Feasibility Analysis for Project 10: Sediment and Trash Source Control

Technical Memorandum

USMCA Mitigation of Contaminated Tijuana Transboundary Flows Project

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1200 Pennsylvania Avenue, NW
Washington DC 20460

Prepared by:

PG Environmental, LLC (Subcontractor to ERG)

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

BMP	best management practice
BECC	Border Environmental Cooperation Commission
EID	Environmental Impact Document
EPA	United States Environmental Protection Agency
ERG	Eastern Research Group, Inc.
GIS	geographic information system
kN	kilonewton
LID	low-impact development
NADB	North American Development Bank
NGO	non-governmental organization
O&M	operation and maintenance
SB	Senate Bill
TRAM	Tijuana River Action Month

EXECUTIVE SUMMARY

PG Environmental conducted a feasibility analysis of Project 10, "Sediment and Trash Source Control," one of 10 proposed projects identified to mitigate transboundary wastewater flows in the Tijuana River watershed under the United States–Mexico–Canada Agreement (USMCA).

The project involves implementation of five trash, tire, and sediment source control strategies to control trash and sediment at the source in Mexico, reducing the loadings of these pollutants in transboundary flows from Mexico to the U.S. via the Tijuana River and Goat Canyon. This report presents the source control concepts, identifies current and past source control activities that can inform project feasibility, and discusses implementation issues and challenges that affect project feasibility and cost. This analysis considered existing work previously undertaken by federal, state, and local organizations. PG identified and evaluated five individual sub-projects:

1. **Road paving** in both developed and developing areas of Tijuana. This sub-project was found to be technically feasible and will reduce sediment loads in transboundary flows. Costs for individual paving projects depend on their location and accessibility, the need for stabilization of underlying soils, road width and grade, and the need for special equipment and construction-related erosion controls. Street- and parcel-level GIS data for existing infrastructure and further analysis are needed to identify specific roads that can be paved and which paving projects would maximize erosion control at the least cost.

2. **Trash and tire collection, processing, and disposal,** using trash full capture devices, institutional controls, and collection or reuse of waste tires. This sub-project was found to be technically feasible as evidenced by existing programs, particularly institutional controls and projects to collect and reuse waste tires. Such strategies can reduce trash, waste tires, and associated pollutants in transboundary flows. The primary challenge for trash and tire collection, processing, and disposal strategies is ensuring long-term implementation and ongoing availability of supporting infrastructure (e.g., trash or waste tire processing facilities). Feasibility of recycling or reuse programs also depends on demand for the recycled product. Trash capture devices are only feasible in areas with storm sewer catch basins. Evaluation of feasibility and cost for this sub-project could be enhanced by more information on implementation and effectiveness of existing programs, as well as street- and parcel-level GIS data for existing infrastructure to identify potential locations for trash capture devices and waste tire reuse projects.

3. **Public education, outreach, and participation programs** to raise awareness and change behaviors to facilitate implementation and long-term maintenance of best management practices (BMPs). This sub-project was found to be technically feasible, is likely to cost less than infrastructure-based source controls, and could facilitate public acceptance of investment in higher-cost trash and sediment source control projects. The City of Tijuana, or whoever implements the programs, could further control costs by expanding on existing programs with local and bi-national organizations. However, further information and analysis are needed on existing programs' funding and effectiveness before specific outreach and education opportunities can be identified.

4. **Land stabilization** of exposed and highly erodible soils in developed and developing areas. This sub-project was found to be technically feasible in some areas of Los Laureles Canyon, but opportunities for some land stabilization practices such as revegetation may be limited across the watershed because exposed areas consist primarily of unpaved roads. In those

areas, road paving is a more feasible strategy than land stabilization. Where feasible, land stabilization is expected to reduce sediment loads in transboundary flows. Land stabilization costs are widely variable and depend on the individual project's site topography, land use conflicts, utility considerations, soil type, and availability of materials. In general, vegetative land stabilization methods are more cost-effective than methods requiring sediment transportation. Using waste tires to stabilize soils saves costs by providing source control for multiple pollutants, though standards and inspection protocols may need to be developed. Street- and parcel-level GIS data for existing infrastructure and further analysis are needed to identify opportunities for specific land stabilization projects.

