



Tijuana River Valley Needs and Opportunities Assessment – Trash Technical Memorandum

San Diego, California

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1 Introduction

1.1 Background

The Tijuana River Valley has a long history of water quality issues related to transboundary flows originating in Mexico. These issues include sewage, industrial waste, trash, and sediment transported across the border during both dry- and wet-weather conditions. Regulations and policies on both sides of the border have been enacted resulting in some water quality improvements. However, wet-weather flows, or stormwater, continue to convey significant quantities of sediment, trash, and other contaminants into the Tijuana River Valley from sources in both the United States (U.S.) and Mexico. The transport of sewage, sediment, and trash causes water quality impairments, threatens life and property from flooding, degrades valuable riparian and estuarine habitats, and affects recreational opportunities for residents, workers, and visitors in the area.

The Tijuana River Watershed is a large, binational watershed in southern California and northern Baja California, Mexico. Three quarters of the watershed lies in Mexico and includes the cities of Tijuana and Tecate. On the U.S. side, the watershed extends into the County of San Diego and the City of San Diego. The Tijuana River, the primary river in the watershed, flows from Mexico into the U.S. and discharges to the Pacific Ocean through the Tijuana River Estuary.

The flow of the river, at any given time, may consist of stormwater, effluent discharged from wastewater treatment plants in Mexico, sewage spills, industrial/agricultural discharges, groundwater, and other unidentified sources from Mexico. The river and estuary, combined, are listed as having 37 impairments on the Clean Water Act 303(d) list of impaired waters. River flows laden with sewage, trash, and contaminants reaching the Pacific Ocean in the U.S. pose health and safety risks and environmental concerns.

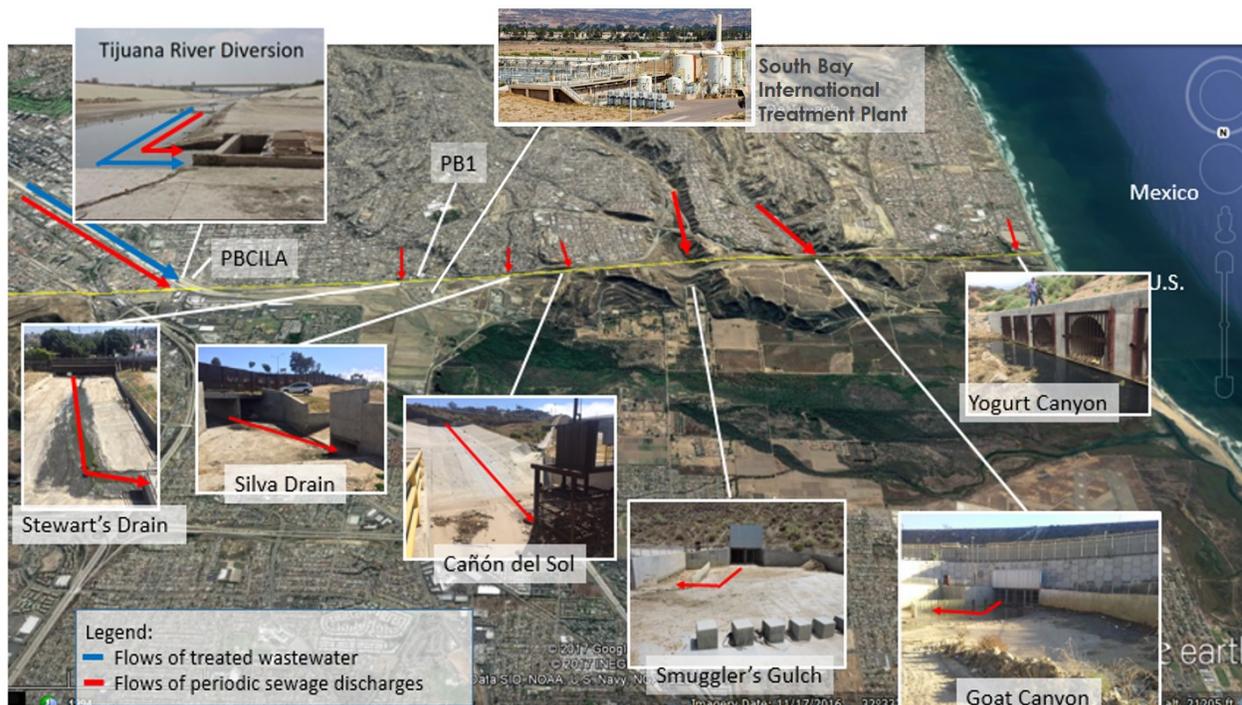
There is an agreement between the U.S. and Mexico to divert water from the Tijuana River in Mexico prior to crossing the border to the U.S. The U.S. and Mexico sections of the International Boundary and Water Commission (IBWC) are responsible for mitigating sewage problems and their associated water quality issues in the Tijuana River Watershed. IBWC's efforts have led to the construction and operation of infrastructure on both sides of the border to capture, treat, and discharge the transboundary flows from Mexico. The infrastructure includes the following, as shown on Figure 1:

- The River Diversion Structure and Pump Station CILA (PBCILA) divert flows from the Tijuana River at a point just south of the international border to a Pacific Ocean shoreline discharge point approximately 5.6 miles south of the U.S.-Mexico border.
- A combination of pump stations and wastewater treatment plants in Mexico diverts and treats sewage discharges.
- Concrete channels and basins form canyon collector systems designed to capture transboundary flows from Mexico in canyons and ravines draining north across the border to the Tijuana River. The five canyon collector systems are the Smuggler's Gulch Diversion Structure, Goat Canyon Diversion Structure, Cañon del Sol Collector, Stewart's Drain Canyon Collector, and Silva Drain Canyon Collector.

- The South Bay International Wastewater Treatment Plant treats sewage and flows collected by the canyon collectors.

PBCILA is designed to handle dry-weather river flows up to 23 million gallons per day (mgd). Flows in excess of 23 mgd enter the river channel and cross into the U.S. PBCILA shuts down during storm events where flows exceed this level and during system malfunctions. Without the diversion system, water flows untreated through the main river channel and Tijuana River Estuary and could potentially discharge into the Pacific Ocean. Flows in the Tijuana River can reach over a billion gallons per day during storm events. After a storm event, it can take several months for the river channel flow to fall below 23 mgd and for existing infrastructure to restart.

Figure 1. Dry-weather Flow Infrastructure in the Tijuana River



In 2012, the Tijuana River Valley Recovery Team set forth a Recovery Strategy that identified actions to clean up and restore the River Valley's beneficial uses. The Recovery Strategy focused on actions to address water quality issues, sediment, and trash that currently degrade the river's beneficial uses, exacerbate flooding, affect habitat, and affect recreation. As part of this program, the need for an additional study that objectively and comprehensively identifies possible solutions on the U.S. side of the border to address transboundary sewage flows (point and nonpoint sources), trash, and sediment in four priority watersheds: Tijuana River, Smuggler's Gulch (Cañón de los Mataderos), Goat Canyon (Cañón de los Laureles), and Yogurt Canyon (Cañón Los Sauces). The Tijuana River Valley Needs and Opportunities Assessment (NOA) is intended to identify the critical issues within each of the four priority watersheds and to identify projects that could be implemented to address the impacts of transboundary flows on the Tijuana River Valley.

