole SW3. Undertake remedial work of pipe/sump to eliminate groundwater/diesel entering (as required).

Limitations

This memorandum has been prepared by Pattle Delamore Partners (PDP) on the specific instructions of Vbase for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

HORNCASTLE ARENA

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1. AERIAL IMAGERY (FLOWN 2016) PROVIDED UNDER LICENCE FROM ENVIRONMENT CANTERBURY WHO MAKES NO CLAIMS AS TO ITS RELIABILITY, ACCURACY OR ADEQUACY FOR ANY PARTICULAR PURPOSE.
2. CADASTRAL INFORMATION DERIVED FROM LINZ DATA.

APPROXIMATE EXTENT OF DIESEL PLUME (PRODUCT)

SCALE : 1:1,000 (A4)

0 5 10 20 30 40
Meters

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