5. **Green infrastructure** to manage stormwater runoff. This sub-project was found to be technically feasible for select locations but not practicable across the watershed. Street- and parcel-level GIS data for existing infrastructure and further analysis are needed to identify specific locations that may be suitable for green infrastructure projects. In addition, more information on implementation and effectiveness of existing programs is needed to identify entities that should be involved in implementation and ongoing maintenance of green infrastructure projects, as well as the potential sediment load reductions in transboundary flows. Green infrastructure projects are highly customizable to site conditions. As with other types of source control strategies, the cost for green infrastructure projects is highly variable, depending on the type of BMP chosen and specific site conditions. BMPs installed during construction of larger development projects tend to be more cost-effective than retrofit installations. Successful implementation may necessitate new training, changes to local codes, and outreach to local community members.

PG has also explored Project 10's projected performance in mitigating effects from discharges of trash, tires, and sediment, including some high-level environmental and social impacts. ERG is preparing an Environmental Impact Document with a more thorough evaluation of potential environmental and social impacts in the U.S. associated with Project 10.

Note that more information on background data analyzed and referenced in this document can be found in PG's *Baseline Conditions Summary: Technical Document,* available from EPA.

1. INTRODUCTION

Under EPA Contract No. 68HERH19D0033, Task Order No. 53, PG Environmental conducted a detailed feasibility analysis of 10 proposed projects to mitigate transboundary wastewater flows in the Tijuana River watershed. Each feasibility analysis considered an estimate of capital costs; an estimate of design, project, and construction management costs; operation and maintenance (O&M) costs; project implementation schedule; regulatory, engineering, and any possible implementation issues; and social and environmental impacts.

This feasibility analysis specifically addresses Project 10: "Sediment and Trash Source Control." During the analysis, PG reviewed previous work including the following:

- *Recovery Strategy: Living with the Water* (Tijuana River Valley Recovery Team 2012).
- *Solid Waste & Waste Tire Strategic Plan* (Border Region Solid Waste Working Group 2017).
- *The Flow of Used and Waste Tires in the California-Mexico Border Region* (Institute for Regional Studies of the Californias 2009).
- *Runoff, Erosion and Sediment Load Modeling in Los Laureles Canyon* (Biggs et al. 2020).

Baseline Conditions Summary: Technical Document, prepared for EPA under the United States-Mexico-Canada Agreement (USMCA) Mitigation of Contaminated Tijuana Transboundary Flows Project, contains more information on background data analyzed, U.S. and Mexico entities, infrastructure and its operating conditions, water bodies, affected areas, other studies and reports, and dry- and wet-weather flow conditions referenced in this document.

This report has been revised and finalized from the draft version based on comments and discussions with EPA. Consistent with the task order scope, PG will work with EPA to develop and analyze several infrastructure alternatives, including a preferred alternative, to mitigate the transboundary wastewater and stormwater flows. The alternatives will include groupings of one or more projects evaluated in the feasibility analyses, scaled if necessary, and will be presented to EPA in the Alternatives Document.

1.1 Project Purpose

As stormwater runoff flows through the Tijuana River watershed, it becomes contaminated with trash, including waste tires, and sediment. The contaminants are deposited downstream in the estuary, harming the environment and disrupting the operations of U.S. Customs and Border Protection. The purpose of Project 10 is to control trash and sediment at the source in Mexico, reducing the loadings of these pollutants in transboundary flows from Mexico to the U.S. via the Tijuana River and Goat Canyon (called Los Laureles Canyon on the Mexico side of the border). Source control is preferable to downstream trash and sediment removal, as it is generally more cost-effective and protects larger areas of the watershed (Tijuana River Valley Recovery Team 2012). PG evaluated the feasibility of implementing five source control strategies: (1) road paving; (2) trash and tire collection, processing, and disposal; (3) public education, outreach, and participation programs; (4) land stabilization; and (5) green infrastructure.

1.2 Current Conditions

The Tijuana River watershed occupies 1,724 square miles in both the U.S. and Mexico. About 70 percent of the watershed lies in Mexico, where the river flows through canyons, towns, and cities, including the City of Tijuana. The mouth of the river is on the U.S. side and flows into the Tijuana River National Estuarine Research Reserve, which multiple agencies maintain. During dry weather, the river flows are diverted and discharged to the Pacific Ocean about 6 miles south of the border. In wet weather—mainly from November to April—the diversion is often shut down and the flows continue into the U.S. In recent years, wet weather events have increased, resulting in more water discharging into the estuary (Stantec 2020).

