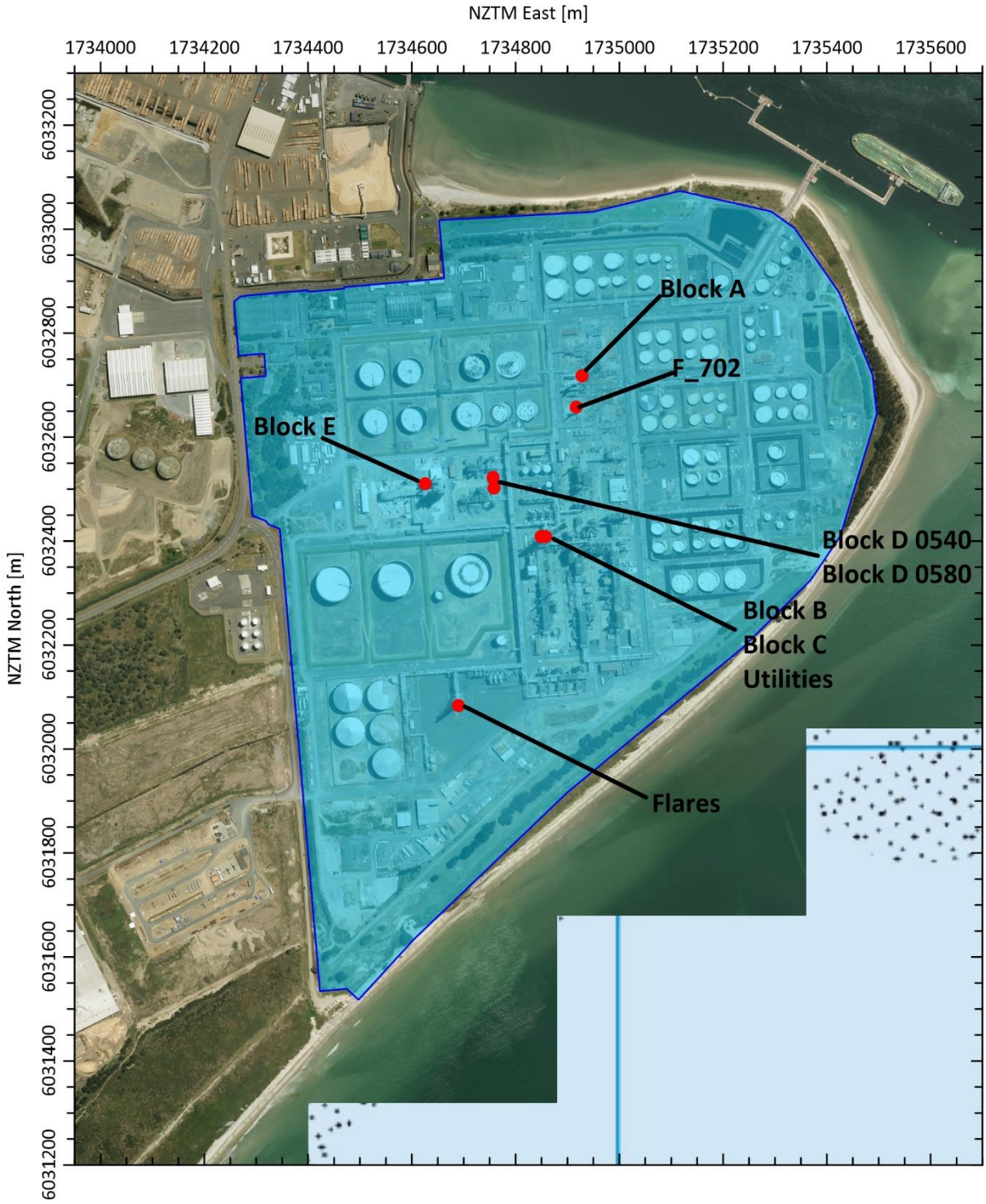


*Figure 2.4: Location of discharge stacks and flares (Northland Urban Aerial photos 2014-2015 – LINZ).*

## 2.4 Flaring

The site operates a group of flares located to the south of the site as indicated in Figure 2.4. A photograph of the flare is provided in Figure 2.5. These flares discharge at 110 m above ground level.

