**Henry T. Perea**
Manager, CA/OR/WA Government Affairs

February 15, 2019

Ms. Cynthia Marvin
California Air Resources Board
1001 I Street
Sacramento, California 95814

via e-mail at cynthia.marvin@arb.ca.gov

**Re: Chevron Comments to Proposed At Berth and At Anchor Regulation Emission Inventory and Preliminary Health Analyses**

Dear Ms. Marvin,

Chevron Products Company and Chevron Shipping Company (collectively, "Chevron") have prepared comments in response to the release of data related to the *DRAFT: 2018/2019 Update to Inventory for Ocean-Going Vessels: Methodology and Results* and *Preliminary Health Analyses: Control Measure for Ocean-Going Vessels (OGV) At Berth and At Anchor ("HRA").*

After close review of the Inventory, Chevron contends that some of the data and assumptions used when calculating the inventory dramatically overestimate emissions from tankers at Richmond Long Wharf (RLW). Specifically, the areas of major concern are:

- Substantial underestimation of the impact of Tier III tankers which will significantly reduce emissions from vessels at berth as early as 2030.
- Overestimation of activities of tankers at berth, resulting in significantly inflated emissions inventory for tankers.
- Application of highly incompatible data from POLB/POLA to operations at RLW, resulting in a significantly inflated inventory.
- Forecasts of future vessel traffic growth that significantly exceed historical data and Chevron's own forecast for tanker traffic at RLW.
- Potential misinterpretation of the HRA model as currently depicted. Chevron recommends minor changes in the presentation of the HRA data to provide a better representation of the actual situation.

We recognize that CARB has spent considerable time and effort on this analysis, and we offer the following comments in an effort to provide greater accuracy. Chevron looks forward to continuing discussions on how to proactively and practically reduce emissions from our facilities in support of on-going CARB efforts.

# 1. Introduction of Tier III Compliant Vessels prior to 2030

- **Delayed expected introduction of Tier 3 marine engines to 2030 or later, based on a study by Starcrest and Ports of LA/LB**

At the core of CARB's proposed regulation is the assumption that there will be zero Tier III-compliant vessels in service before 2030, and consequently, CARB asserts the only mechanism to achieve emission reductions by OGVs is through regulation of OGV at berth emissions. CARB cites a study by Starcrest (2017), which concludes that there will be no Tier III vessels in service in the world's fleet, and Starcrest's study is based on vessels with the potential to call at the Port of Long Beach (POLB) and Port of Los Angles (POLA).

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As a marine terminal, Chevron RLW receives a distinctly different population of tanker vessels than POLA/POLB. In short, marine terminals operations and the vessels that call at them are distinctly different than port operations. In particular, the RLW and other Northern California marine terminals lack the capability to accommodate ULCC and VLCC vessels.