1.2 Purpose

Trash can cause water quality impairments, degrade habitats, affect aesthetics, and potentially cause flooding when clogging results from an accumulation of trash at a screen or fence. As stormwater flows cross the border from Mexico to the U.S., trash and debris are deposited along channels and in vegetation with some trash or debris making it to the estuary and ultimately the ocean. The deposited trash and debris are a nuisance, creating a vector breeding environment and impacting the aesthetics in the valley. This technical memorandum (TM) identifies projects that are viable and feasible to be implemented on the U.S. side of the border to improve trash capture in the River Valley during both dry- and wet-weather flows. The final goal is to reduce health and safety impacts and improve the aesthetics of the area through trash removal.

Section 2 of this TM identifies existing projects and studies designed to address the trash issues in each priority watershed. Section 3 identifies the remaining unaddressed priority issues related to trash in each priority watershed. Section 4 identifies potential projects to address the issues in each priority watershed. A planning-level cost estimate is provided for project implementation and for ongoing costs. Section 5 discusses emergency measures to address transboundary trash flows until permanent infrastructure—and other projects, policies, and procedures—can be implemented. Finally, Section 6 summarizes the potential projects to be considered for additional study that may be helpful in minimizing trash-related concerns in the Tijuana River Valley.

2 Review of Existing Projects and Information

The information gathered during Step 1 of this assessment was reviewed to identify specific project-related information that would help in developing potential projects and alternatives. The following sections describe the information and projects that were reviewed and considered as appropriate.

2.1 Tijuana River

The following documents include key information regarding trash and trash-related concerns in the Tijuana River, including upcoming potential projects and a visual assessment of trash present in the area. Currently, no trash capture devices are located in the Tijuana River. *60% Report Feasibility Study for Sediment Basins – Tijuana River International Border to Dairy Mart Road* (Stantec 2019)

- The feasibility study establishes the preferred location and size of a sediment basin in the main channel of the Tijuana River. The sediment basin will be designed to also capture trash, debris, and transboundary flows. The sediment, trash, debris, and flow management strategies are intended to improve water quality and reduce adverse health risks to people and the environment. This study will develop three alternative concepts for the basins, recommend a preferred alternative, and present a conceptual design for the preferred alternative.
- *TRV Stakeholder Solution to Sediment, Waste, Sewage and Chemicals* (Surfrider Foundation 2019)

- The memorandum presents the San Diego chapter of the Surfrider Foundation’s proposal for an all-encompassing plan aimed at addressing the range of pollution concerns within the Tijuana River Valley. This includes a conceptual design that will improve the infrastructure at the South Bay International Wastewater Treatment Plant. It also incorporates other infrastructure-related suggestions and broader policy objectives to improve conditions in the Tijuana River Valley.
- *Report of Trash, Waste Tire and Sediment Characterization – Tijuana River Valley, San Diego, California* (URS 2010)
 - The report summarizes the nature, extent, and characteristics of trash and sediment particles present in the lower Tijuana River Valley. It also considers impacts to Smuggler’s Gulch.
- U.S. Army Corps of Engineers (USACE) *Basis for Design Memorandum – Tijuana River Project, San Diego, California* (1977)
- U.S. Army Corps of Engineers (USACE) *Phase I Hydrology, Floodplain and Sediment Transport Report Final – Tijuana River United States-Mexico International Border to the Pacific Ocean San Diego, California* (2018)

2.2 Smuggler’s Gulch

The following documents provide key information regarding trash in Smuggler’s Gulch, including dredging totals, sediment load expectations, disposal costs of sediment and trash, and trash observed in Mexico that may cross the border.

- *Smuggler’s Gulch Dredging Historical Totals* (County correspondence, 2019)
 - The spreadsheet includes estimated historical records (sediment quantities, costs, etc.) for dredging in Smuggler’s Gulch.
- *Assessment and Implementation Advisory Report on Trash and Sediment Source Control in Mexico* (Alter Terra 2014)
 - The report is meant to assist in restoration and conservation initiatives throughout the watershed and to support stakeholders, policy makers, and potential funders in building collaborative partnerships that will lead to the recovery of the Tijuana River Valley to a healthy wetland ecosystem. Alter Terra is working to address trash and sediment issues in the Tijuana River Valley that originate upstream in uncontrolled informal dump sites and unplanned urban developments.
- *Excavation and Post-Storm Observations in Tijuana River Valley* (City of San Diego 2011)
 - An evaluation that documents the nature and quantity of trash and sediment that accumulated in Smuggler’s Gulch and the Pilot Channel.
- *Nelson Sloan Management and Operations Plan and Cost Analysis* (AECOM 2016) (also contains information on Goat Canyon)
 - The plan describes the management and operation of filling activities to meet the requirements of a reclamation plan to restore the Nelson Sloan Quarry.

Trash booms were installed in Smuggler’s Gulch in 2019 as a step towards resolving the trash concerns in the area. Figure 2 shows those installed booms. Trash booms are typically efficient at capturing a large portion of the trash, but do not prevent all trash from passing by the structure. Trash is collected and disposed of as part of the sediment removal operations. The trash booms at Smuggler’s Gulch are currently being maintained by Alter Terra. Trash screens are located at the Smuggler’s Gulch outlet (Figure 3) that capture some trash when closed.

Figure 2. Trash Booms at Smuggler’s Gulch



Figure 3. Screens at Outlet



2.3 Goat Canyon

The following documents include key information regarding Goat Canyon trash, including sediment load expectations, disposal costs of sediment and trash, and trash observed in Mexico that may cross the border.

- *Los Laureles Canyon Transborder Trash Tracking Study* (Alpha Forma, LLC 2012)
 - A study that documents the dumpsites and trash classification in Goat Canyon. It includes information about the tracking of the movement of trash.
- *Nelson Sloan Management and Operations Plan and Cost Analysis* (AECOM 2016) (also contains information on Smuggler’s Gulch)
 - The plan describes the management and operation of filling activities to meet the requirements of a reclamation plan to restore the Nelson Sloan Quarry.

Goat Canyon currently has trash booms installed to help capture trash flowing into the area (Figure 4). The trash booms capture floating trash but are unable to capture trash flowing below the surface. Nets were previously installed to capture the subsurface trash and debris. As shown in Figure 4 below, trash booms are generally efficient at capturing a large portion of the trash, but do not prevent all trash from passing by the structure. Trash is collected and disposed of as part of the sediment removal operations. As with Smuggler’s Gulch, screens at the Goat Canyon outlet (Figure 5) capture some trash when closed.

