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TECHNICAL NOTE			TN. 02
Revision	5	Date:	Wednesday, 2nd July 2025
Principal's Representative:	Andrew Allsopp-Smith		
Contractor:	Apex Water		
Contract:	Delmore Wastewater Treatment Plant		
Contract No.:	241104		
Subject:	**Technical Note – Truck Movements and Volumes**		

Dear Andrew,

Technical Note 2 – Support of Delmore Consent Application

Prepared by: Apex Water

In support of the Delmore consent application, Apex Water has prepared this technical memorandum to support the application for approvals related to the development of private, on-site wastewater treatment and discharge infrastructure for the Delmore land development project.

This document supports the Wastewater Treatment Plant (WWTP) Design Report included in the consent documentation and provides a holistic view of truck movements that the site could experience in response to a range of different scenarios. These scenarios are described below, alongside assumptions utilised in any resulting calculations.

Existing Infrastructure for Storage and Handling of Byproduct Streams

The treatment plant, as detailed in the substantive fast-track application, has provision for the following storage of waste and byproduct streams that cannot be immediately discharged of on-site:

1. Raw wastewater – 1,000m^3 tank – In order to accumulate and balance out peak flows from the network (e.g. at times of peak wet weather flows, and in case of a treatment plant break-down), raw wastewater can be accumulated in a 1,000m^3 balance tank prior to entering the treatment plant. This is noted as the Balance Tank in Figure 1 below. Whilst all wastewater from this tank is normally treated through the treatment plant prior to discharge, it is also possible to connect the discharge of the raw wastewater balance tank to the wastewater load-out tankering system without going through the treatment plan, as a contingency against system failure or unavailability of the treatment plant for any other reason such as natural disaster.

2. Treated wastewater – 1,000m^3 tank – Depending on the time of year, and the requirements of the removal of different waste streams from the site, this tank can be configured to store permeate for later discharge, RO reject for off-site removal, or mixed waste streams from the site for off-site removal. This is noted as the Permeate tank in Figure 1 below.

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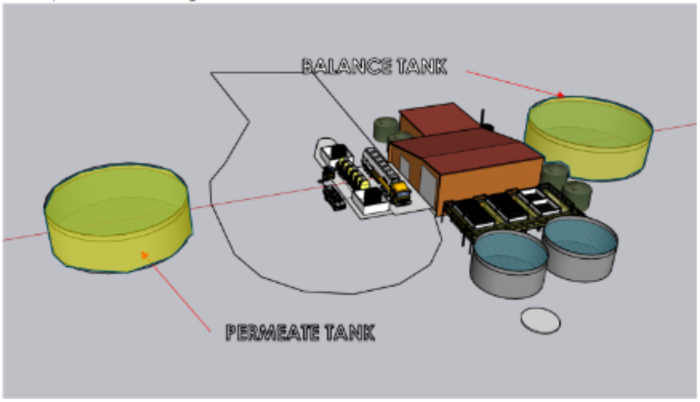

Figure 1 – The proposed permeate and balance tank locations

3. RO Reject – Two dedicated 30m^3 tanks (total 60m^3). The RO Reject is stored in 2no. 30m^3 tanks onsite prior to removal. This is sufficient to store 24hours worth of average retentate production. These tanks are shown within the red dashed box in Figure 2 below. Should these tanks be full, the 1,000m^3 permeate tank can store significant additional RO reject.

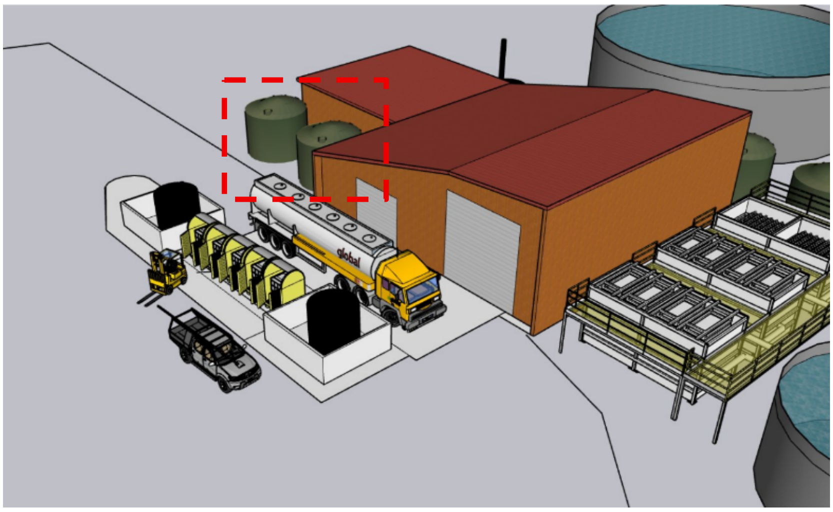

Figure 2 – The Reverse Osmosis reject tanks

4. Waste activated sludge is thickened on site via a simple gravity settlement process prior to dewatering. The dewatered sludge is collected in a skip bin located within the main treatment plant building. This skip bin is removed, and the dry sludge is disposed of to landfill. Figure 3 shows the location within which the sludge skip is located.