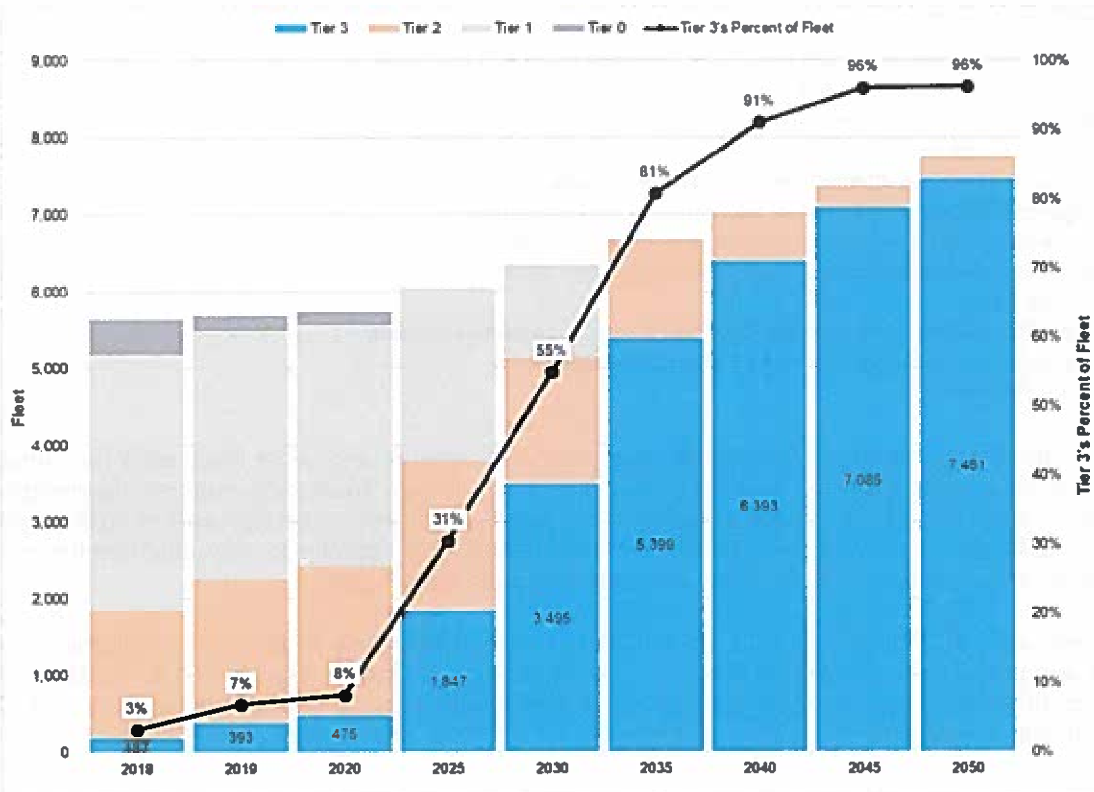
Further, Chevron implements vessel clearance procedures to ensure that all vessels calling at RLW are suitable to fit our fender spacing at berth, and meet our operational, health and safety standards or "OE" standards. Consequently, our vessel vetting criteria effectively prohibits foreign-flagged tankers older than 18 years to call at RLW. There may be other vessel types with a longer useful life up to 25 years, such as chemical carriers that carry only clean refined products, or US-flagged Jones Act vessels. Nevertheless, the vast majority of ships that can call at RLW, and that meet our vessel clearance standards, will be 18 years of age or younger. These age guidelines for vessels calling at marine terminals are common to the industry.

Using an industry vessel database purchased from Clarksons, Chevron Shipping assessed the portion of the world's fleet that has the capability to call RLW. For existing vessels, one can estimate the keel laid date and determine what engine tier level was installed in the ship. As of 2018, 1-2% of the world fleet meets Tier III requirements. In fact, Chevron took delivery of 2 Tier III vessels in 2018, and one third of our total fleet will be Tier III by 2021. This is significant because there are currently more than zero Tier III vessels, indicating large errors in Starcrest's forecast that Tier III tanker vessels will not exist until 2031 at the earliest (Figure 3.8, Starcrest 2017).

More specifically, Chevron built two Suezmax-sized tankers that are used to lighter nearly 70% of Richmond Refinery's crude deliveries to the RLW. These two lightering vessels have keel-laid dates in 2013 but were designed to be able to operate their electrical generation at RLW in low-emission mode by using superheated steam auxiliary boilers and turbogenerators, which do not produce diesel particulate matter (DPM) and have a much lower NOx emissions than Tier III diesel engines. In fact, according to a boiler burner maker, marine boiler NOx emissions are 0.78g/kWh, significantly lower than the Tier III limit for a 900 rpm diesel generator which is 2.31g/kWh www.volcano.co.jp/english/pdf/Volcano_TCS_Bulletin_004PB.pdf. As of 2018, these vessels, with NOx emissions below Tier III levels, represent a considerable amount of our annual at berth emissions (70% of our crude deliveries are via Suezmax-sized vessels).