Figure 4. Goat Canyon Trash Boom



Figure 5. Screens at Goat Canyon Outlet



2.4 Yogurt Canyon

The following document includes key information regarding trash in Yogurt Canyon, including an assessment of trash present in the area. Currently, no trash capture devices are located in Yogurt Canyon.

- *Detection, Mapping and Communication of Solid Waste Pollution Sources in the Tijuana River Valley* (Alpha Forma, LLC 2014)
 - The report documents studies of the dumpsites and trash classification of the trash found in Smuggler's Gulch and Yogurt Canyon.

3 Priority Issues

Trash, tires, and various types of solid waste is transported across the border in the Tijuana River Valley from Mexico to the U.S. during both dry- and wet-weather flows. Alter Terra and Alpha Forma, LLC, have been researching environmental challenges at the U.S.-Mexico border for more than a decade. Their research and field work have been the primary source of information regarding transboundary trash flow. As reported by Alpha Forma, LLC, in its paper *Los Laureles Canyon Transborder Trash Tracking Study* (2012), uncontrolled dumping is occurring on the Mexico side of the border, and waste disposal systems are inadequate to handle the volume of trash.

According to Alter Terra's *Assessment and Implementation Advisory Report on Trash and Sediment Source Control in Mexico* (2014), "trash and sediment issues in the Valley are a product of non-point source pollution originating upstream in uncontrolled informal dump sites and unplanned urban developments that drain trash and sediment into the Valley through the binational Tijuana River System." These trash flows can degrade the environment and threaten public health. For planning purposes, the classification (type of trash) and volume of trash were evaluated for this TM.

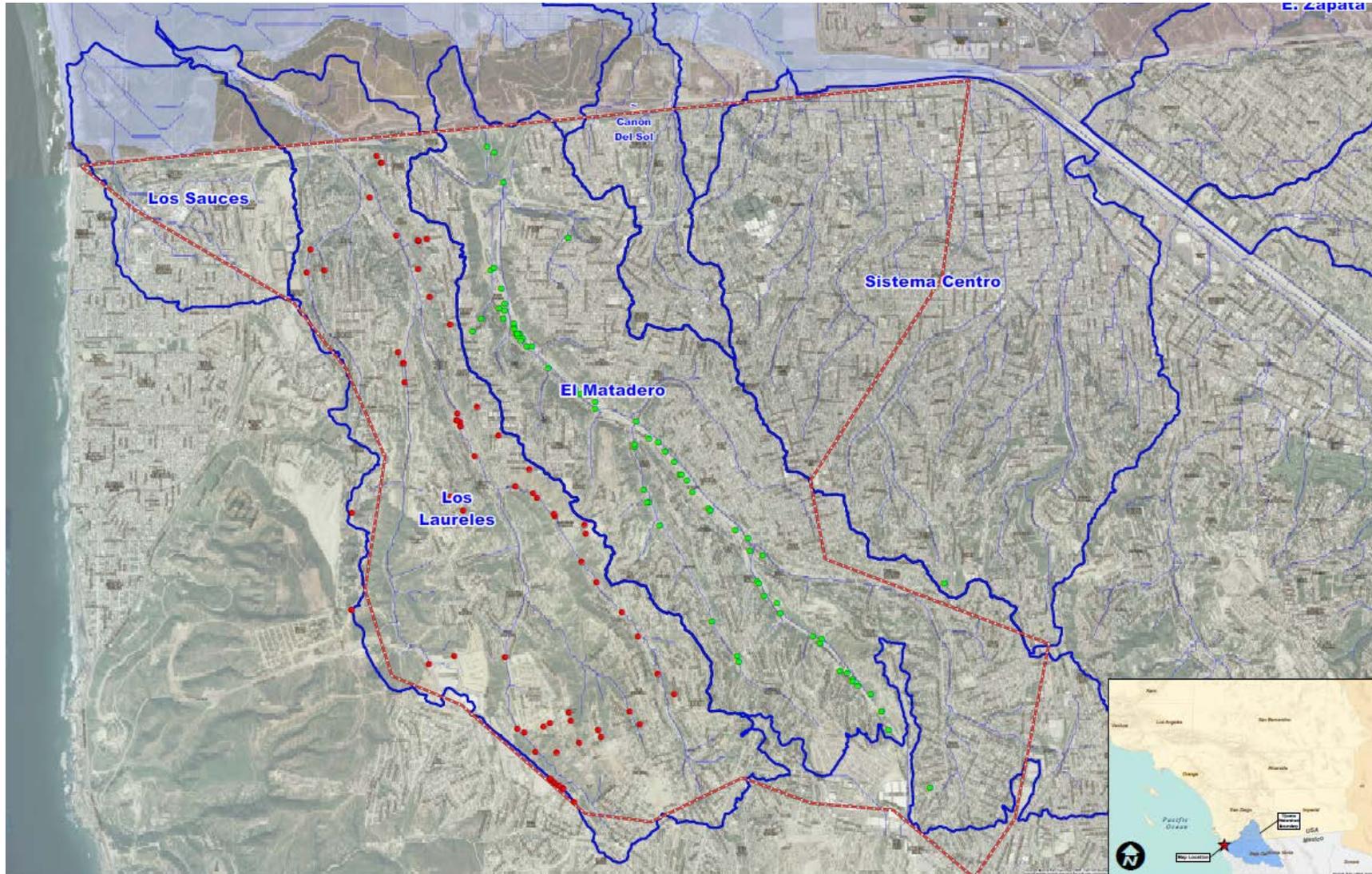
The type of trash that may be anticipated in the transboundary flow was considered and evaluated. Trash classification studies performed in the U.S., such as the 2018 *Regional Trash Generation Rates for Priority Land Uses in San Diego County*, prepared by Michael Baker International, and the 2014 *San Francisco Bay Area Stormwater Trash Generation Rates*, prepared by EOA, Inc., determined the type and quantity of trash that may be expected from different land uses. Studies of trash in the transboundary area have shown that these results do not apply to trash in Mexico, as discussed below.

Alpha Forma, LLC, and Alter Terra have done considerable research regarding tracking and classifying the transboundary flow of trash. As part of their research, site visits were performed to survey the types and locations of trash. Efforts were also made to track the flow of trash by leaving tracking devices at dumpsites to determine where the trash was going. Some of the issues observed were inadequate waste disposal systems and uncontrolled open dump sites on the Mexico side of the border.¹ These issues may be the result of inconsistent trash management exacerbated by inaccessibility of roads and the lack of availability of trash pickup trucks, resulting in widespread dumping of residential, commercial, and construction waste. Studies have been performed at two canyons, Los Laureles (Goat Canyon) and Los Mataderos (Smuggler’s Gulch) and will be discussed in the following sections.

Figure 6 shows the locations where dumping was occurring on the Mexico side of the border in the Goat Canyon and Smuggler’s Gulch watersheds. Other watersheds were not studied but would presumably have similar patterns of trash dumping.