The Refining NZ flares are only used for emergency flaring; infrequent process flaring occurs on site. During shutdown or maintenance during operation, flaring is a crucial safety precaution that involves the releasing of pressure and safe venting of hydrocarbon gases. The flares at the Refinery are configured to only treat significant releases, meaning that unlike many refineries the flare is not being used to treat off-gas continuously.

All flares are monitored via a television link, and remedial measures are taken to minimise any smoke effects that arise.

*Figure 2.5: Photo of flares with the Block B, C and Utilities stacks in the background.*

## 2.5 Ship loading and unloading

Crude oil is delivered by ships to one of three jetty berths. The ships give rise to emissions (particularly $SO_2$) when berthed and consideration is given in this assessment to such emissions in terms of the cumulative effects of the site's discharges.

The refinery jetty comprises two separate arms as can be seen in Figure 2.4 and Figure 2.6:

- Jetty 1 (the eastern jetty) is the crude jetty or reception jetty, which averages six ships per month, ranging in size from 80,000 to 120,000 tonnes;
- Jetty 2 (the western or up-harbour jetty) is the product jetty which averages eight ships per month, each with a capacity of approximately 28,000 tonnes; and

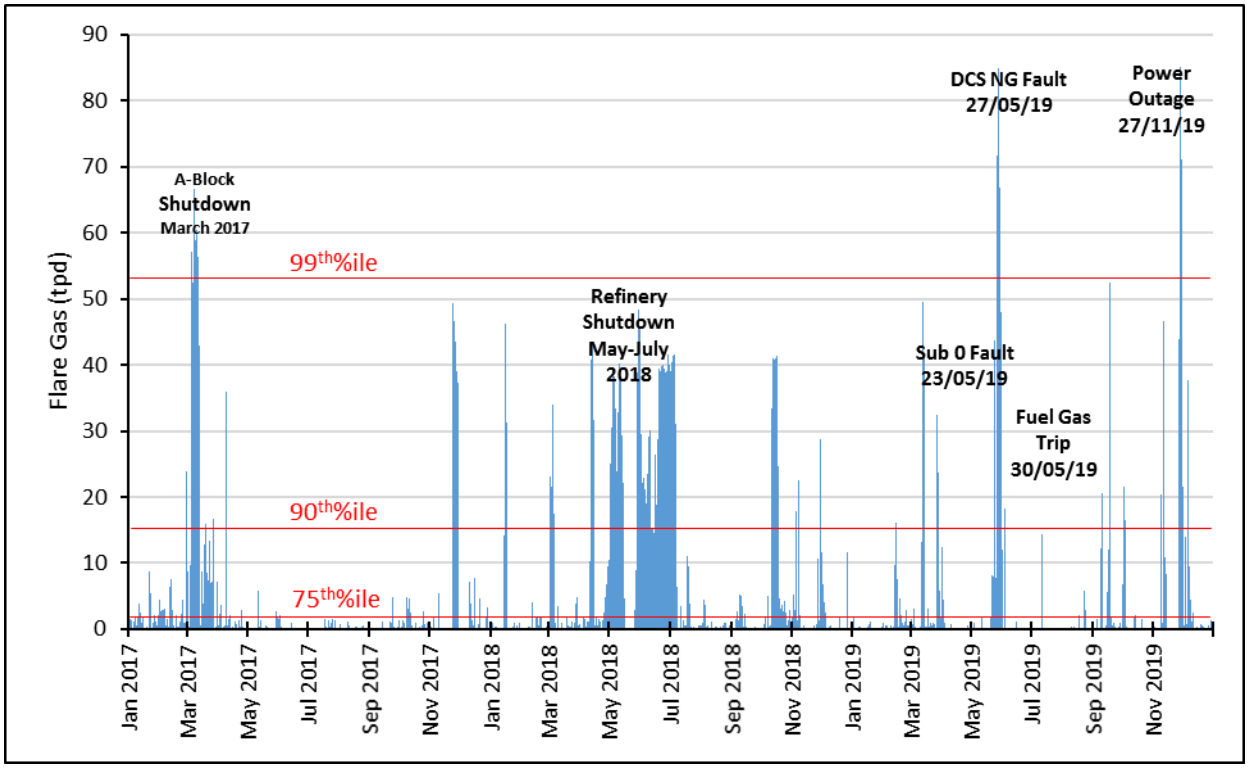


*Figure 3.4: Gas flow rates to the fare, 2017 to 2019 inclusive. Redlines and text annotate the percentile gas flow rates to the flare. Black text annotation highlights various significant flaring events.*

## 3.3 Fugitive emissions

At most refineries, the bulk of fugitive emissions are comprised of volatile organic compounds (VOC) emitted primarily from crude and product storage and transfer, as well as to some extent the process areas. The high level of control on VOC leaks from the Refinery's process area was noted in a Status Report by the then Department of Health's Regional Air Pollution Control Officer in 1991. This report commented on the Refinery's "very high degree of containment" of process emissions and indicates the site has good systems and processes in place for minimising fugitive emissions. It was noted that hydrocarbons, other odour-causing compounds and flare emissions occur only during emergency situations, from minor leaks, or during infrequent catalyst regeneration at certain processing units.