Our study concluded that 55% of vessels calling at RLW would be expected to be Tier III compliant by 2030, and 80% of vessels would be Tier III compliant by 2035. In addition to our analysis, an independent 3rd party conducted a similar analysis and demonstrated similar results – about 50% of vessels by 2030. With two independent data evaluations, we believe the Starcrest (2017) report is erroneous and calls into question the entire purpose of the proposed at berth regulation. If nearly 80% of vessels calling at Northern California Marine Terminal Complexes owned/operated by major oil companies will be Tier III-compliant by 2035, then this regulation will have less than 5 years of relevance toward achieving its target emission reductions before vessel-side technologies meet or exceed the 80% control factor. Further, on-board emission controls will exceed the magnitude of reductions capable with at berth controls, because on-board controls will benefit the entire Emission Control Area (ECA) during transit and maneuvering. Consequently, the cost-effectiveness of this proposed at berth regulation appears to be very low.

**Figure 1-1: Forecast of percentage of Tier III vessels capable of calling at RLW by year**
(*Source: Chevron forecast using Clarkson's commercially available fleet database, factoring in vessel clearance procedures*)




**Key Assumptions**

- 2018 global fleet data from Clarksons Research
    - Data as of December 2018
- Ships built after 2020 assumed Tier 3
    - 50% assumed Tier 3 in 2019
    - 50% assumed Tier 3 in 2020
- Useful life per industry standards
    - Crude and Product – 18 years
    - Chemical – 25 years
- Fleet growth assumed to be 1% per year

# 2. Vessel Parameters and Activities at Berth

### 3. General Emissions Inventory Methodology and Sources

Broadly, the following steps describe the inventory process, with more detail included later in the report, along with the source data:

1. Vessel broadcasting data along with GIS mapping determines the number of vessel visits for each port in California (grouped by vessel type and vessel size)
2. Vessel broadcasting data also determines the average length of stay for all vessel visits (by vessel type, size and port)
3. Information on average engine effective power (based on the Starcrest Vessel Boarding Program) is combined with vessel visit and duration information
4. Future years are forecasted by applying a growth rate (specific to port, vessel type, and in some cases vessel size) and assuming an equivalent age distribution of vessel visits in the future
5. Compliance data from CARB's Enforcement Divisions is used to determine reduced engine activity time – and therefore reduced emissions – resulting from CARB's At Berth Regulation

The table below (Table 2-1) summarizes the vessel categories and auxiliary and boiler loads as a percentage of pumping load for pumping, loading and idle activities. Using this methodology, Table 2-2 compares the energy used per vessel type for vessels calling at RLW against CARB's calculated energy per vessel type assuming POLA/POLB engine loads, and corresponding emissions. CARB's current methodology appears to over-estimate the at berth emissions at RLW by at least a factor of two or more, depending upon vessel type.

As mentioned previously, VLCCs and ULCCs do not call at marine terminals in Northern California. For the remaining vessel categories, there are distinct differences between the load factors seen in POLA/POLB and those at RLW. In addition to the load factors, the actual activities performed by the vessels calling at RLW and, likely, other marine terminals are significantly different than the way CARB has represented the activities in their calculations.

The largest difference appears to be that CARB's calculation of "Average Engine Effective Power" assumes vessels are pumping 100% of the time that they are at berth, when in fact, at RLW, vessels except Suezmax spend significant amount of their time at berth loading by gravity feed. The pumping rates/discharge rates are generally higher than the gravity-fed loading rates. Vessels are also idle for a substantial period while at berth, when they are neither pumping nor loading. Consequently, the assumption that the vessels are pumping continuously leads to over estimating emissions at berth.

Vessels at berth pump to two primary destinations within Chevron Richmond Refinery:

1. Crude deliveries are pumped directly to low-elevation crude tanks,
2. Non-crude deliveries are pumped to the base of the RLW causeway, whre electric booster pumps move delivered products to tanks higher in the refinery tank field.

The non-crude ships discharging feedstocks or blendstocks use only enough energy to push the product from the cargo hold and fill the pipeline, but not to move the product up hill. Using electric pumps in the refinery pump stations is a low-emission means of offloading vessels and distributing product to the refinery tankage.