¹ Alpha Forma, LLC (2012) and Alter Terra (2014)

Figure 6. Trash and Sediment Sources in the Tijuana River Valley Watershed Areas off Goat Canyon, Smuggler’s Gulch, and Other Tributaries



Source: Alter Terra (2014)

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Table 1 shows the types of trash identified at the dumpsites in Goat Canyon.² Similar classifications of trash were found at sites in Smuggler’s Gulch.³

Table 1. Waste Class Definitions

Waste class	Definition
Animal	Carcasses, feces, manure
Appliances	Refrigerators, stoves, dishwashers, washers, dryers
Ashes	Burnt trash of unidentifiable source
Car parts	Bumpers, windshields, frames, mufflers, doors, etc.
Commercial	Food waste, packaging, shelving, etc. from stores, restaurants, markets, offices, hotels
Construction	Building materials typical of demolition debris: roofing materials, concrete, bricks, wood, etc.
Electronics	Used smaller appliances: televisions, printers, computers
Excavation	Broken ground, broken concrete, pieces of road, soils removed to level building lots
Foam	Packaging, furniture stuffing, etc.
Hospital	Used needles, plastics, gloves, gowns, medications, body parts, specimen samples
Industrial	Factory wastes from manufacturing
Mixed	Wastes of more than three types/sources combined
Organics	Yard waste, farming crops, trimmings, trees, bushes, nonnative plants
Palettes	Wooden shipping and storage palettes
Plastics	Bottles and anything made from plastic
Soils	Various sediment transported from other areas
Tires	Used tires

Source: Alpha Forma, LLC (2012)

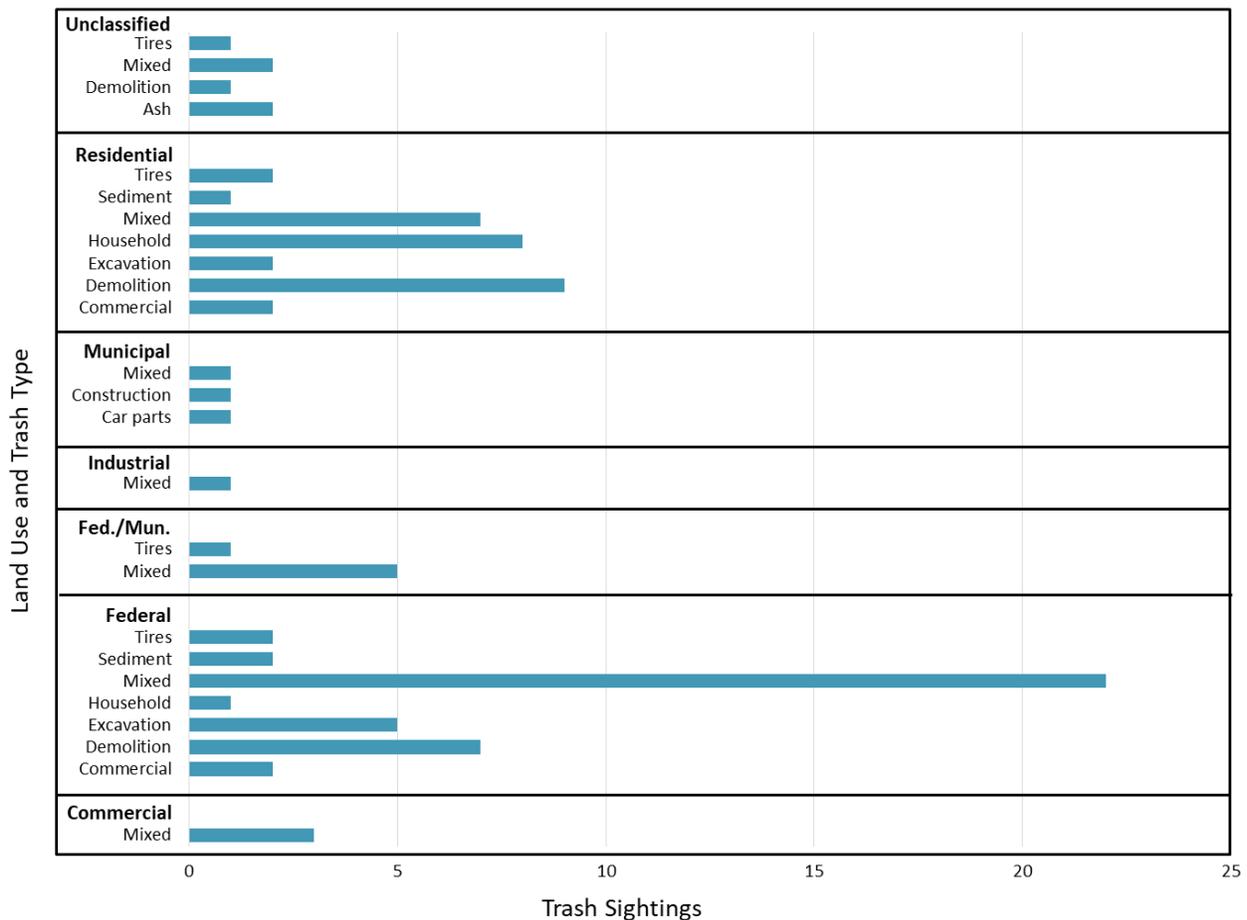
Studies have been performed in the U.S., including California, to determine the type and quantity of trash that may be expected from land use types. However, the same expectations of trash type and quantity cannot be applied to Mexico. Because trash pickup in Mexico is inconsistent and the availability of trash pickup trucks is limited, dumping of trash is widespread and dumpsites form in many different land use areas. A residential area in the U.S. would have trash associated with household waste found in the streets. However, Figure 7 shows that dumpsites in residential areas in the Smuggler’s Gulch area contain a variety of trash types including tires, mixed trash, demolition waste, commercial, and sediment as well as household waste. Similar discrepancies were found for all the land use types in Smuggler’s Gulch and Goat

² Alpha Forma, LLC (2012)

³ Alter Terra (2014)

Canyon.⁴ For this reason, the trash types that should be expected for each land use in Mexico cannot be confirmed. Given the widespread dumping practices, any type of trash/waste could potentially be found in any land use area. For example, the residential land use had the most sightings of dumped demolition waste, which would not typically be expected. It seems that demolition crews and others are dumping where it is convenient as opposed to using official dump sites. This appears to be happening for other types of land uses as well, and illegal dumping continues. Based on current practices, all trash types should be anticipated in each of the watersheds for all land uses.

Figure 7. Sightings (Visible Dumpsites) of Trash Types by Land Use



Source: Alter Terra (2014)

Note: Trash types described in Table 1.

The volume of transboundary trash that may be anticipated will vary based on rain events and the potential for illegal dumping, as previously discussed. For planning purposes, operation volumes, previous studies, and clean-up efforts were reviewed.