Goat Canyon, known as Los Laureles Canyon on the Mexican side of the border, runs perpendicular to the international border about 1.5 miles inland from the Pacific Coast and empties into the Tijuana River at the estuary near the coast in San Diego County (Institute for Regional Studies of the Californias 2009).

Uncontrolled trash, waste tires, and sedimentation are ongoing issues in the Tijuana River watershed, particularly on the Mexican side of the border, posing public health and environmental hazards throughout the region (Tijuana River Valley Recovery Team 2012). In wet-weather events, trash, tires, and sediment flow downstream, causing buildup along the banks, blocking waterways, and collecting in the estuary.

In addition to environmental and public health issues, improper disposal of trash and solid waste poses a threat to the O&M of conveyance and treatment systems designed to mitigate transboundary flows. Projects evaluated in feasibility analysis reports for USMCA Projects 1, 2, 4 and 6 address these O&M issues. Mexico's National Institute of Statistics and Geography reported that 15% of trash produced each day in Tijuana is not collected for proper disposal (Dibble 2020). A news article published in *Mexico News Daily* reported that only 60% of households in Tijuana had garbage collection, with the lack of garbage collection attributed to insufficient funding to repair necessary equipment (Mexico News Daily Staff 2017). Additionally, the state of Baja California has limited collections infrastructure and the individual municipalities lack the resources to meet the growing need for trash collection programs. In 2009, the amount of trash that entered the Tijuana River from non-permitted dischargers was estimated to be 608 tons/year (Tetra Tech 2009). In addition to stormwater runoff, high winds can also mobilize and transport trash.

An estimated two-thirds to one-half of the 1 million to 1.5 million waste tires annually disposed of in Mexico are illegally dumped. These improperly discarded tires can wash downstream during storm events (Border Region Solid Waste Working Group 2017). Used tires become waste tires quicker than new tires. In 2006 alone, 637,500 used tires were imported to Baja California from California (Institute for Regional Studies of the Californias 2009).

Unpaved roads, channel erosion, and sheet and rill erosion from vacant lots are the primary sources of sediment entering the Tijuana River (Yuan et al. 2015). Road paving has been unable to keep up with the population growth around the border. Broken water mains add to erosion issues. For example, in 2016, a water main failure resulted in a gully approximately 10 meters wide and 7 meters deep on an unpaved road in the San Bernardo neighborhood (Biggs et al. 2020). This single gully accounted for approximately 9% of the annual sediment loading in the Los Laureles Canyon watershed that year (Biggs et al. 2020). The negative impacts from sedimentation in the Tijuana River Valley include change to topography, destruction of habitat, increase in flood risks, human health issues, and long-term wildlife health.

Land disturbance associated with new development in Los Laureles Canyon has led to significant erosion of hillsides, as exemplified by the Google Earth satellite images in Figure 1-1 below, which were taken about two years apart.

Imagery date: 9/23/2004

Imagery date: 6/9/2006

Figure 1-1. Aerial Imagery Showing Hillside Erosion in Los Laureles Canyon

Many of the residential areas in Los Laureles Canyon have unpaved roads, which are also susceptible to erosion. There are two sediment basins maintained by California State Parks on the north side of the border that intercept approximately 60,000 cubic yards of sediment, trash, and debris annually (HDR 2020). At these loadings, maintaining the basins is both challenging and costly.

In 2015, the Border Region Solid Waste Working Group was formed by the California-Mexico Relations Council when the California legislature passed Senate Bill 83 to address waste tires, solid waste, and excessive sediment at the border. SB 83 tasked the group with developing and coordinating long-term solutions to address and remediate waste management problems in the border region. Additionally, the legislation appointed $300,000 from the California Tire Recycling Fund to the California Environmental Protection Agency. The money was provided as grants to nonprofit organizations to address tire and solid waste issues at the border (Border Region Solid

Waste Working Group 2017). Source control programs for trash and tires implemented on both sides of the border have yielded some positive results, but the challenges of excessive trash and waste tires have increased with Tijuana's growing population. The increase in population also means an increase in disturbed areas as roads and structures are built to meet the needs of the new residents.

Refer to the *Baseline Conditions Summary* for additional discussion about current known conditions in the Tijuana River main channel and Los Laureles Canyon.