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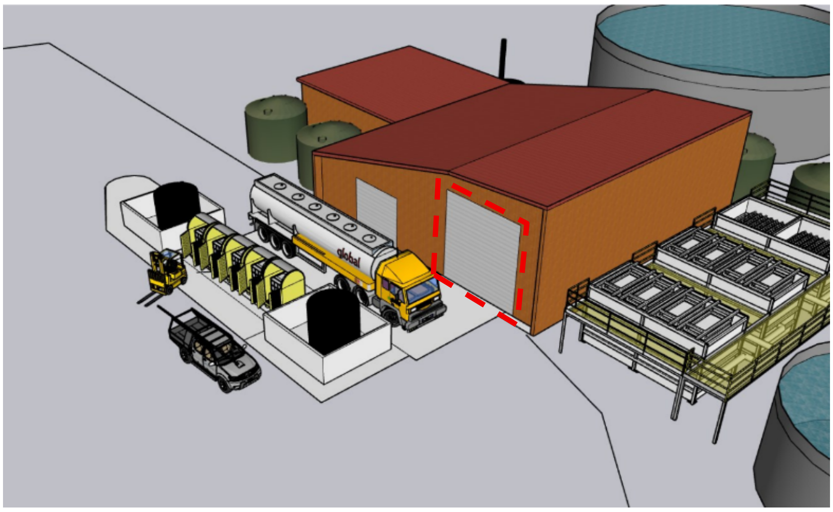

Figure 3 – Dewatered sludge storage location

The dewatered sludge is stored in simple gravity settlement tanks allowing the heavy solids the opportunity to settle while the clear water is decanted from the top. By decanting and concentrating the waste sludge, the dewatering process can achieve a higher percentage of water removal. By dewatering the sludge, a dry cake is produced which mitigates against any inherent risks of sludge handling and allows it to be removed from site in a skip bin. The removal of this skip is conducted in a similar manner to any rubbish skip collection process. The liquid removed by the dewatering process is recycled back into the treatment plant process. This process is common to nearly all modern wastewater treatment plants and by dewatering the sludge to produce a dry cake, many of the inherent risks of handling and disposing of this waste stream are mitigated, allowing it to be disposed of to an appropriately licensed landfill, as opposed to a specialist liquid waste receival site.

The water stored within the reverse osmosis reject tanks and the permeate tank will be exceptionally clear and of a solids content similar to that of typical drinking water. The reverse osmosis reject stream is passed through an ultrafiltration membrane prior to the reverse osmosis step, leaving only trace amounts of solids. After being passed through the ultrafiltration membrane, the permeate stream is further filtered and passed through a reverse osmosis membrane which is capable of solids removal down to the molecular level. The permeate in this instance is functionally free of solids. Due to the very low concentration of solids in these two streams, the storage tanks used for their handling do not typically accumulate any sediment.

In addition to this, storage on site is provided to allow for flow buffering in the event of wastewater peaking events. During heavy rainfall events there is the possibility of rainwater entering the wastewater networks through surface flooding, or damaged pipework. This provides additional loading on the plant and increases the rate at which any on site storage is filled, requiring increased tankers to remove any waste streams that otherwise cannot be discharged onsite. While new networks are less susceptible to peaking events, the design has considered up to 6.7x peaking and the requirement to buffer flows by providing on site storage. This ultimately reduces the number of trucks required during peak events by allowing for accumulation and storage on site.

Conveyance of Wastewater and Reverse Osmosis Reject for Disposal Offsite

Treated Wastewater

The proposed conditions of consent require that during the summer months (December to February), at least 80% of discharge flows must be trucked off-site, with the remaining 20% being discharged to the irrigation field or infiltration bed, as appropriate. When treated waste streams such as surplus treated water or RO reject need to be taken offsite

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for disposal, these waste streams shall be conveyed to a suitable location (discussed below) where they can be loaded into an appropriately sized road tanker and removed from the site.

The waste streams shall be pumped from the treatment plant in a dedicated high-density polyethylene pipe to the central collection point where infrastructure shall be made available for the connection of a road tanker to the discharge pipework. The location of this pipework and the collection point for Delmore has been identified by McKenzie & Co and is addressed in its report and plans. This collection infrastructure shall be similar to tanker fill stations commonly found across Auckland for the collection of potable and non-potable water into trucks. An example of a tanker filling station can be seen in Figure 4 below. In this application, the valve is locked and only made available to authorized personnel.

Figure 4 – A tanker filling station for the filling of road tankers with water.