Trash flow cannot be metered, and the volume of trash is often considered as part of the sediment load that is excavated. Trash is also collected as part of volunteer clean-up

⁴ Alter Terra (2014)

efforts. However, volumes of trash collected during these efforts may be more dependent on volunteer time than on trash present in the Tijuana River Valley. Information obtained from County of San Diego in February 2019 regarding current dredging efforts indicates that of the 10,000 cubic yards (CY) of sediment removed recently from Smuggler’s Gulch, only 40 CY were trash. This would be approximately 0.4 percent trash in the dredged volume. The City of San Diego *Excavation and Post-Storm Observations in TJ River Valley* report (2009) estimated the cubic yards of trash present in the excavated channel to be from 0 to 15 percent of the excavated material. These percentages of volume are reasonable based on the 2010 *Report of Trash, Waste Tire and Sediment Characterization – Tijuana River Valley, San Diego, California* prepared by URS (2010). As part of the study, a visual observation was performed to determine the approximate trash density. Various observation sites (data points) in the Tijuana River Valley were selected, and the trash density recorded. Of 1,015 data points total, 568 (56 percent) had 0 to 1 percent trash density and 233 (23 percent of total) had 2 to 10 percent trash density—indicating that 797 (79 percent) had a trash density of 10 percent or less. Table 2 summarizes the results.

Table 2. Trash Density by Visual Observation

Trash density (%)	Number	Total (%)
0–1	568	56
2–10	233	23
11–25	89	9
26–50	30	3
51–75	31	3
76–100	64	6
Total	1,015	100

Source: URS (2010)

As indicated previously, there is uncertainty regarding the trash expected to cross the border during wet- and dry-weather flows. No study has evaluated the quantity of trash expected during individual storm events annually. However, much of the information available for trash is based on the sediment collected or dredged. Nearly 80 percent of the sites previously observed had equal to or less than a 10 percent trash density. The County information regarding dredging in Smuggler’s Gulch indicated a 0.4 percent trash density and a City of San Diego report noted trash to be 0 to 15 percent of the excavated material in the channel, therefore, it would be appropriate to evaluate potential future trash in a similar range of the dredged and observed values. A value of 10 percent was determined based on the majority of observations. The estimate of 10 percent trash per annual sediment load could be used to determine anticipated volumes and costs of disposal.

The following sections provide information regarding the potential anticipated trash for each of the four watersheds. For planning purposes, a volume of 10 percent was used to evaluate how much annual trash to anticipate based on annual average sediment loading and dredging information discussed above. An approximate tonnage of trash was

determined based on investigations with trash haulers. A value for loose solid waste of 350 pounds per cubic yard was used in the calculations in the following sections to provide a sample reference for weights that may be anticipated. The tonnage of trash will vary significantly depending on the type of waste collected. As mentioned previously, anticipated trash types in the watersheds cannot be classified at this time.

3.1 Tijuana River

Using sediment load to determine trash in the Tijuana River may lead to inconsistencies. The USACE *Basis for Design Memorandum* and *Phase I Hydrology* report and model were reviewed. Sediment loading over time varied widely, as discussed in the companion to this TM, *Tijuana River Valley Needs and Opportunities Assessment – Sediment* TM. A 10-year bed material load of 60,000 CY may be anticipated but does not include the much greater wash load. The 1977 USACE report notes that the load may be up to 271,000 CY, and the 2018 USACE report noted that the load may be up to 430,000 CY. Both volumes result in much greater volumes of trash (and potential cost) than previously anticipated. For planning estimates, the more conservative volume was used (Table 3).

Table 3. Potential Trash Volumes and Tonnage for Tijuana River

Watershed area	Average annual sediment dredged (CY)	Potential % trash in dredged material	Trash anticipated (CY)	Sample tonnage
Tijuana River	430,000	10	43,000	7,525

Source: USACE (2018)
Note: CY = cubic yards

3.2 Smuggler's Gulch

As discussed at the beginning of this section, it is expected that the reported 0.4 percent of trash collected while dredging may not represent the total trash that could be expected. For planning purposes, a more conservative value is recommended. Using the more conservative volumes reported in the study *Nelson Sloan Management and Operations Plan and Cost Analysis* (AECOM 2016) for sediment in Smuggler's Gulch, a reasonable volume of potential trash could be determined based on the 10 percent estimate (Table 4).

Table 4. Potential Trash Volumes and Tonnage for Smuggler’s Gulch

Watershed area	Average annual sediment dredged (CY)	Potential % trash in dredged material	Trash anticipated (CY)	Sample tonnage
Smuggler's Gulch (north of Monument Road)	6,300	10	630	110
Pilot Channel/ Smuggler's Gulch (Monument Road)	12,600	10	1,260	221

Source: AECOM (2016)
 Note: CY = cubic yards

3.3 Goat Canyon

Although a trash capture device is located in Goat Canyon, potential volumes of trash were evaluated. Like Smuggler’s Gulch, Goat Canyon was evaluated using sediment volumes reported in the *Nelson Sloan Management and Operations Plan and Cost Analysis*. Table 5 presents the potential trash anticipated.

Table 5. Potential Trash Volumes and Tonnage for Goat Canyon

Watershed area	Average annual sediment dredged (CY)	Potential % trash in dredged material	Trash anticipated (CY)	Sample tonnage
Goat Canyon	45,000	10	4,500	788

Source: AECOM (2016)
 Note: CY = cubic yards

3.4 Yogurt Canyon

Yogurt Canyon appears to be an exception to the rule of widespread trash issues, based on information from *Detection, Mapping and Communication of Solid Waste Pollution Sources in the Tijuana River Valley* (Alpha Forma, LLC 2014). That study evaluated Smuggler’s Gulch and Yogurt Canyon to review the open dumpsites in the area. The report notes that the area was found to be “very clean and all residents have trash pickup services. No dumpsites were observed in this area.” The report also notes that the drainage consists of “urban runoff from car washes, residential lots, and public pools and hotels.” On the U.S. side of the border, clean-up efforts by volunteers do not appear to be concentrated in the Yogurt Canyon area, indicating that trash is not a major issue in the area. No further indications regarding a need for structural trash solutions was identified.

Regarding other drainage areas, Cañon del Sol and Stewart’s Drain have collectors that may capture trash and need to be maintained; however, no additional information was available.

4 Development of Potential Projects

The data collection and review of projects for the Tijuana River Valley area indicate a variety of trash collections and disposal opportunities. The previous efforts and current evaluations indicate that trash racks at the collectors and trash traps, particularly booms, are the most appropriate structural solution for most of the watershed drainage areas.