VOC fugitive emissions associated with the refinery operations and fuel storage are largely comprised of benzene, toluene, ethylbenzene and xylene (BTEX) and these compounds are typically used as indicator species for evaluating the fugitive emissions from refineries. These emissions are assessed through monitoring, which is discussed later in Section 6.

## 3.4 Odour

Odour emissions from the site can occur from a wide range of activities/sources. This includes the following:

- Sulphur type odours associated with combustion of high-sulphur fuels. As these sources discharge via tall stacks they are not expected to be prevalent source of odour in the receiving environment;

- Reduced sulphur compounds, such as hydrogen sulphide, which can be discharged from some onsite processes but also from the displacement of air during the filling of coastal tankers with fuel oil. $H_2S$ is particularly odorous with an unpleasant 'rotten egg' character;
- Fugitive emissions of hydrocarbon odours (discussed in Section 3.3) associated with vapour emissions from feedstock and storage tanks. Such odours are likely to be largely localised in and around the site; and
- Oily type odours associated with the operation of the site's wastewater treatment plant. These odours are likely to be localised in and around the site.

## 3.5 Dust

The main source of dust associated with the operation of the refinery is from abrasive blasting associated with the maintenance of tanks and structures on the site. Abrasive blasting involves the use of an abrasive medium to remove unwanted surface materials, such as rust and paint, in preparation for resurfacing of the tank/structure. Abrasive blasting can be undertaken using wet or dry methods, with the dryer the method the greater the potential for dust to be created.

Because of the size and scale of tanks and structures, they are often too big to practicably enclose. Accordingly, there is a need for abrasive blasting to be routinely undertaken onsite as part of ongoing maintenance.

Dust associated with abrasive blasting can create a dust nuisance effect on nearby sensitive receptors, including soiling surfaces. Potential health effects can be associated with the respirable fraction of the dust, such as respiratory and lung diseases, especially where there is a high silica content of the abrasive medium. For this reason, there are limits in the regional plans limiting the silica content of abrasive medium to less than 5 % free silica (Rule C.7.2.1 of the Proposed Regional Plan for Northland – Appeals Version – 29 July 2019). Refining NZ proposes to comply with this requirement.

## 3.6 Firefighting training

Emissions from firefighting training activities will be combustion gases and some smoke associated with the burning of fuel (light tops). However, light tops being similar to petrol, will burn relatively cleanly compared to other types of fuel. Furthermore, emissions are expected to be negligible in the context of other combustion sources on site, given the very small scale of this combustion activity, along with it only occurring for relatively short periods and infrequently.

# 7 Assessment of Effects – Odour Emissions

## 7.1 Assessment method

The odour effects associated with the Refinery have been assessed qualitatively in line with MfE guidance (MfE 2016b). This includes a review of complaint records, wind information conducive to poor dispersion of odours and an objective evaluation of potential odour impacts in terms of the frequency, duration, intensity, offensiveness of impacts at sensitive locations (the FIDOL factors).

## 7.2 Assessment

While odour complaints (or a lack thereof) are not conclusive indicators of odour nuisance effects or an absence of those effects, the record of odour complaints and confirmed incidences of offensive or objectionable odour can provide a broad indication of odour nuisance experienced near existing operations.

The frequency of odour complaints received by Refining NZ are summarised in Table 7.1 – these records exclude complaints relating to other environmental issues such as noise. Overall, the level of recorded complaints relating to odour since 2015 has been very low for a large heavy industrial complex such as the Refinery, with only 19 complaints being recorded over the 4.5 year period. The bulk of these complaints (15) were received in 2016 and 2017. Further analysis of the complaints over this period indicates that not all of the recorded complaints are likely to have originated from the Refinery, but the majority are based on analysis of wind conditions at the time of the complaint and the description of the odours given.