The dedicated polyethylene pipeline servicing the filling station shall be pressurized such that the load out point is constantly pressurized to allow tankers the ability to collect and remove waste streams from the site even when no wastewater treatment plant operations staff are on-site. The control system shall automatically monitor these discharges. A typical discharge shall proceed as follows:

1. A tanker driver parks his vehicle at the designated load out station.
2. They shall have a key or code to the lock on the load out connection kiosk which they shall unlock before connecting their pipework to the hydrant fitting.
3. Once connected, the driver shall slowly open the hydrant valve which shall provide pressurized flows to the tanker.
4. The tanker shall fill under the guidance of the driver.
5. Once the tanker is full, they shall close the valve and stop the transfer.
6. The driver shall remove their pipework and lock the kiosk before travelling to the offsite discharge location.

Raw Wastewater – Contingency Option

Should Raw wastewater need to be removed from site, then the raw wastewater from the sewer network can be accumulated in the 1,000m^3 raw water (or equivalent) balance tank(s) which can then be discharged to the tanker load-out station detailed in Figure 4 above. This would utilize the same size of tanker detailed in Figure 5 below.

Sludge

Waste activated sludge is removed in a standard sized skip. A truck designed to remove waste skips from site, as is commonplace on construction sites can collect and dispose of this solid waste stream at a suitably licensed and operated landfill site. This skip is located at the wastewater treatment plant site.

Potential Locations for the Disposal of Waste Streams

There are a number of potential destinations for the waste streams removed from the treatment plant site for offsite disposal.

Both the reverse osmosis reject and the treated wastewater are of such high quality that should there be available hydraulic capacity and the infrastructure to receive the flows, any wastewater treatment plant could receive these discharges without contributing any notable biological loading to their treatment processes. It is expected that the impact of these flows would be a net dilution of the wastewater currently in the treatment plant receiving these waste streams. This would make it suitable for discharge at any Watercare site that has septage receival infrastructure, subject to commercial agreement. Depending on the availability of receival infrastructure, plant capacity and subject to commercial agreement, possible locations for discharge may include:

- WSL Rosedale
- WSL Mangere
- WSL Warkworth
- WSL Omaha Beach
- WSL Snell's Beach
- WSL Pukekohe

Should raw wastewater be tankered off site under contingency scenario 3 detailed below, then any of these facilities that have suitable receival infrastructure and sufficient treatment capacity available (such as Mangere) could receive the water subject to commercial agreement with Watercare.

Additionally, there may be locations with existing consents allowing the discharge of treated wastewater for irrigation, such as golf courses. By commercial agreement and subject to any planning permissions, treated wastewater or reverse osmosis reject that cannot be disposed onsite, could be beneficially re-used for landscape irrigation in this manner. One such location is detailed below:

- Wainui Golf Course (Variation to the existing Wainui Gold Course consent for discharge of treated wastewater would be required)

While Apex Water is not aware of the current state of the consent, the Wainui golf course located 4.5km from the proposed Delmore site has in the past and possibly at present holds consent for the discharge of treated wastewater to land for irrigation. Subject to any planning approvals and commercial agreement, variations to this or other existing and similar consented discharges may make these suitable for receipt of these byproduct streams.

The waste-activated sludge shall be transported to an appropriately licensed landfill such as that located in Hampton Downs.

Evaluation of Waste Volumes and Truck Movements

Description of Scenarios

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Scenario 1 – This scenario models the construction and subsequent occupancy of 483 residential lots over a 24-month period. It assumes an average completion and occupancy rate of 20 lots per month. The associated truck movements resulting from this activity have been assessed over the same time frame.

Scenario 2 – This scenario examines the operation of the treatment plant at full capacity. A 10-year historical rainfall dataset has been used to model the frequency and impact of peak flow events on truck movements.

Scenario 3 – This scenario examines raw wastewater is tankered off site. This is the contingency option noted above.

Description of Assumptions

Scenario 1 & 2 consider the off-site removal of the following waste streams via tankers, under the specified conditions:

1. Highly Treated Wastewater – Removed during periods when the receiving environment is experiencing Mean Annual Low Flow (MALF) conditions, assumed to occur in the months of December, January, and February. This aligns with the findings and recommendations in the Viridis discharge memo lodged with the substantive application and the proposed conditions of consent.
2. Reverse Osmosis (RO) Reject Stream – Assumed to require removal throughout the year.
3. Waste Activated Sludge (WAS) – Also assumed to require removal throughout the year.

Scenario 3 considers the removal off-site of all raw wastewater - no additional waste streams are considered as under these conditions the wastewater treatment plant would not be operating.

Treatment System Performance Assumptions

The performance of the treatment system and the generation of waste streams have been assessed using the following assumptions:

1. Total Number of Lots: A maximum of 483[1].
2. Occupancy per Lot: 3 persons
3. Wastewater Generation per Person: 180 L/day
4. Peaking Factor: 6.7
5. RO Reject Rate: 15%. This figure has been determined through biological modelling of the treatment process, utilising strategies to minimise the reject volume below typical reject rates for wastewater.

Ten years of rainfall data have been used to model the occurrence and effect of peak flow events.

