Review: 2. Source analysis with annual load estimates

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Based on my expertise and experience, I am reviewing the findings, assumptions, or conclusions I agreed I could review with confidence:

2.a. Are the seven transboundary flows the significant sources of anthropogenic indicator bacteria and trash in the lower Tijuana River?

- Sound scientific knowledge, methods, and practices.

Considering the document analysis, it was possible to verify that the proposed rule of the item under review, taken as a whole, is scientifically consistent but could be better grounded. As mentioned in the Request file, the Draft TMDL staff Report is not a highly technical document. However, considering the reviewer's responsibility to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices, it is suggested to deepen the scientific basis (in terms of theoretical-scientific reference) in sections 4 and 5.

Through the review, few theoretical references were observed to support the draft's assumptions, findings, and conclusions (which, as justified, were primarily based on independently produced technical studies/reports). By introducing a few more citations of academic articles published in leading journals, for example, the draft values and conclusions will have greater scientific robustness.

This better scientific robustness can be verified in some of the supporting documents used in the draft TMDL staff report, such as the Final Programmatic Environmental Impact Statement: USMCA Mitigation of Contaminated Transboundary Flows Project (USEPA and USIBWC, 2022). Some interesting references/assumptions that could be considered for the scientific basis are listed below.

- Ayad, M., Li, J., Holt, B., & Lee, C. (2020). Analysis and classification of stormwater and wastewater runoff from the Tijuana River using remote sensing imagery. Frontiers in Environmental Science, 8, Article 599030. https://doi.org/10.3389/fenvs.2020.599030 →

e.g. Can be cited to support water Quality assumptions, especially in sections 4.1.2 and 4.2.1 (E. Coli and enterococci data analysis).

- Feddersen, F., Boehm, A. B., Giddings, S. N., Wu, X., & Liden, D. (2021). Modeling untreated wastewater evolution and swimmer illness for four wastewater infrastructure scenarios in the San Diego–Tijuana (US/MX) border region. GeoHealth, 5(11), e2021GH000490. https://doi.org/10.1029/2021GH000490 →

e.g. Can be used to reinforce data analysis assumptions (especially considering wastewater Flows- sources data). Feddersen et al. (2021) point out that the flow of untreated wastewater (QD) was not measured in their study and is likely more variable and complex than the

simple assumptions adopted. In addition, TJRE (Tijuana River Estuary) untreated wastewater inputs downstream of the IBWC flow gauge (e.g., Goat and Yogurt Canyons) occasionally occur with rainfall with unknown magnitude and are not included in the article. It is also known that “untreated wastewater contributes to high bacterial concentrations in the Tijuana River and tributaries, creating health risks for recreational users, and introduces other pollutants of concern” (USEPA and USIBWC, 2022).

- Additional subjects that should be considered as part of the scientific basis.

- Climate change

The Intergovernmental Panel on Climate Change (IPCC) projections indicate climate change will impact water resources in California and Mexico, as more intense rainfall and associated flooding in arid regions are predicted. It is known that Semi-arid riverine environments such as the Tijuana River Valley can be defined by high variability in flow characteristics that may be influenced yearly, seasonally, or even daily. Moreover, Tijuana's urbanization and population growth contribute to climate change vulnerability, and due to this, there is a general increase in existing contaminants and waste generation (Beaver & Rountree, 2023; Rodriguez Esteves, 2020; USEPA and USIBWC, 2022).

The draft report does not mention climate change aspects or its significative characteristics that can interfere directly with source analysis scenarios and variability, interfering with the Tijuana River Watershed hydrology in terms of quantitative analysis, as addressed by Das et al. (2010). Such inferences about this additional subject can be incorporated as part of the item 2 discussion (Problem Statement). Figures 2.2, 2.3, and 2.4 support this approach. Another possibility of including this discussion would be in Item 7 (Linkage Analysis), as climate change is a substantial factor that potentially contributes to both indicator bacteria and trash loads. In this sense, it is essential to include a brief theoretical approach to consider this additional subject in the TMDL draft.

  - Das, Tapash, Michael D. Dettinger, and Daniel R. Cayan. (2010). Potential impacts of global climate change on Tijuana River Watershed hydrology-An initial analysis.
  - Beaver, E., & Rountree, V. (2023). Who Has the Power? A Case Study of the Adaptive Watershed Management and the Challenge to Implement Climate Change Action Across Boundaries.
  - Rodriguez Esteves, J.M. (2020). The Socio-hydrological Challenge of the Tijuana River Watershed to Address Climate Change. Región y sociedad 32.