**Table 7.1 Summary of complaints received regarding odour from the site, 2015 to 2019**

| Year | # complaints | Detail |
|---|---|---|
| 2015 | 2 | Both complaints occurred over two days and were traced back to a process upset associated with the biotreater lasting for a few days.<br>Winds were from the south and blowing towards the location where the complaints originated from (Little Munro Bay and McLeods Bay). |
| 2016 | 7 | Two of the seven complaints occurred on 2 April 2016 originating from One Tree Point and relating to hydrocarbon odours. However, the winds were from the Northwest at this time and unlikely to have originated from the site.<br>The remainder five complaints were all associated with locations downwind of the site at the time of the complaint, include One Tree Point, Marsden Bay, Little Munro Bay and Whangarei Heads (within a radius of approximately 4 km). In most cases the source of the odour was not determined, with the exception of one complaint that was possibly linked to shipping and not the refinery. Descriptions of the odours where recorded included an 'oily smell', 'hydrocarbon smell', 'sulphur-methane smell', all of which could be associated with refinery activities.<br>The duration of recorded odour exposure varies between less than an hour to several days. |
| 2017 | 8 | Of the eight complaints received, two are not likely to have been caused by the refinery as the winds were not in the direction of the complainants on those occasions.<br>Of the remaining six complaints, these originated from Little Munro Bay, Whangarei Heads, Reotahi and Taurikura (i.e., within a radius of approximately 4 km). |

| Year | # complaints | Detail |
|---|---|---|
| | | Reported durations for the six downwind complaints are mostly unknown. |
| 2018 | 1 | The odour complaint recorded for 2018 related to 'Shutdown 2018' and occurred on 2 May 2018. The location of the complainant was not recorded. |
| 2019 | 1 | A single complaint received as at June 2019 relating to odour observed at One Tree Point on 20 March. |
| 2020 | 1 | A complaint regarding strong odour experienced at Ody Road, Whangarei Heads throughout 4 January 2020. Strong winds from the southwest were present throughout the day. Refinery operation was normal within discharge limits. Monitoring of ambient $SO_2$ at Whangarei heads showed levels in the excellent range. This indicates the stack emission were unlikely to be significantly contributing to the described odour. No refinery shipping related activity was occurring and no other obvious odour sources were identified on site. |

Local meteorology has an important role in the dispersion of odours. Strong winds will act to rapidly disperse and dilute odours, whereas light winds (typically below 2.5 m/s) will poorly disperse and dilute odours and are therefore 'worst-case' in terms of odour effects. Figure 7.1 provides a windrose for the site overlaid onto of an aerial of the site, showing the direction from which light winds typically blow. From this, it is evident that the vast majority of light wind is from the upper harbour (westerly) and would carry odours away from most sensitive residential locations. Light winds from the east (which could carry odours towards One Tree Point and Marsden Bay) are very infrequent. Similarly, winds from the southeast through to south that could carry odours towards Reotahi, Whangarei Heads and Little Munro Bay are also infrequent. This analysis is consistent with the relative low number of odour complaints from these locations associated with the Refinery.