Truck Requirements

The number of truck movements required to transport the calculated treated wastewater and reverse osmosis reject volumes has been determined based on a truck capacity of **28.8 m³**, consistent with the standard capacity of a Fonterra tanker. A large road tanker like that described is shown in Figure 5 below. Should Raw wastewater need to be removed from site, the same size of tanker would be used.

[1]The proposed number of lots in Stage 1 is 461, however flexibility is sought in the event that the WWTP is not built (ie. a public connection can be provided) and/or Council chooses not to acquire the park within Stage 1. The conservative figure of 483 is used.

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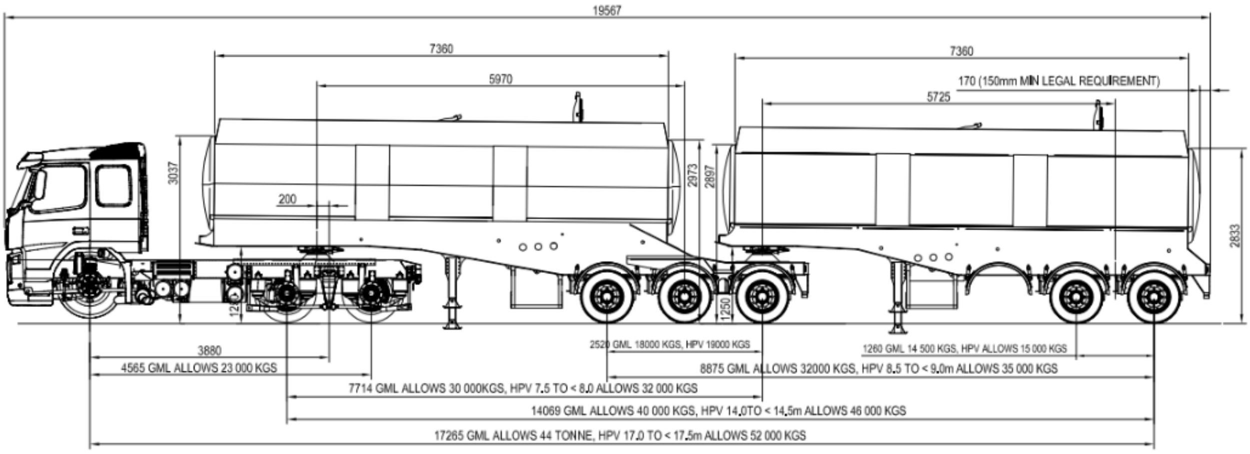

Figure 5 – A large road tanker, similar to that which has been used in the calculation for the number of truck movements.

The dewatered sludge is collected in a skip bin on site. While the size of the skip bin shall vary with the number of houses completed and occupied, this skip may be collected by a standard skip truck, or otherwise a small flat deck truck and hiab. An example of a skip collection truck can be seen in Figure 6 below.

Figure 6 – A skip bin collection truck (Waste Management, 2025)**. Noting the skip bin proposed shall be smaller than that displayed.**

Bulk chemicals such as acetic acid are typically delivered in Ixom tankers that range in size from a single truck unit to a truck and trailer as shown in Figure 7 below:

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Figure 7 – Typical bulk chemical delivery tankers (smaller units used for sites with restricted access)

Note: Should raw wastewater be tankered off site under Scenario 3 detailed below, then no bulk chemical deliveries or sludge removal truck movements would be required from the wastewater treatment plant itself during that period.

Scenario 1 -

In this scenario, it is assumed that 20 houses are constructed and become occupied each month over a 24-month period, resulting in all 483 houses contributing wastewater flows to the treatment plant by the end of the period. Rainfall data from NIWA for the period February 2023 to February 2024 has been used to calculate peak flow conditions.

The average number of daily truck visits required under this scenario is presented in Table 1 below.

Table 1 – Average Daily Truck Visits

Description	Truck Movements	Comment
Average Daily Truck Movements for Removal of Liquid Waste	1.52	To and from the filling location described within the Mckenzie & Co report and plans
Average Daily Truck Movements for Removal of Waste Activated Sludge (WAS)	0.14	To and from the wastewater treatment plant site
Average Daily Truck Movements for Delivery of Chemicals	0.07	To and from the wastewater treatment plant site
Total	**1.73**	

To support this analysis, Figure 8 (below) illustrates the projected daily truck movements over the projected 24-month construction and occupancy period. The figure shows a steady increase in daily truck movements, reflecting the progressive connection of new households to the wastewater network. Notably, there are distinct step changes in truck movements during the months of December, January, and February, corresponding to periods when local discharges are restricted due to the assumed presence of Mean Annual Low Flow (MALF) conditions in the receiving stream.