The *60% Report Feasibility Study for Sediment Basins Tijuana River International Border to Dairy Mart Road* (Stantec 2019) currently being undertaken for the USIBWC (USIBWC Sediment Feasibility Study), reviewed various best management practices (BMPs) for trapping trash. The trash traps investigated included in-line screens, self-cleaning screens, and booms and baffles. The findings of the report indicated that in-line screens, generally installed as angled, vertical metal bars in the flow path, tend to clog and are not reliable. Self-cleaning screens, such as Continuous Deflective Separation (CDS) units, are used in situations where the drainage area is less than 1,200 acres, but they require substantial head to operate. Trash booms and baffles were found to deflect and trap litter at low-flow velocities with large drainage areas. Considering the location constraints of each of the different traps, trash/debris booms would be the most appropriate type of traps. The findings of the report are consistent with the results of the Goat Canyon sediment basin project.

Of course, no trash device is 100 percent effective at capturing trash. This is attributable, in part, to the need to limit flooding events by allowing flows to bypass the system— i.e. allowing some trash to pass and thus furthering the need to continue manual efforts of trash collection. As such, nonstructural efforts can also be considered, such as clean-ups and recycling incentives.

The following section provides additional information about the potential alternatives in each watershed.

4.1 Tijuana River

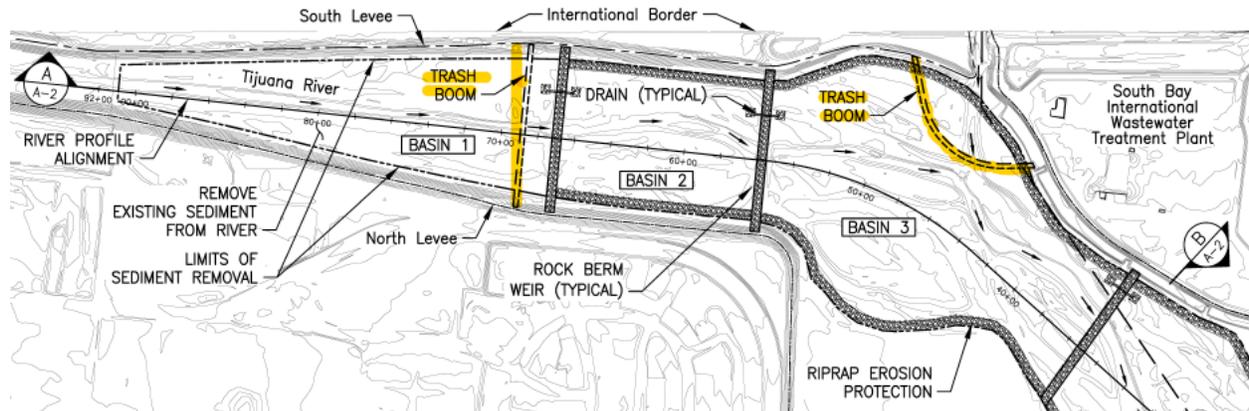
4.1.1 Projects

Trash booms are currently being studied by USIBWC and Surfrider for use in the Tijuana River. Trash booms are designed to remove the floating trash and debris in a channel or river. Other similar types of devices are trash nets and socks which are designed to capture trash in a flow path. As studies progress, similar, alternative trash capture devices may be found to be more appropriate.

The USIBWC Sediment Feasibility Study determined the most appropriate trash BMPs for the Tijuana River are the trash/debris booms. The booms can accommodate large watershed areas and have limited clogging issues. The consultant preparing the report expects to prepare estimates to determine sediment and trash volumes to predict the performance of the basin(s) and the efficiency of the trash capture devices. The consultant plans to use the existing sediment removal for the Goat Canyon sediment basin for reference to provide perspective on anticipated characteristics of material flows.

The USIBWC report considers several alternatives, but each alternative considers the same trash capture, as shown on Figure 8 for the location of trash booms.

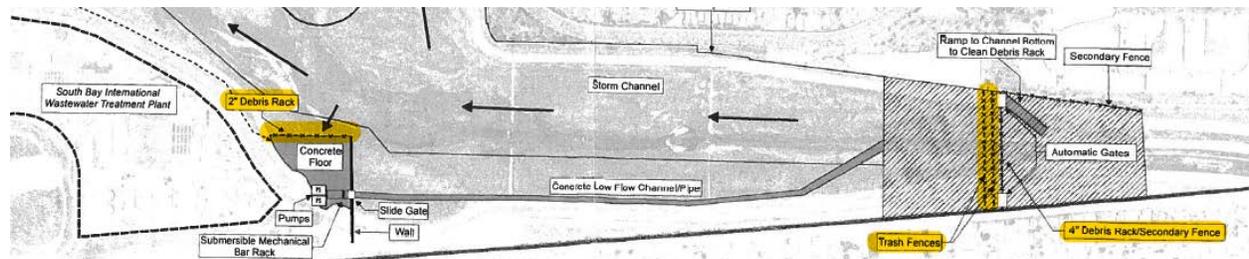
Figure 8. Excerpt from the USIBWC Report of Concept Design Alternatives



Source: Stantec (2018)

Surfrider Foundation, in its February 4, 2019, letter regarding *TRV Stakeholder Solution to Sediment, Waste, Sewage and Chemicals* offers a similar solution to that proposed in the USIBWC report regarding trash capture for the Tijuana River. The preliminary concept identifies trash fences and debris racks to capture trash as it leaves the concrete-lined channel of the river. The concept could protect the inlet to the South Bay International Wastewater Treatment Plant (Figure 9).

Figure 9. Excerpt from Surfrider Foundation's Concept Solution



Source: Surfrider Foundation (2019)

4.1.2 Cost

The \$12 to \$26 million cost estimates from the USIBWC Sediment Feasibility Study are based solely on the estimated volume of earthwork. These costs are anticipated to be refined in the upcoming 90 percent feasibility report to include separate costs for the trash capture devices. The Surfrider conceptual project's preliminary cost estimate is approximately \$15 million. The costs for installing trash devices may be between 10 and 30 percent of the cost of the project; a range of \$1.5 million to \$4.5 million may be anticipated. Early conversations with boom manufacturer GEI Works indicate that costs would be approximately \$850,000 for each section (\$1.7 million for both sections considered). For the purposes of this study, an anticipated cost of <\$2 million is anticipated. This cost is closer to the range from GEI Works and more consistent with most recent updates from USIBWC which indicate a preference for an alternative on the lower end of their original cost range.

Cost for disposal of 43,000 CY of trash is estimated at \$2.5 million annually. To determine the disposal costs, previous reports were reviewed. The previously prepared Nelson Sloan study from AECOM considered the costs of hauling and disposal. A value of \$56.87 per cubic yard was reported for hauling and disposal at Miramar Landfill and \$31.32 per cubic yard was reported for Otay Landfill. Based on information provided by a local waste company, those values still appear appropriate. Conservatively, Miramar Landfill costs were used. Trash volume is based on a calculation of sediment as described above. This volume and cost are significantly higher than previously anticipated, and the volume of trash should be investigated in future studies along with ongoing efforts to confirm the need for this volume of trash.