To achieve a more accurate estimate of actual at berth emissions, CARB should follow the calculation methodology proposed below by ship type to reflect that vessels at berth are performing different activities during their visit, namely pumping to discharge feedstocks, and then loading to take refined product which is at the vessel "idle" or "hoteling" load:

1. [Average Pumping Duration] x [Average Pumping Load] x [Emission Factor] = Pumping Emissions
2. [Average Ballasting Duration] x [Average Ballasting Load] x [Emission Factor] = Ballasting Emissions

3. [Average Hoteling Duration] x [Average Hoteling Load] x [Emission Factor] = Hoteling Emissions
4. Total Vessel at Berth Emissions = [Pumping Emissions] + [Ballasting Emissions] + [Hoteling Emissions]

NOTE: The pumping load is correlated to the pumping rates by vessel type at RLW. The pumping rates at each terminal are unique to the piping and tank configuration, geography and operational constraints of each terminal.

**Table 2-1: RLW Vessel Type, Activities and Associated Loads Represented as % of Pumping Load.**

| Vessel Type | Pump Type | Percent of Calls | Average Hotel Time (hrs) | % of Hotel Time | | | % of Auxiliary Load during pumping | | | % of Boiler Load during pumping | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Loading | Discharge | Idle | Loading | Discharge | Idle | Loading | Discharge | Idle | |
| SeaWayMax | Diesel | 54% | 42.70 | 43% | 37% | 20% | 70% | 100% | 55% | 100% | 100% | 100% | |
| | Steam | 2% | 54.96 | 64% | 0% | 36% | 100% | 100% | 80% | 100% | 100% | 100% | Steam pumpers at RLW only load |
| PanaMax | Diesel | 3% | 69.47 | 0% | 75% | 25% | 55% | 100% | 36% | 100% | 100% | 100% | |
| | Steam | 4% | 58.98 | 9% | 59% | 32% | 100% | 100% | 64% | 45% | 100% | 45% | |
| AfraMax | Steam | 7% | 57.37 | 31% | 38% | 31% | 100% | 100% | 63% | 33% | 100% | 33% | |
| SuezMax | Steam | 30% | 28.09 | 0% | 63% | 37% | 100% | 100% | 69% | 45% | 100% | 37% | |
| Averages | | 100% | 40.90 | 27% | 46% | 27% | 82% | 100% | 60% | 77% | 100% | 74% | |

**Table 2-2: Emission Inventory Comparison for RLW – Chevron vs. CARB values.**

| Vessel Type | Engine Type | Energy Used (kWh) | | NOx (tpy) | | PM10 (tpy) | | PM2.5 (tpy) | | DPM (tpy) | | SOx (tpy) | | CO2eq (tpy) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Chevron | ARB | Chevron | ARB | Chevron | ARB | Chevron | ARB | Chevron | ARB | Chevron | ARB | Chevron | ARB |
| SeaWayMax | Auxiliary | 7,088,183 | 10,003,056 | 98.84 | 138.07 | 2.03 | 2.01 | 1.88 | 1.85 | 2.03 | 2.01 | 3.91 | 4.68 | 5,429.0 | 7,451.4 |
| | Boiler | 1,360,426 | 32,994,774 | 2.98 | 72.56 | 0.21 | 5.96 | 0.19 | 5.49 | - | - | 0.90 | 21.33 | 1,409.5 | 33,978.7 |
| PanaMax | Auxiliary | 1,144,086 | 1,175,238 | 15.39 | 15.81 | 0.33 | 0.24 | 0.30 | 0.22 | 0.33 | 0.71 | 0.63 | 0.55 | 876.3 | 875.5 |
| | Boiler | 1,084,622 | 6,147,537 | 2.33 | 13.52 | 0.16 | 1.11 | 0.15 | 1.02 | - | - | 0.70 | 3.97 | 1,098.5 | 6,330.9 |
| AfraMax | Auxiliary | 956,242 | 1,046,180 | 12.36 | 13.69 | 0.27 | 0.21 | 0.25 | 0.19 | 0.27 | 0.21 | 0.53 | 0.49 | 732.4 | 779.3 |
| | Boiler | 951,820 | 7,268,350 | 1.84 | 15.98 | 0.13 | 1.31 | 0.12 | 1.21 | - | - | 0.55 | 4.70 | 867.5 | 7,485.1 |
| SuezMax | Auxiliary | 1,411,786 | 5,702,957 | 19.53 | 69.76 | 0.40 | 1.15 | 0.37 | 1.05 | 0.40 | 1.15 | 0.78 | 2.67 | 1,080.4 | 4,248.1 |
| | Boiler | 6,909,414 | 13,281,139 | 11.42 | 29.21 | 0.80 | 2.40 | 0.74 | 2.21 | - | - | 3.43 | 8.59 | 5,394.6 | 13,677.2 |

