

MEMORANDUM

Date: June 10, 2024

To: Paul Philley, Sacramento Metropolitan Air Quality Management District

From: Luke Habib, Rajashi Parikh, Anthony Gerigk, and John Grant

Subject: Harbor Craft, Dredge and Barge Emission Factor Calculator, version 2.0 Updates

This memorandum describes the updates that Ramboll made to the Harbor Craft, Dredge and Barge Emission Factor Calculator (Harbor Craft Tool). Ramboll developed the Harbor Craft Tool (version 1.0)¹ and associated documentation² in 2017. Updates for the Harbor Craft Tool (version 2.0), described herein, bring the tool into alignment with the latest California Air Resource Board (CARB) harbor craft emission inventory methodology³ and include substantial updates to criteria air pollutant (CAP) emission factors and other input assumptions (e.g., load factor, average annual hours of use). Greenhouse gas (GHG) emission factors were also updated.

HARBOR CRAFT TOOL UPDATES

In 2021, CARB released a revised harbor craft emission inventory³. The main updates from CARB's previous harbor craft emission inventory are to emission inventory activity defaults such as load factor, average rated horsepower, engine profile (e.g., vessel types, engine types, useful life), and emission factors. Similar to the previous version, the new Harbor Craft Tool (version 2.0) does not estimate emission reduction benefits from the implementation of aftertreatment devices. Certain aftertreatment devices (e.g., selective catalytic reduction, diesel particulate filters) are used to comply with CARB's latest Harbor Craft regulations⁴.

Ramboll made the updates listed below to the Harbor Craft Tool (version 1.0)¹ so that it is consistent with CARB's 2021 emission inventory methodology.

1. 'CARB_EFs' tab:

- i. Zero-Hour Emission Factors: CARB's 2021 harbor craft emission inventory model includes updates to emission factors. Zero-hour emission factors in the 2021 CARB model are specified by engine type (i.e., main or auxiliary), horsepower bin, model year, and tier level. In the 2021 CARB model, there is no difference in emission factors between marine category 1 and category 2 engines by tier, nor between marine and off-road certified engines³. Similar to Harbor Craft Tool version 1.0, reactive organic gas (ROG) zero-hour emission factors were assumed

¹ Harborcraft, Dredge, and Barge Emission Factor Calculator, Sacramento Metropolitan Air Quality Management District (SMAMQD), 2017. https://www.airquality.org/LandUseTransportation/Documents/SMAQMD_HC_Calculator_30Jun2017_v1_0.xlsx, Accessed December 2023.

² Harbor Craft, Dredge and Barge Emission Factor Tool, memorandum, Ramboll, 2017. https://www.airquality.org/LandUseTransportation/Documents/SMAQMD%20Tugs%20Calculator%20Doc%20Memo_30Jun2017.pdf, Accessed December 2023.

³ 2021 Commercial Harbor Craft Model, California Air Resources Board, 2021, <https://ww2.arb.ca.gov/our-work/programs/msei/road-categories/road-diesel-models-and-documentation>, Accessed December 2023.

⁴ Final Regulation Order Commercial Harbor Craft Regulation, California Air Resources Board, 2022. <https://ww2.arb.ca.gov/rulemaking/2021/chc2021>

- to be equal to hydrocarbon (HC) zero-hour emission factors. Zero-hour emission factors for particulate matter less than 2.5 microns (PM_{2.5}) were assumed to be 95.6% of the particulate matter less than 10 microns (PM₁₀) emission factors, consistent with the 2021 CARB Inventory³. Formulas within the tool that reference the zero-hour emission factors table were updated accordingly.
- ii. Deterioration Factors: Ramboll updated deterioration factors by vessel type, engine type, and horsepower bin based on the 2021 CARB inventory. Vessels were grouped into nine categories (e.g., barges, ferries, tugboats, etc.) and two engine types (main and auxiliary). ROG deterioration factors were assumed to be equal to HC deterioration factors and the PM_{2.5} deterioration factors were assumed to be 95.6% of the PM₁₀ deterioration factors.
 - iii. Fuel Correction Factors (FCF): The 2021 CARB inventory does not distinguish FCF based on horsepower bin; FCFs are distinguished by model year and calendar year combination. The FCF table and any associated formulas used in the calculator were updated accordingly.