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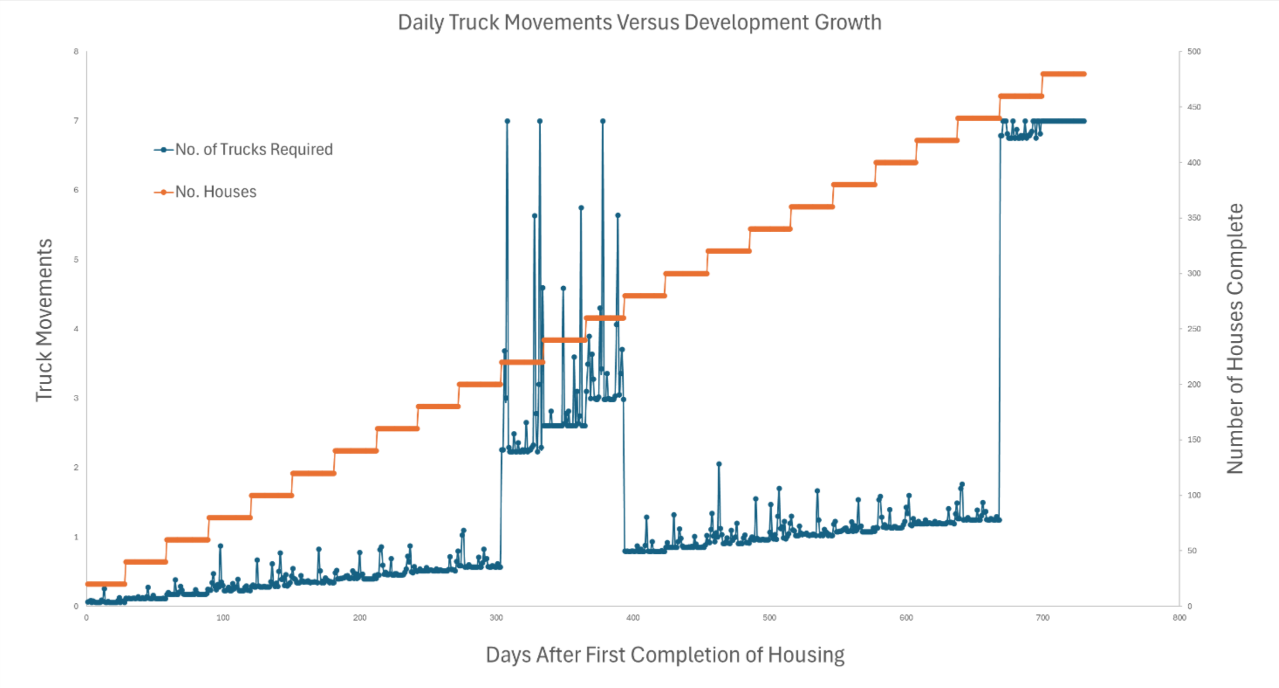

Figure 8 – Change in Daily Truck movements with development growth over the first 24-month period

Additionally, Figure 9 (below) presents a normal distribution curve representing the number of daily truck movements required to remove all liquid waste generated on-site over the assessed period. The distribution includes markers indicating the 50th, 70th, 80th, 90th, and 95th percentiles, providing insight into the frequency and scale of peak transport demand.