Chevron will transmit the underlying data and calculations to CARB as confidential business information, however, the main drivers for the differences are likely due to the following:

a. Chevron's estimate is based upon (discharge pumping rate) x (discharge time plus hoteling load) x (hoteling time plus ballasting load) x (ballasting time) because vessels are not continuously pumping, sometimes they are simply idle, and some vessels load via gravity feed from shore tankage for a longer duration than they pump while at berth.
b. ARB uses same boiler and auxiliary loads for steam and diesel pumpers which were most likely measured (or determined through interviews) on steam pumpers at berth in Starcrest's Vessel Boarding Program while pumping. Almost all SeawayMax vessels and a large portion of PanaMax vessels that stop at RLW are diesel pumpers.
c. The ratio of crude versus product carriers is incorrect for SeawayMax and PanaMax vessel types.
d. Boiler emissions are lower because the vessels are not pumping the entire time at berth.
e. SuezMax auxiliary engine emissions are lower because of Chevron-owned lightering vessels, which use the boilers and turbogenerators to deliver electricity and account for 70% of refinery crude feedstock deliveries. No DPM is emitted and NOx emissions are lower than Tier III diesel auxiliaries.
f. For all crude carriers, 25% of boiler exhaust is pumped into cargo tanks as inert gas and not released at berth during discharge. When these vessels lighter with the VLCC in Southern California, they vapor balance with the VLCC ship. The inert gas in the SuezMax vessel is pumped into the VLCC as inert gas.

### Vessel Activity Databases

San Francisco Marine Exchange is a suitable database and would use assumptions/processes consistent with those employed in South Coast area, but it needs supplemental data from Chevron to estimate at berth activities. Chevron will transmit its operational summary tables as confidential information for at berth activity as an output from our proprietary database.

### 3.1. Base Year Vessel Visits and Time At Berth

The inventory updates for vessel visits and time at berth are based on:

- 2016 IHS-Markit Vessel Registry data for vessels that visited California
- 2016 IHS-Markit at berth times for California
- 2016 South Coast Marine Exchange Arrival and Departure Data

The IHS-Markit data is used for the majority of California territorial waters, and the South Coast Marine Exchange is used specifically for the Ports of LA/LB.