2. 'CARB_Defaults' tab:

- i. Horsepower Category: Updated horsepower bins to be consistent with the 2021 CARB inventory.
- ii. Engine Categories: Updated engine type and vessel type bins consistent with the 2021 CARB inventory.
- iii. Greenhouse Gas Parameters:
 - a) Updated GHG emissions per unit activity (g/gal) based on CARB's Documentation of California's 2000-2020 GHG Inventory 2000-2020⁵
 - b) Updated the global warming potential (GWP) values for each GHG based on the AR6 GWP-100-Year values⁶.
- iv. Vessel Default Parameters: Default parameters such as load factor, useful life, and average annual hours were taken from the 2021 CARB Inventory. Implemented default average annual hours exclude low-use vessels. Average horsepower was taken from the 2021 CARB Inventory documentation. The calculator only uses default values for optional inputs when the user does not specify those inputs.

3. 'Input' tab: Ramboll added functionality to the calculator to estimate daily emissions rates. Users provide project specific "Life-of-Project", or "Monthly Reporting" input data as described below.

⁵ Documentation of California's 2000-2020 GHG Inventory, California Air Resources Board, 2020, <https://ww2.arb.ca.gov/applications/california-ghg-inventory-documentation>. Accessed January 2024.

⁶ Climate Change 2021 The Physical Science Basis, Intergovernmental Panel on Climate Change, 2021, https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf. Accessed February 2024.

- i. A1. Inventory Calendar year and input data type: Added "Input Data Type" field (cells C22: F22) in which the user selects either monthly reporting or life-of-project data.
- ii. A2. Project Information: Added fields in which the user enters project start date and project end date (cell O21 and cell O22, respectively).
- iii. A3. Main Engine Inputs: Added columns in which the user is required to enter if the vessel has a main engine (column E), the number days of main engine use (column G), and main engine hours of operation (column H).
- iv. A4. Auxiliary Engine Inputs: Added columns in which the user is required to enter if the vessel has an auxiliary engine (column P), the number days of auxiliary engine use (column R), and auxiliary engine hours of operation (column S).

4. 'MainEngineEmissRates' tab:

- i. Vessel/Engine Information: Added column K and column L for the number of days of operation and total hours of operation, respectively.
- ii. Main Engine Daily Emission Rates: Added calculation of main engine daily emissions rate (lb/day) in column AG to column AP.

5. 'AuxEngineEmissRates' tab:

- i. Vessel/Engine Information: Added column L and column M for the number of days of operation and total hours of operation, respectively.
- ii. Auxiliary Engine Daily Emission Rates: Added calculation of auxiliary engine daily emissions rate (lb/day) in column AH to column AQ.

6. 'VesselDesc' tab:

- i. Vessel Description: Updated tab to reflect vessel descriptions based on CARB's 2021 report⁷. Added a new column E which includes supplemental summary descriptions of typical auxiliary engine type applications.

7. Other Minor Updates: Ramboll made the following minor updates to the Harbor Craft Tool.

a. 'Input' tab:

- i. Updated drop-down ranges for calendar year, vessel type, and auxiliary engine type columns.
- ii. Added clarifying notes to several field name cells in Table A2 and Table A3.

⁷ CARB's Public Hearing to Consider the Proposed Amendments to the Commercial Harbor Craft Regulation, 2021, <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/chc2021/isor.pdf>. Accessed June 2024.

- b. **'Calculations' tab:** Made minor changes to both the main engine and auxiliary engine emission factor formulas consistent with updates described above for the 'CARB_EFs' tab.
- 8. **'Documentation' tab:** Added a summary of the updates described in this memorandum.
- 9. **Combined Harbor Craft and Construction Mitigation Tool Results Summary:**
 Ramboll added a new '*Summary*' tab to combine summary project specific (i) emission rates from the Harbor Craft Tool (version 2.0) and (ii) emission results from the Construction Mitigation Tool (version 10.0). The '*Summary*' tab is auto populated with project information and emission rates from the Harbor Craft Tool. In order to include information from the Construction Mitigation Tool, the user is instructed to copy specific cells from their Construction Mitigation Tool spreadsheet into the '*Summary*' tab.