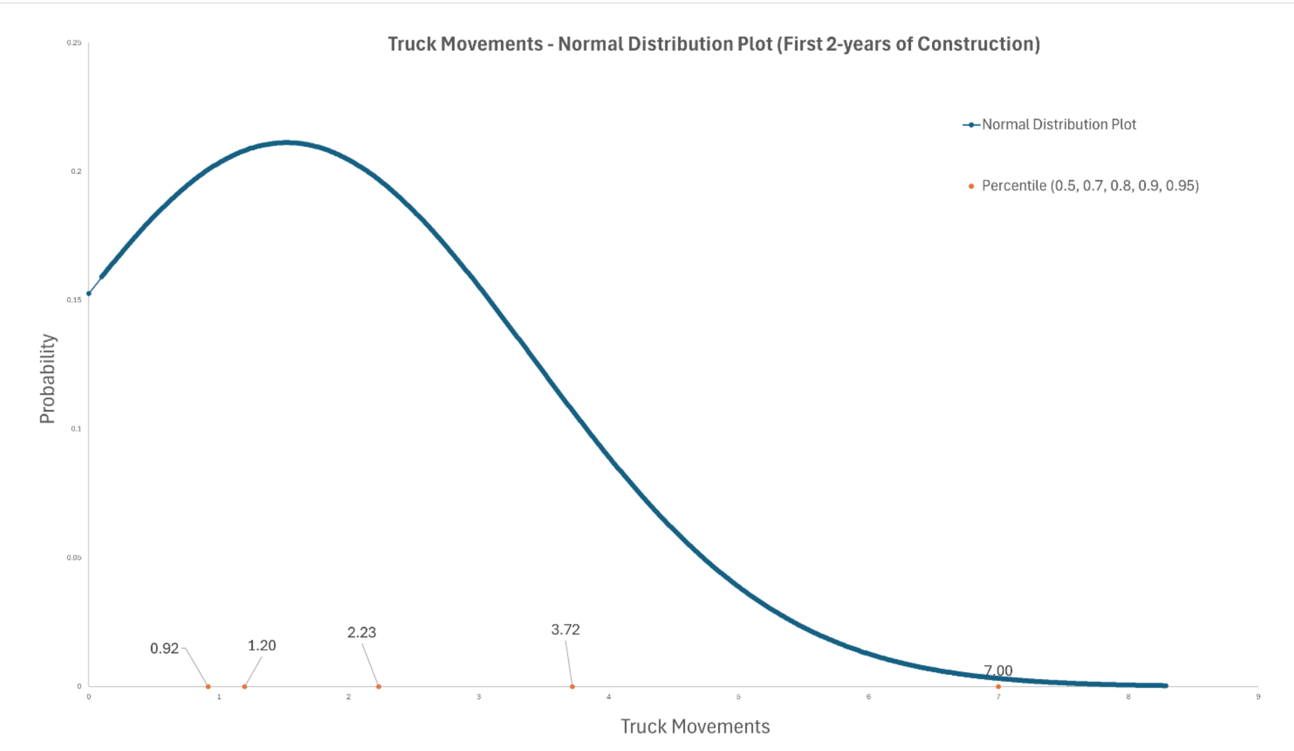

Figure 9 – Normal distribution of truck visits over the first 24-month period

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It is important to note that, although the normal distribution in Figure 9 extends beyond seven truck movements per day, the on-site balance tanks provide sufficient capacity to buffer peak flows. As a result, the maximum number of truck visits required over the assessed period is limited to seven per day.

Additionally, it is noteworthy that the 90th percentile value is 3.72, indicating that 90% of the days assessed would require fewer than 3.72 truck visits, highlighting the relatively infrequent occurrence of figures higher than this.

A summary of the figures derived in this scenario are detailed in Table 2 below:

Table 2 – Summary of Calculated Figure for Scenario 1.

Description	Truck Movements
Average Daily Truck Movements	1.73
Maximum Number of Truck Movements	7
50% Percentile	0.92
90% Percentile	3.72

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Scenario 2 -

In this scenario, it is assumed that all 483 houses have been completed and are contributing wastewater flows to the treatment plant over a 10-year operational period. To assess peak flow conditions, rainfall data from NIWA covering the 10 years up to February 2024 has been utilised.

The average number of daily truck visits required under this scenario is presented in Table 3 below.

Table 3 – Average Daily Truck Visits

Description	Truck Movements	Comment
Average Daily Truck Movements for Removal of Liquid Waste	3.18	To and from the location described within the Mckenzie & Co report and plans
Average Daily Truck Movements for Removal of Waste Activated Sludge (WAS)	0.14	To and from the wastewater treatment plant site
Average Daily Truck Movements for Delivery of Chemicals	0.07	To and from the wastewater treatment plant site
Total	**3.39**	

To support this, Figure 10 below highlights the normal distribution of the number of truck movements required to remove all the liquid waste generated in a day from site over the period assessed including markers for the 50%, 70%, 80%, 90% and 95%, 99% percentiles.