- Covid-19 Pandemic and its effects on water bodies quality

TMDL draft does not mention Covid-19 Pandemic as well. Covid-19 Pandemic has led to several impacts on the world’s environment, especially on water bodies' quality. Population habits have also changed since the pandemic, which could have possibly contributed to increase wastewater discharges and trash flows in the lower Tijuana River during the period. In this sense, it is essential to include a brief theoretical approach to consider this additional subject in the TMDL draft.

- Solid waste management in integrated water environment scales (from river basin to ocean).

- Minor improvement discussions and suggestions for a better scientific basis to be evaluated by the technical staff:

- Page 43- Item 4.1 Data Inventory: Data sources are properly listed and briefly described in section 4.1 and items 4.1.1, 4.1.2, and 4.1.3. However, it would be important to insert a small paragraph justifying the adoption and relevance of the documents listed for data collection.
- Page 45- Item 4.1.3 Trash Data: Most trash data are from studies carried out more than six years ago. In this sense, justifying the adoption and relevance of the documents gathered for trash analysis is even more important to strengthen the draft's scientific used methods.
- Page 58- Item 5.2 Transboundary Discharges: After listing the seven transboundary flows, there are only two photos (without date) showing the Goat Canyon collector and Smuggler's Gulch Canyon situations. Although there are other photos on topic 2.1 (Problem statement) and Figure 4.1 shows the Key sites in the Tijuana River Valley, it would fit to introduce a figure showing the seven transboundary sites' situations. Figures 1-2 (Overview of ITP Canyon Collector System) and 1-3 (Photographs of Canyon Flow Diversion Structures) from the USEPA and USIBWC (2022) document are good examples.
- Page 61- Item 5.2 Transboundary Discharges- Trash flows: In section 5, the references used to approach the trash volumes carried by cross-border sources are also too old to support the issue addressed: (USIBWC, 2008), (URS, 2010), (California-Mexico Border Relations Council, 2017). The recent investments made by the CESPT to increase the number of wastewater connections are mentioned. However, some more recent actions related to this issue, such as the Plastic Ban (Tijuana became the first Mexican city on the border with the United States to implement a plastic bag ban by the City Council in September 2018), are not mentioned. Below are other more recent references that address such issues and can be used for a better scientific theoretical basis:

  - Bennett, M. D., Walther, S. C., & Tirrell, A. (2021). Transboundary Water and paradiplomacy in the San Diego-Tijuana binational region. →

    "Solid waste has long plagued the Tijuana River Valley, and it has become a greater concern as the amount of plastics within the watershed has increased in recent decades. Choking waterways and becoming entangled within vegetation, trash transported into the lower estuary results in serious harm to wildlife. Plastic, which does not swiftly break down following improper disposal, has resulted in large sections of the valuable salt marsh habitat of the Tijuana Estuary being matted with solid waste (TRNERR 2010). This occurs in the main channel of the Tijuana River, but the worst conditions exist at the smaller cross-border urban flows of Goat Canyon and Smuggler's Gulch, particularly following heavy rainfall events." (Bennett et al., 2021).

  - Hoellein, T. J., & Rochman, C. M. (2021). The "plastic cycle": a watershed-scale model of plastic pools and fluxes. Frontiers in Ecology and the Environment, 19(3), 176-183. https://doi.org/10.1002/fee.2294 →

    "Rapid population growth has strained solid waste and wastewater management in the Tijuana region, contributing to rafts of litter that flow across the border and into the ocean." (Hoellein & Rochman, 2021).

- Data analysis and Load calculations: Appropriateness of using values and conclusions.

By checking data analysis and load calculations, it is possible to infer that the proposed rule, taken as a whole, is based on sound scientific knowledge, methods, and practices. Potential sources of indicator bacteria and trash are well described, but it is possible to identify divergences between data presented in section 5 and those in Appendix C, as well as small errors referring to the load calculations in the tables from item 5.2 to item 5.9.