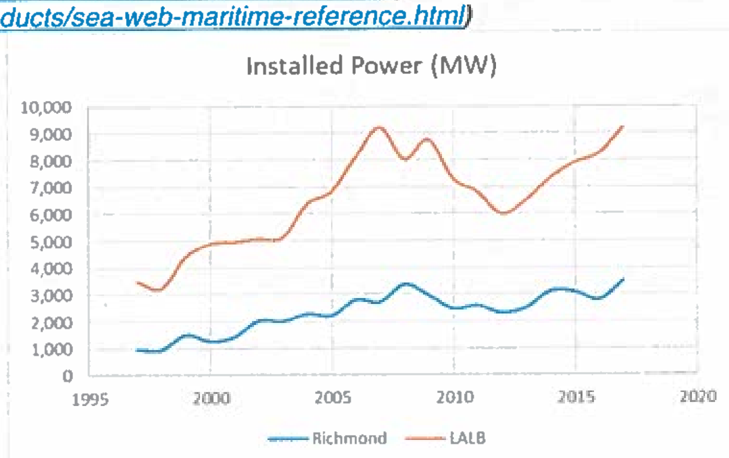
## 3. Comparison of POLA/POLB to RLW

As discussed on January 24, 2019 with CARB, there are significant differences between the vessels calling at POLA/POLB and those calling at RLW. Because of the significant differences in vessel particulars and operations, the data from POLA/POLB cannot be used to accurately represent operations or emissions at RLW and other Northern California marine terminals.

*a. Installed Power*

The installed power (determined from the U.S. Army Corps of Engineers Foreign Vessel Entrances and Clearances data as calls time propulsion power in MW) for vessels calling at POLA/POLB is nearly a factor of 3 greater than RLW.

**Figure 3-1: Installed power comparison between vessels calling at RLW and POLA/POLB 1997-2017**
*(Source: U.S. Army Corps of Engineers Entrances and Clearances data from 1997 to 2017 (https://publibrary.planusace.us/#/series/vessel%entrances) and IHS Sea-Web data on ship characteristics (https://ihsmarkit.com/products/sea-web-maritime-reference.html)*




*b. The Vessel Distribution at POLA/POLB is Significantly Different than RLW*

**Table 3-1: Summary comparison of POLA/POLB to RLW vessel characteristics and calls**
*[Source: 2014 LA/LB Marine Exchange Data vs. 2016 RLW San Francisco Marine Exchange – previously purchased data sets]*

| | Calls | | Percent Steam | | Ave Hotel (hrs) | |
|---|---|---|---|---|---|---|
| Ship Type | LALB | RLW | LALB | RLW | LALB | RLW |
| SeaWayMax | 205 | 212 | 9% | 3% | 39.7 | 43.0 |
| PanaMax | 221 | 27 | 77% | 63% | 51.4 | 62.9 |
| AfraMax | 96 | 25 | 100% | 100% | 62.2 | 57.4 |
| SuezMax | 83 | 114 | 100% | 100% | 82.1 | 28.1 |
| VLCC | 47 | 0 | 100% | | 71.5 | |
| ULCC | 12 | 0 | 100% | | 95.6 | |

The key points to recognize are:

1. Suezmax spend 3 times longer at POLA/POLB than they do at RLW.
2. RLW receives nearly 90% fewer Panamax vessels than POLA/POLB, and nearly 75% fewer Aframax.
3. The percent of vessels with steam auxiliaries is different at POLA/POLB for both SeaWayMax and Panamax.
4. Unlike POLA/POLB, RLW and other Bay Area marine terminals, are not physically configured to accept VLCCs and ULCCs.

## 4. Freight Analysis Framework (FAF) Forecast for Future Vessel Traffic Growth is Unrealistic

As mentioned during the January 24, 2019 in person meeting, Chevron stated that a 46.5% growth rate by 2050 is not feasible and does not reflect the mass balance and operational constraints that exist for Richmond Refinery.

Any small growth in marine traffic is likely to be in way of product leaving the facility which does not require vessels to pump, so additional at berth emissions would be limited to hotel and ballast water treatment loads, significantly less than pumping loads.

**Table 4-1: Richmond Forecasted Vessel Growth Rates per CARB Emission Inventory (from FAF, 2017), Emission Inventory Appendix C**