4.2 Smuggler's Gulch

4.2.1 Projects

Trash booms have recently been installed in Smuggler's Gulch. Other similar types of devices that could be considered to capture trash in Smuggler's Gulch are trash nets and socks. As studies progress, similar, alternative trash capture devices may be found to be more appropriate.

Alter Terra has designed and built trash booms for installation at Smuggler's Gulch (Figures 10 and 11). The booms are made from recycled materials (plastic collected within the watershed) and were installed in 2019. These trash booms could compliment a new sedimentation basin in the Smuggler's Gulch area (see the *Tijuana River Valley Needs and Opportunities Assessment – Sediment TM*).

Figure 10. Trash Booms at Smuggler's Gulch Prior to Installation



Figure 11. Close-up View of Trash Boom Comprised of Recycled Material



4.2.2 Cost

The estimated ongoing cost of trash disposal of approximately 1,900 CY of trash is approximately \$100,000 per year based on the previously mentioned landfill costs and County information from Alter Terra.

4.3 Goat Canyon

The trash issue in Goat Canyon is currently being addressed by the existing trash booms (Figure 12) and maintenance activities in the sedimentation basins. No new projects are recommended at this location.

Figure 12. Trash Collected at the Booms in Goat Canyon



4.3.1 Projects

The sedimentation basins and trash booms in Goat Canyon are operated by California State Parks, and those booms are the primary devices to prevent trash from flowing into other parts of the Tijuana River Valley from Goat Canyon. While no new facilities are being recommended at this time, continued long-term operation of these facilities is necessary to prevent trash and sediment from flowing into the Tijuana River and Estuary.

4.3.2 Cost

The cost can vary significantly based on the sediment and trash loading. Information provided by the County of San Diego and by the *Nelson Sloan Management and Operations Plan and Cost Analysis* (AECOM 2016) indicated that in 2016, costs ranged from \$37,500 to \$2.5 million per year based on disposal for sediment and trash. A planning-level estimate of approximately \$250,000 per year for 4,500 CY of trash could be used, although some years will have significantly higher costs if annual trash disposal was not implemented.

4.4 Yogurt Canyon and Other Areas

4.4.1 Projects

As discussed previously, no specific structural projects are recommended for Yogurt Canyon or other, smaller watershed areas at this time.

Existing trash collectors at the U.S.-Mexico border require long-term maintenance to remove trash and debris. Collector maintenance of all facilities must continue to ensure blockages do not occur. The existing trash racks at Stewart's Drain and Cañon del Sol may be retrofitted to allow for a redundant trash rack structure to capture trash once the initial structure is clogged.

Other options may include recycling incentives and volunteer clean-up events. 4Walls International is an organization considering the option for investment bond funding for alternative uses of trash with the backing of NAD Bank. Although the Border Impact Bond model assumes a return on investment, an initial investment is required. Community clean-ups are regularly held by organizations such as WILD Coast, and events such as "I Love a Clean San Diego" will continue to benefit the area.

4.4.2 Cost

Estimated costs for the programs discussed above are as follows:

- Collector maintenance: greater than \$1 million per year annually
- 4Walls International Recycling Incentive: initial investment of \$3 million
- Nongovernmental organization clean-up events: minimal because of volunteer efforts

5 Emergency Action Plan

Emergency protocols for trash would most likely take place at the collectors before the trash enters the Tijuana River Valley, which would distribute it across the region. Surfrider Foundation (2019) has recommended a binational monthly clean-up program for the channel collectors. Collector maintenance is included in this TM, and the regular cleaning of the collectors would help control the collection of trash and capture it prior to a wet-weather event to limit the risk of flooding from clogged trash traps.

Costs for professional services to develop plans could range from \$100,000 to \$250,000 for trash and up to \$500,000 for other constituents. Implementation of the plans could be up to \$1 million annually.

5.1 Trash Management

As sediment is dredged, trash will be collected and removed. This could be accomplished by using shakers or screens to remove the trash. Trash exclusive of waste tires will be disposed of separately and can be taken to a landfill or recycled, as appropriate. Any hazardous waste observed will be taken to a Class III landfill.

Handling waste tires on site requires the operator to become a waste tire generator (AECOM 2016). A permit from CalRecycle will be required if more than 500 tires are stored on site. A registered waste tire hauler will be required to collect the tires, and the hauler can determine if they can be recycled. The California-Mexico Border Relations Council Board Region Solid Waste Working Group's *Solid Waste & Water Tire Strategic Plan* (2017) considered alternatives to remediate the transboundary flow of waste tires. Pilot projects were commissioned, and they found the need for permitting and enforcement, tire recycling and market development, and programmatic infrastructure for dealing with waste tires.

6 Summary of Project Recommendations

This section describes the recommended projects for reducing trash in the watersheds.

Planning-level costs were developed based on the following assumptions:

- Planning-level cost estimate accuracy ranges from 50 to 20 percent below to 30 to 100 percent above the actual cost.
- Operation and management costs were calculated based on typical operation and management costs and historical County of San Diego costs.
- Costs were adjusted to 2019 using the ENR Construction Cost Index.

Coordination with stakeholders will continue to be a key element in the Needs and Opportunity Assessment process. The Tijuana River Valley Recovery Team members were instrumental in the data collection effort and have been identified as a key stakeholder group to continue through the Needs and Opportunity Assessment. Specifically, participation by the implementing agencies within the Tijuana River Valley Recovery Team (USIBWC, U.S. Environmental Protection Agency, California State

Parks, U.S. Customs and Border Protection, City of San Diego, and County of San Diego) will be critical to the success of the project implementation. It is anticipated that a series of meetings, workshops, and other outreach opportunities will be effective in continuing the dialogue and advancing project development in the next phase.

See Table 6 for a list of projects that would be feasible to implement among the four watersheds.

Table 6. Proposed Implementation Projects

Project #	Project title	Project description	Estimated project cost	Example
1	Tijuana River Trash Booms/ Traps	<p>Install trash capture devices (booms) across the span of the Tijuana River just upstream of the transition from a concrete to earthen channel (within USIBWC’s flood control channel). The booms would catch trash as it enters the United States side of the Tijuana River, and would require frequent maintenance.</p> <p>This project is currently being analyzed by USIBWC through a feasibility study, as well as a conceptual study by the Surfrider Foundation.</p>	<ul style="list-style-type: none"> • Estimated implementation cost: <\$2 million • Estimated ongoing cost: <\$2.5 million/year 	
10	Smuggler’s Gulch Trash Booms	<p>Maintain trash devices (booms) across Smuggler’s Gulch, downstream of existing collector structure. The booms catch trash as it enters the United States side via Smuggler’s Gulch.</p> <p>Alter Terra has installed the trash booms in coordination with the County of San Diego (see Project 16 for trash management component).</p>	<ul style="list-style-type: none"> • Estimated ongoing cost: \$100,000/year 	

Table 6. Proposed Implementation Projects

Project #	Project title	Project description	Estimated project cost	Example
16	Sedimentation Basins and Trash Management in Goat Canyon	<p>California State Parks operates two existing sedimentation basins and trash booms in Goat Canyon. Funding for long-term operation and maintenance of these facilities is necessary to keep trash and sediment from flowing into the Tijuana River and Estuary.</p> <p>This project is currently being assessed by the Senate Bill 507 Needs and Opportunities Assessment.</p>	<ul style="list-style-type: none"> Estimated ongoing cost: <\$5 million/year 	
24	Recycling Incentives	<p>Provide incentives for additional recycling of plastics and tires to prevent trash discharge on the Mexico side of the border. An example would be the 4Walls initiative (Border Impact Bond) in cooperation with NAD Bank. 4Walls is promoting investment bond funding with the backing of NAD Bank. Additional funding could potentially come from operations and management cost savings on the U.S. side of the border. Although the Border Impact Bond model assumes a return on investment, an initial investment is required.</p>	<ul style="list-style-type: none"> The 6-year plan requires an initial investment of \$3 million. 	