Indicator bacteria and trash loads were estimated based on appropriate values and conclusions. However, the scientific basis of the proposed rule could also be strengthened by a few comparisons with other scientific research findings, especially considering that no quantitative data were available to estimate annual loads for some potential sources. Below are some references that address similar conclusions regarding indicator bacteria sources:

- Allsing, N., Kelley, S. T., Fox, A. N., & Sant, K. E. (2022). Metagenomic Analysis of Microbial Contamination in the US Portion of the Tijuana River Watershed. International Journal of Environmental Research and Public Health, 20(1), 600. doi: 10.3390/ijerph20010600 →

  "In 2019–2020, water samples were collected within 48 h of major rainfall events at five transborder flow sites and at the mouth of the river in the US portion of the Tijuana River and estuary (J River Concrete Channel, Stewart's Drain, Smuggler's Gulch, Boca Rio, Goat Canyon, and Yogurt Canyon sites.)" (Allsing et al., 2022).

  "There was a clear relationship between proximity to the transborder sites (versus estuarine) and fecal contamination, and the genomes of pathogenic species were detected at these fecal contaminated sites. In Tijuana only about 50% of households have sanitation systems that safely dispose of and treat sewage. Furthermore, urban areas in the United States and other countries utilize combined storm and sanitary sewer systems, and wastewater surveillance in these systems should correct for dilution factors when stormwater flows increase." (Allsing et al., 2022).

- Rocha, A. Y., Verbyla, M. E., Sant, K. E., & Mladenov, N. (2022). Detection, quantification, and simplified wastewater surveillance model of SARS-CoV-2 RNA in the tijuana river. ACS Es&t Water, 2(11), 2134-2143. https://doi.org/10.1021/acsestwater.2c00062 →

  According to Rocha et al. (2022): "Transboundary flows represented 12 billion liters of combined waters including treated and untreated sewage, groundwater, runoff, and stormwater that discharge into the Tijuana River. Sewage runoff also drains into the Tijuana River from two canyon collectors, Stewart's Drain and Canyon del Sol, located upstream of the sample sites. The high sewage load in the Tijuana River is evidenced by the high concentrations of fecal indicator bacteria (FIB), total coliforms, E. coli, and enterococci as well as pathogenic bacteria and viruses".

Tables in Section 5 and Appendix C, containing annual indicator bacteria and trash loadings from the sources, are not numbered/titled, which makes the document visualization somewhat difficult for review purposes. Some review considerations about the load calculations and data that are presented in the TMDL draft are listed below.

- Page 50- Item 4.2.1: The method used (Ott, 1995) is scientifically sound. The draft justifies its use and mentions similar methods that were applied in the development of other TMDLs.
- Pages 61 and 62- Item 5.2 Transboundary Discharges: The Table presenting annual indicator bacteria and trash loadings from the transboundary flows has some inconsistencies. The first concerns the value of trash loading at Silva Drain, which is estimated as 124 tons/year according to Appendix C (C-5 page 175) but appears as 121 tons/year in the table in section 5 (third line, last column). The trash total value in the table (last line and column) and the Excel Load Estimates Spreadsheet confirms that the correct sum is referring to the annual load of 124 tons/year for Silva Drain (3764 tons/year of Total Transboundary Discharges).
- Page 63- Item 5.3 Discharges from HSA 911.12: The Table shows total trash loadings of 55 tons/year for Discharges from HSA 911.12. However, in Appendix C (Page 179; C-9), the trash loading of this source is estimated as up to 82 tons/year. The correct calculated number according to the Excel Load Estimates Spreadsheet is 55 tons/year (as it is stated in Item 5.3).
- Page 65- Item 5.5 Discharges from NOLF-IB Outfalls to the Lower Tijuana River: The table presents E. Coli N/A [only enterococci WQOs apply to saline receiving waters (not E. Coli WQOs)]. According to Appendix C (Page 182; C-12) and the Excel Load Estimates Spreadsheet, however, E. Coli loading from the NOLF-IB outfalls is estimated as 1.16×10^{13} MPN/year.
- Page 68- Item 5.9 Source Assessment Summary: Some values in the Table need to be corrected. I) E.Coli Total is 1.06×10^{17} MPN/year (1.03×10^{17} MPN/year from transboundary flows plus 2.81×10^{15} MPN/year from Sources Generated in the U.S.) The Table in section 5.9 presents 1.03×10^{17} MPN/year. II) The value for total trash from Sources Generated in the U.S. presented in the Table is 133 Tons/year. But the correct sum of the trash loading values of these sources should be 132 tons/year, following the integer numbers presented, being: 55 tons/year from HSA 911.12; plus 68 tons/year from Phase I MS4 Outfalls; plus 3 tons/year from HSA 911.11; plus 6 tones/year from Open Space/Public Lands. The Excel Load Estimates Spreadsheet presents the values in decimal numbers, and the correct sum is 133 tons/year. Therefore, it's suggested to verify the possibility of presenting the numbers in the 5.9 Table considering at least two decimal places.