Richmond

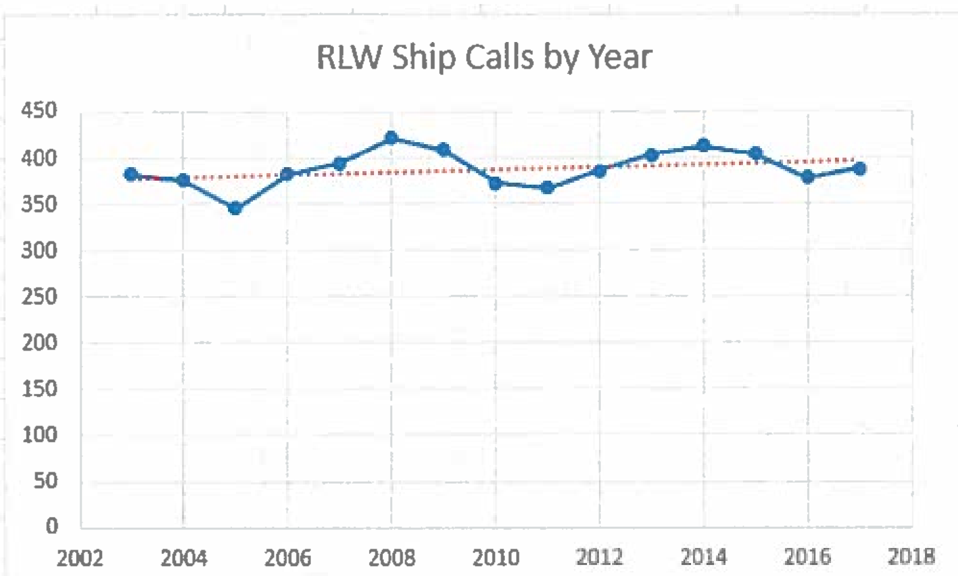
| Vessel Type | Vessel Size | 2016 | 2017 | 2018 | 2019 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auto | | 1.000 | 1.033 | 1.067 | 1.103 | 1.139 | 1.289 | 1.458 | 1.663 | 1.929 | 2.192 | 2.491 |
| Bulk | | 1.000 | 1.010 | 1.021 | 1.031 | 1.042 | 1.164 | 1.282 | 1.422 | 1.618 | 1.807 | 2.018 |
| Tanker | Seawaymax | 1.000 | 0.993 | 0.987 | 0.980 | 0.973 | 1.006 | 1.077 | 1.162 | 1.258 | 1.357 | 1.465 |
| Tanker | Panamax | 1.000 | 0.993 | 0.987 | 0.980 | 0.973 | 1.006 | 1.077 | 1.162 | 1.258 | 1.357 | 1.465 |
| Tanker | Aframax | 1.000 | 0.993 | 0.987 | 0.980 | 0.973 | 1.006 | 1.077 | 1.162 | 1.258 | 1.357 | 1.465 |
| Tanker | Suezmax | 1.000 | 0.993 | 0.987 | 0.980 | 0.973 | 1.006 | 1.077 | 1.162 | 1.258 | 1.357 | 1.465 |

Figure 4-1, below, demonstrates that RLW historical 2007-2017 vessel calls did not escalate continuously, but rather are cyclical, and primarily driven by operational and maintenance activities within the refinery itself.

Consequently, CARB should not rely upon the FAF Report as a future forecast for vessel activity for RLW and the Richmond Refinery. Based on our past 10 years operation, we would not expect greater than 1% growth over a 10-year period. Forecasting it to 2040, that would equate to a vessel growth rate of 1.03 (3% relative to 2016).

Chevron will transmit the underlying historical vessel call data to CARB as confidential information.

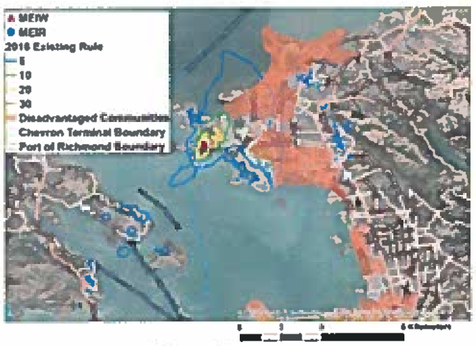
**Figure 4-1: Richmond Actual Vessel Calls By Year, 2007-2017**



## 5. Health Risk Assessment Comments

Although the HRA methodology appears sound, the underlying emissions data inputs are incorrect. This results in incorrect estimates of health risks.