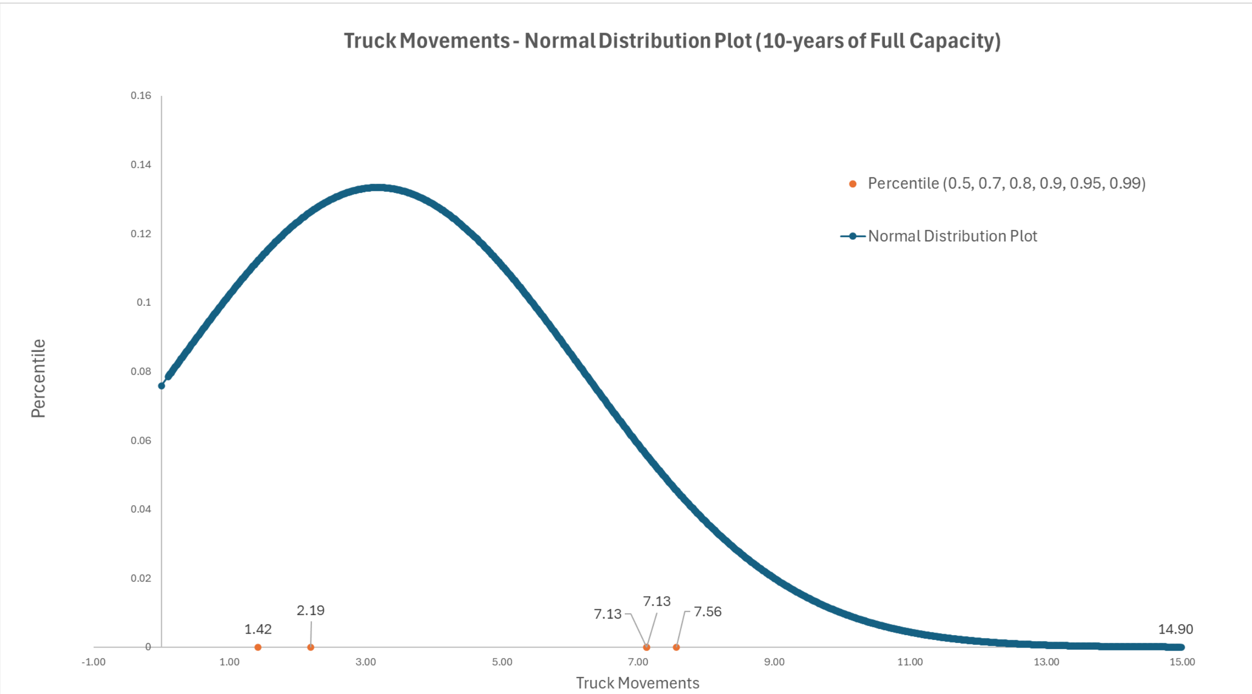

Figure 10 – Normal distribution of truck visits over 10-years of full operation

It is noteworthy that the 90th percentile value is 7.13, indicating that 90% of the days assessed would require fewer than 7.13 truck visits.

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A summary of the figures derived in this scenario are detailed in Table 4 below:

Table 4 – Summary of Calculated Figure for Scenario 2.

Description	Truck Movements
Average Daily Truck Movements	3.18
Maximum Number of Truck Movements	16
50% Percentile	1.42
90% Percentile	7.56
99% Percentile	14.9

While the maximum number of truck movements required over the 10-year assessment period is 16 per day, the 99th percentile value is 14.9. This indicates that the peak value of 16 represents an outlier, likely associated with an extreme wet weather event occurring during a dry-weather period. Based on this analysis, 99% of the assessed days would require fewer than 14.9 truck visits.

Further examination of the dataset reveals that, out of the 3,259 days modelled, only 81 days required 10 or more truck visits. Of these, 80 days coincided with peaking events during the dry-weather period, underscoring the influence of rainfall patterns on peak trucking events during the dry-weather period.

Conclusions on Scenario 1 & 2

During the initial phases of the project, the daily number of truck movements is relatively low, gradually increasing in line with the progressive completion and occupancy of houses. Over the 24-month construction period, the maximum number of truck movements per day reaches 7, with an average of 1.73 movements per day.

At full occupancy of 483 houses, the daily truck movements become significantly influenced by several key factors:

1. The occurrence of peaking events
2. The peaking factor applied in the calculation methodology
3. The assumption that 80% of all wastewater flows must be transported off-site during the months of December, January, and February

Out of 3,259 days modelled, there were 81 days that required more than 10 truck movements. Notably, all but one of these high-demand days occurred within the December to February period and were associated with peaking events. Adjusting the calculation methodology to permit local discharge during peaking events—specifically for rainfall exceeding 5 mm/day during the dry-weather period—substantially reduces the maximum number of daily truck movements required.

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Scenario 3 – Contingency

In this scenario, it is assumed that 20 houses are completed per month and the wastewater treatment plant is not yet available to treat the wastewater for disposal on-site. In this scenario, the same tanker trucks illustrated in Figure 5 above are utilised.

The average number of truck movements in this scenario gradually grows as more houses are completed, with the correlation between houses completed and tanker movements shown in Figure 11 below:

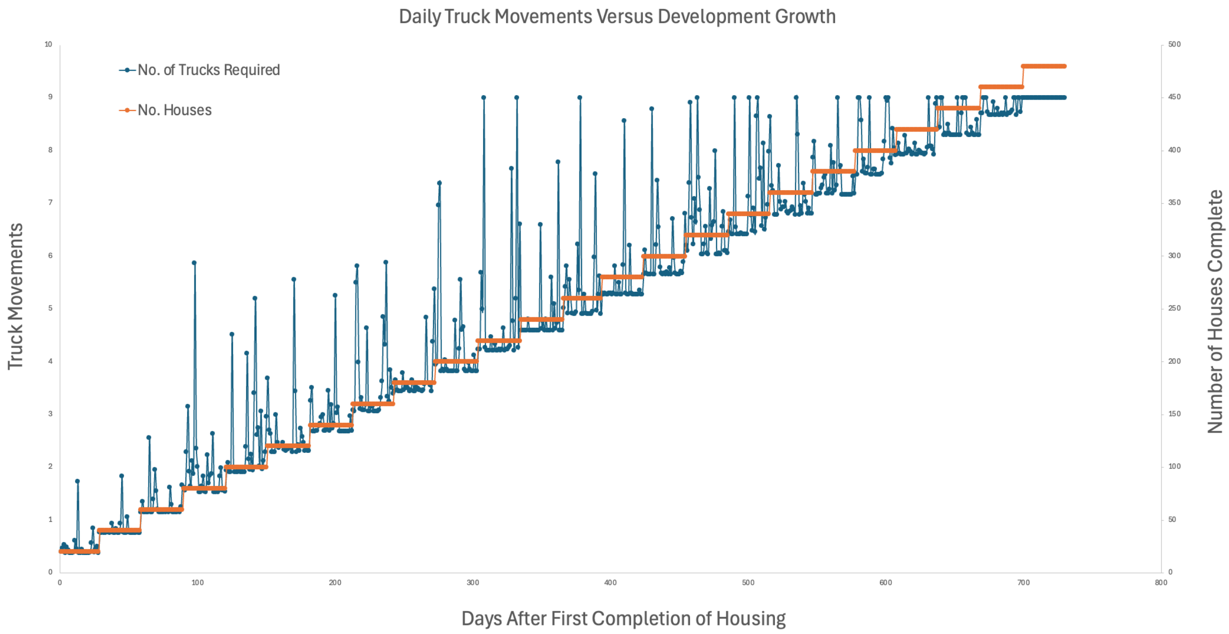

Figure 11 – Estimated tanker movements required to removal all raw sewage off site

Peaks in the Number of Trucks Required per Day (blue curve) represent expected peak sewer flows due to rainfall events based on historical rainfall data (assuming commencement in February for seasonality).

In the scenario modelled, all wastewater produced is tankered away each day until the number of tanker trips reaches 9 per day at which point the 1,000m^3 balance tank is utilised to restrict peak number of tanker truck movements to 9 per day. Under these conditions, at no point is the full 1,000m^3 volume of the balance tank utilised. In reality, the balance tank would likely be used earlier to further reduce peak number of tanker trips required per day even for early peaks up of to six to seven tanker truck movements per day during early wet weather events.

While less relevant to this progressive loading rate, the distribution of truck movements is provided in Figure 12 below for comparison to the other scenarios:

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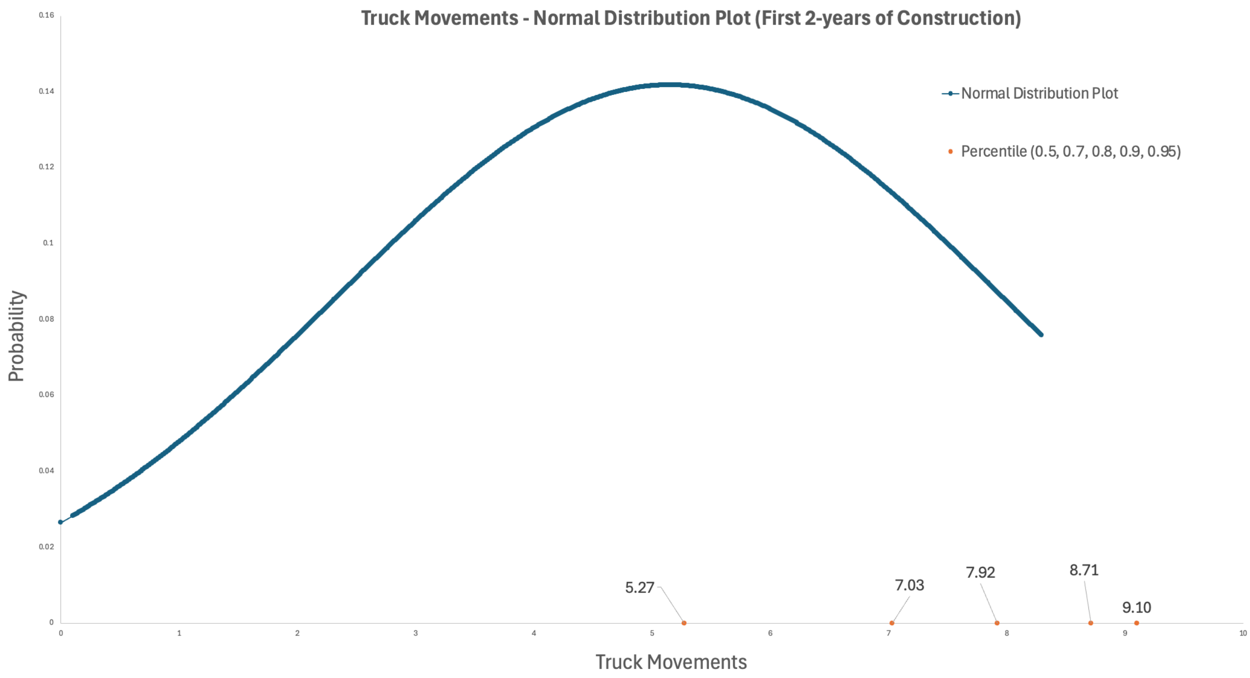

Figure 12 – Frequency of truck movements required per day under scenario 3.

Conclusions

In conclusion, under the contingency scenario where the wastewater treatment plant was not available for onsite treatment and disposal of wastewater, truck movements are expected to peak at nine tanker trucks (as per those detailed in Figure 5) per day with the 1,000m^3 raw wastewater balance tank being utilised to limit the peak number of truck movements to nine per day. Under this scenario, the median number of truck movements per day is approximately five per day.