Descriptions of how indicator bacteria and trash loads were estimated for each of the potential sources are well presented in Appendix C. Specifically regarding transboundary discharges (Section 2- Items 2.1 → 2.7; Pages C1 → C9), loadings estimations for E-coli and Enterococci explains satisfactorily the dry weather and wet weather portions of the values for each correspond cross-border source, as well as the transboundary trash estimations. Although the descriptive text of the calculation methods is somewhat repetitive for the reader, it contributes to restating a consistency in the findings and methods adopted.

As for the conclusions regarding the values obtained, it would be interesting to present a final ranking of the seven cross-border nonpoint sources (transboundary flows). The sources could be presented in descending criticality order of pollution potential (for indicator bacteria and trash). For anthropogenic bacteria indicators, for example, the Sources: 1. Tijuana River Flood Control Channel, 2. Goat Canyon, and 3. Smuggler's Gulch are the three most significant. As for trash loads, the three cited sources are also the most representative, but following order: 1. Smuggler's Gulch, 2. Tijuana River Flood Control Channel and 3. Goat Canyon.

In conclusion, from the data analyzed, it can be affirmed that the seven transboundary flows (1. Tijuana River Flood Control Channel; 2. Smuggler's Gulch; 3. Goat Canyon; 4. Stewart's Drain; 5. Silva Drain; 6. Yogurt Canyon, and 7. Canyon del Sol) are the significant sources of anthropogenic indicator bacteria and trash in the lower Tijuana River.

❖ Additional- Formatting notes

Although this review is not directed at aspects documental formatting aspects, throughout the analysis it was possible to identify errors in the draft that can compromise the understanding and soundness of the proposal or that are in disagreement with formatting conventions. Some examples are listed below.

- Page 39- Topic United States-Mexico-Canada Agreement Comprehensive Infrastructure Solution: In the last line of the first paragraph, it is stated that the "Design and construction of the approved projects is anticipated to begin in 2023". Would the correct year be 2024?
- Page 50- Topic Data Analysis of Key Sites (Lower Tijuana River and Transboundary Flows): It is stated that “Indicator bacteria concentrations impair the lower Tijuana River’s recreational beneficial uses. Available sources of data as described in section 4.1.1 for E. Coli and enterococci...". Nevertheless, the available data sources for E. Coli and enterococci are described in section 4.1.2, not in section 4.1.1.
- Page 53- Item 4.2.2 Trash: On page last line: "The information in Tables 4.3 and 4.4 demonstrates the positive impact of local volunteers and their level of commitment to protecting the river valley, estuary, and downstream coastal waters.". The correct Tables number are 4.4 and 4.5. The same error when referring to the Tables numeration can be seen on page 54 ("The removal estimates in Table 4.3"→ Correct to Table 4.4), and page 55 ("The removals performed by these agencies far exceed the volunteer clean-up values in Tables 4.3 and 4.4" → Again, should be corrected to Tables 4.4 and 4.5).
- Page 63- Item 5.3 Discharges from HSA 911.12: Before the Table: "Maximum annual indicator bacteria and trash loadings from the transboundary flows are estimated below.". Instead of "transboundary flows", it should be written HSA 911.12.
- Page 101- Item References: The reference "Souza-Neto, J.A., Powell, J.R., and Bonizzoni, M. 2018. Aedes aegypti vector competence studies: A review. November 19, 2018. https://pubmed.ncbi.nlm.nih.gov/30465912/" is placed out of alphabetic order.
- Page 173- Item C-3 Appendix C- 2.2 Stewart’s Drain: "MPN/year" is written twice for Enterococci loading estimates ("9.91 x 1015 MPN/year MPN/year"). The same mistake appears on C-4 and C-5 after Enterococci loading numbers.

- ➢ Page numbering adopted in this review document refers to that available in the pdf reader since the pages of the Revised Draft Staff Report are not numbered and do not correspond to the numbering available in the Table of Contents.
- ➢ It would also be important to put numbers and titles in all the Tables in Section 5 and Appendix C.