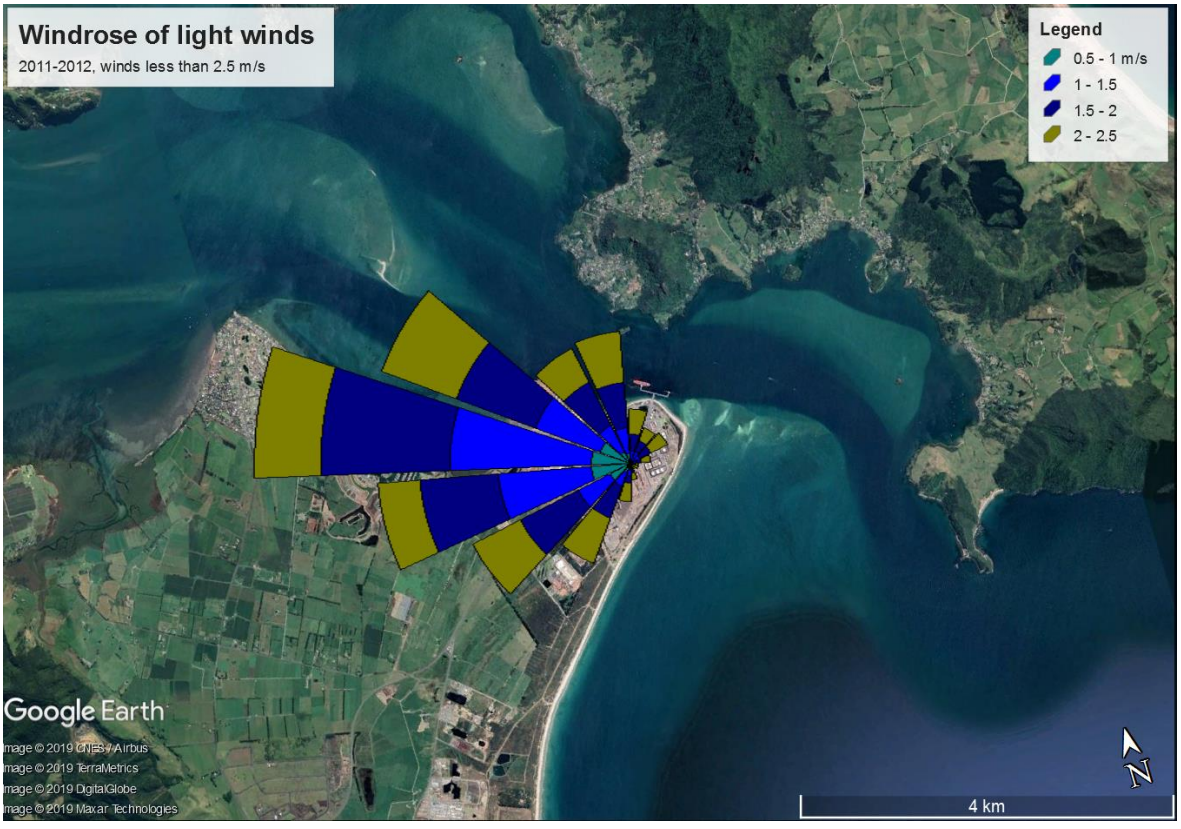


*Figure 7.1: Windrose showing light winds (≤ 2.5 m/s) measured at the Refinery for 2011 – 2012.*

The potential for offensive or objectionable odour effects can be objectively assessed by considering the FIDOL factors (frequency, intensity, duration, offensiveness/character and location) for locations where odour may be observed. A FIDOL assessment of odour impacts, informed by the above complaints analysis, is provided in Table 7.2.

**Table 7.2: FIDOL odour assessment**

| | |
|---|---|
| **Frequency** | The frequency of exposure to odours is a function of both the frequency of discharges and the frequency of winds that might carry odours towards a sensitive receptor location.<br>On-site activities that give rise to odour will be intermittent, typically associated with a particular activity or event.<br>Winds, particularly light winds that are worst case for dispersing odours, blow infrequently from the direction of the Refinery towards sensitive locations as discussed above.<br>The combination of both infrequent wind conditions and odour activities means the overall frequency of odour events should be low. This is also reflected in complaint records being relatively infrequent (up to six valid complaints per year since 2015, and only one for each of 2018,2019 and 2020 to date). |
| **Intensity** | The intensity of odour impacts (i.e., the strength of odours) is difficult to ascertain from complaint records, with the exception of the most recent complaint in 2020 which notes the occurrence of strong odour. However, given that sensitive locations are located a significant distance from the site, it is expected any odours would normally be significantly diluted by the time they reach those locations. Given this, it is expected that the strength of any such odours is at worst distinct, and that strong odours are unlikely. |
| **Duration** | The duration of odour exposure depends on both exposure to winds from the direction of the refinery and in relation to events.<br>Wind data suggests very infrequent light winds (and therefore duration) blowing towards sensitive locations surrounding the site. This is reflected in records where the odour exposure duration is recorded, which is mostly less than 1-hour. |
| **Offensiveness** | The descriptions of odours recorded in complaint records include 'oily', 'hydrocarbon', 'sulphur/methane'. These types of odours are generally considered to be unpleasant in character. |
| **Location** | Sensitive locations surrounding the site are buffered by the adjoining industrial zone and port, or the Whangarei Harbour. The industrial zone and port are considered to be of a low sensitivity to any odour impacts. |

On balance, given the relatively low level of recent odour complaints, the infrequent light wind conditions that could transport odours towards sensitive locations, and the overall FIDOL analysis, it is considered that odour effects as a result of discharges from the Refinery are less than minor.