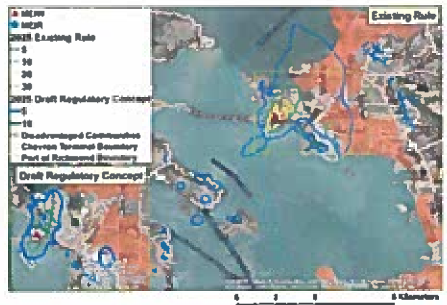
**Figure 16. 2018 Impacts from Vessels At Berth for Existing Rule – Richmond Complex Potential Cancer Risk Isopleths (chances per million)[1]**




1 Assumes exposure duration of 70 years. FAH equals 1

Figure 17 shows the risk isopleth for both the existing rule and Concept in 2025. The isopleth for the existing rule would continue to expand if the Concept was not implemented. Under the existing rule, the highest risk isopleth is 30 chances per million. With the Concept, the isopleth becomes smaller and the 20 chances per million isopleth and 30 chances per million isopleths would be eliminated. This is due to the emissions control requirement for vessel types that visit the Richmond Complex beginning in 2025.

**Figure 17. 2025 Impacts from Vessels At Berth for Existing Rule and Concept – Richmond Complex Potential Cancer Risk Isopleths (chances per million)[1]**




1. Assumes exposure duration of 70 years. FAH equals 1.

**Figure 18. 2031 Impacts from Vessels At Berth for Existing Rule and Concept – Richmond Complex Potential Cancer Risk Isopleths (chances per million)[1]**


1 Assumes exposure duration of 70 years. FAH equals 1

### *a. Misrepresentation of Residential Cancer Risk Isopleths*

Health Risk Assessment Figures 16 through 18 illustrate the locations of the MEIR (based on a 30-Year exposure duration) and the MEIW (based on a 25-year exposure duration). The isopleth illustrating the extent of the cancer risks are based only on a 70-year exposure duration. This mixed presentation can be misleading to the general public. Using the 70-year exposure duration assumes that all populations would be living in this same location for 70 years. Although the Risk Management Plan Guidance (CAPCOA, 2015) states that for the population-based cancer risk calculations one should use a 70-year exposure duration, it also states that "studies show that a 30-year exposure duration is a reasonable estimate of the 90th and 95th percentile of residency duration in the population." A 30-year exposure duration isopleth figure should also be included to represent a more realistic spatial estimate of cancer risk. It is also recommended that separate isopleth figures be added to represent a 9-year exposure period and a 25-year worker exposure duration.

### *b. Display the Chevron Industrial Facility Property Boundary*

The Chevron property boundary is not delineated on Figures 16 through 18. The Chevron RLW only serves activities for use explicitly by the Richmond Refinery. Chevron recommends that the refinery property boundary be illustrated on these figures along with the RLW boundary as the RLW is part of the facility itself, which is an industrial facility and does not contain residential receptors. As such, risks should not be calculated within property boundaries of the facility sources.

Chevron appreciates this opportunity to provide comments relating to the CARB At Berth and At Anchor Regulation draft emission inventory and health risk assessment methodologies and results. Separately, we will transmit supporting data as Confidential Business Information.

Sincerely,

Henry Perea, Manager
CA/OR/WA Government Affairs
Chevron Corporation

cc:

Chris Brown, Chevron Shipping
Brian Hubinger, Chevron PGPA

# Technical Appendix

*(Supporting data to be transmitted separately as Confidential Business Information)*

## References:

CAPCOA, 2015. Risk Management Guidance for Stationary Sources of Air Toxics.

OEHHA, 2015. Risk Assessment Guidelines Guidance Manual for Preparation of Health Risk Assessments. Air Toxics Hot Spot Program.

Starcrest, 2014. 2014 Port of LA/LB Vessel Boarding Program – Auxiliary and Boiler engine power

Starcrest, 2017. POLA/POLB Bay Wide Ocean-Going Vessel International Maritime Organization Tier Forecast 2015-2050. San Pedro Bay Ports Clean Air Action Plan.