Table 6. Proposed Implementation Projects

Project #	Project title	Project description	Estimated project cost	Example
25	NGO Clean-up Programs	Continue to promote NGO participation in river/beach clean-up events. Consider partnering with organizations such as Wildcoast and Trash Free Waters to help promote inter-organizational collaboration.	Costs likely to be minimal since efforts are primarily volunteer based.	
26	Development of Emergency Action Plans	Despite existing and anticipated infrastructure, there are times when the volume of flows is too high and sewage spills occur. In these instances, emergency action plans are needed to identify protocols to address water quality, flooding, sediment, and trash.	<ul style="list-style-type: none"> • Estimated soft cost: \$250,000 to \$500,000 • Estimated ongoing cost: <\$1 million/year 	

Notes: USIBWC = U. S. Section of the International Boundary and Water Commission, NGO = nongovernmental organization

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Appendix A. Previous Studies

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Table A-1. Relevant Trash Documents from Collected Information

Title	Type	Watershed area	Summary
<i>Tijuana River Watershed Management Area Water Quality Improvement Plan (2015)</i>	Report	Tijuana River, Goat Canyon, Yogurt Canyon, and Smuggler's Gulch	Water quality improvement plan that includes assessment of water quality issues and comprehensive information on the area, including Potential Strategies for nonstructural and structural best management practices.
<i>Excavation and Post-Storm Observations in Tijuana River Valley (City of San Diego 2009)</i>	Report	Smuggler's Gulch and Pilot Channel	Evaluation of the nature and quantity of trash and sediment that accumulated in Smuggler's Gulch and the Pilot Channel.
<i>Tijuana River Valley Trash, Waste Tire and Sediment Characterization Study and Status Update (URS 2009)</i>	Presentation	Tijuana River Valley	The presentation contains images of trash in four areas of the Tijuana River Valley, trash survey methods, and results of weighing of trash by type.
<i>Solid Waste & Waste Tire Strategic Plan (California-Mexico Border Relations Council Border Region Solid Waste Working Group 2017)</i>	Report	New River and Tijuana River Valley	The plan identifies objectives in the development of solutions to remediate problems associated with waste tires, solid waste, and excessive sediment threatening water quality and public health in the California-Mexico border region
<i>Nelson Sloan Management and Operations Plan and Cost Analysis (AECOM 2016)</i>	Report	Tijuana River Valley	The plan describes the management and operation of filling activities to meet the requirements of a reclamation plan to restore the Nelson Sloan Quarry.
Cross-Border Trash Tracking (Alter Terra)	Website information (accessed September 6, 2018)	Goat Canyon	A study in which tracking devices were used record dump sites and transboundary flow of trash in Goat Canyon.
<i>Report of Trash, Waste Tire and Sediment Characterization – Tijuana River Valley, San Diego, California (URS 2010)</i>	Report	Tijuana River, Smuggler's Gulch	A report that summarizes the nature, extent and characteristics of trash and sediment present in the lower Tijuana River Valley.
2014 Border Coastal Campaign Activity Log (WILD Coast 2014)	Spreadsheet	Tijuana River, Smuggler's Gulch	A spreadsheet that shows information from cleanup and restoration activities, tours, community meetings trainings, and presentations.
TRAM tracking (WILD Coast 2015, 2016, 2017)	Spreadsheet	Tijuana River, Goat Canyon, Yogurt Canyon	A tracking spreadsheet that shows locations, number of volunteers, volume of trash removed, number of tires removed, and other information for Tijuana River Action Month.
<i>Detection, Mapping and Communication of Solid Waste Pollution Sources in the Tijuana River Valley (Alpha Forma, LLC 2014)</i>	Report	Smuggler's Gulch and Yogurt Canyon	Studies of the dumpsites and trash classification of the trash found in Smuggler's Gulch and Yogurt Canyon.

Table A-1. Relevant Trash Documents from Collected Information

Title	Type	Watershed area	Summary
<i>Los Laureles Canyon Transborder Trash Tracking Study</i> (Alpha Forma, LLC 2012)	Report	Goat Canyon	A study of the dumpsites and trash classification in Goat Canyon. Includes information about the tracking of the movement of trash.
<i>30% Report and 60% Report Feasibility Study for Sediment Basins – Tijuana River International Border to Dairy Mart Road</i> (Stantec 2018 and Stantec 2019)	Report	Tijuana River Valley	The feasibility study establishes the preferred location and sizing of a sediment basin within the main channel of the Tijuana River. The sediment basin will be designed to also capture trash, debris, and transboundary flows. The sediment, trash, debris, and flow management strategies are intended to improve water quality and reduce adverse health risks to people and the environment. This study will develop three alternative concepts for the basins, recommend a preferred alternative, and present a conceptual design for the preferred alternative.
<i>Assessment and Implementation Advisory Report on Trash and Sediment Source Control in Mexico</i> (Alter Terra 2014)	Report	Tijuana River Valley	A report to assist in restoration and conservation initiatives throughout the watershed and to support stakeholders, policy makers, and potential funders in building collaborative partnerships that will lead to the recovery of the Tijuana River Valley to a healthy wetland ecosystem. Alter Terra is working to address trash and sediment issues into the Tijuana River Valley that originate upstream in uncontrolled informal dump sites and unplanned urban developments.
Smuggler's Gulch Dredging Historical Totals (2019)	Email (February 13, 2019)	Smuggler's Gulch	A spreadsheet includes estimated historical records (sediment quantities, costs, etc.) for dredging in Smuggler's Gulch.
<i>TRV Stakeholder Solution</i> (Surfrider 2019)	Technical memo/Letter	Tijuana River Valley	The memorandum sets out Surfrider San Diego's proposal for an all-encompassing plan aimed toward addressing the range of pollution concerns within Tijuana River Valley. This includes a conceptual design involving public works that will improve the infrastructure located at the South Bay International Water Treatment Plant. It also incorporates other infrastructure-related suggestions and broader policy objectives to improve conditions.