1.3 Major Project Elements Considered

PG evaluated the implementation of five trash, tire, and sediment source control strategies around the Tijuana River main channel and Los Laureles Canyon:

- **Road paving.** Particularly in Los Laureles Canyon, unpaved roads lead to erosion. This strategy focuses on paving roads in Los Laureles Canyon to prevent erosion that contributes to sediment loadings in transboundary flows.
- **Trash and tire collection, processing, and disposal.** This strategy focuses on the collection, processing, and/or disposal of trash and waste tires in Mexico that currently go uncollected and end up in transboundary flows.
- **Public education, outreach, and participation programs.** This strategy focuses on changing resident behaviors and promoting proper waste disposal.
- **Land stabilization.** This strategy focuses on site suitability for land stabilization in Mexico to reduce erosion and sedimentation.
- **Green infrastructure.** This strategy primarily focuses on site suitability for green infrastructure in Mexico to reduce erosion and sedimentation. Some recommendations for specific green infrastructure best management practices (BMPs) have been considered.

2. SOURCE CONTROL STRATEGIES

For each of the five strategies evaluated, the following sections describe the source control concept, including high level cost considerations; provide examples of activities completed; and discuss the feasibility and challenges that might be encountered when implementing the source control strategy. At this time, additional analysis is not possible due to data limitations including the lack of street/parcel data needed to target locations for BMP implementation. In addition, PG lacks knowledge of the individual Mexican state-level or local-level agencies or nongovernmental organizations (NGOs) (Mexico, U.S., or bi-national) that may or should be responsible for BMP installation or maintenance. PG believes that groups previously engaged with these BMPs may be best suited to continue that engagement but cannot validate this at this time.

The information on activities previously completed for each source control strategy in the sections below demonstrates potential feasibility based on completion of similar activities for source control in Mexico and identifies organizations that could potentially undertake these types of activities.

Effective source control requires coordination with various regulatory entities, NGOs, and the general public. For example, dumping trash into drains in Mexicali, which is federal property, creates challenges because the local governments have no right or authority to remove the trash (Border Region Solid Waste Working Group 2017). In Mexico, state governments are legally responsible for solid waste and tire management, limiting the authority of local governments to implement source control (Institute for Regional Studies of the Californias 2009). However, because source control activities would take place entirely in Mexico, they are not expected to require any burdensome environmental regulatory approvals by U.S. federal, state, or local agencies.

Finally, because PG cannot identify specific locations for BMP installation, it is reasonable to assume that these BMPs could be deployed throughout the watershed and not just within Los Laureles Canyon.

2.1 Road Paving

2.1.1 Source Control Strategy Concept

Unpaved roads are susceptible to erosion from stormwater, flows caused by damaged infrastructure, and wind. Road paving throughout Los Laureles Canyon, particularly in canyon communities, could reduce the formation of gullies and provide sediment stabilization. Studies by EPA indicate that paving roads in Los Laureles Canyon would reduce sediment loads north of the border in Goat Canyon by as much as 40% (Border Region Solid Waste Working Group 2017). Additional studies based on simulations show that road paving on hillside “hotspot areas” would reduce sediment loading by approximately 30% with minimal increases in peak discharges (Biggs et al. 2020).

Paving costs can vary greatly depending on many factors, including erosivity of underlying soils, road width, grade of location, accessibility, need for special equipment (e.g., rock crushers, paving equipment), clearing, and erosion/pollution control (USDA 2020). Additional costs can include permitting and infrastructure improvement prior to paving. Long-term upkeep costs also vary depending on the type of material used, the volume and type of traffic, and weather conditions.

Los Laureles Canyon soils are highly erosive and made up of marine and fluvial sediments (Biggs et al. 2020), with the majority of the lower Tijuana River estuary made up of clay, silt, sand, and gravel on medium sand (HDR 2020). If the pavement subgrade is not stable or does not provide proper support, it can lead to road degradation from flexing and expansion, as well as allowing flowing water to erode soils and cause stability issues. Thus, road construction costs in Los Laureles Canyon may be higher than other areas given the need for soil stabilization.

Information on equipment costs, permitting requirements, infrastructure condition, and potential long-term maintenance considerations that can impact the potential cost for road paving projects is not currently available.

2.1.2 Activities Previously Completed

Various entities have completed road paving activities to various degrees in the Tijuana River watershed. For example, a paving and air quality project for the state of Baja California paved approximately 926 miles of street surface in the five municipalities—Tijuana, Mexicali, Ensenada, Rosarito, and Tecate—that are home to over 90% of the population in Baja California. The project increased the amount of paved streets in urban areas from 59% to 80% (North American Development Bank, 2003). The California Coastal Conservancy funded a watershed diagnostic that was prepared at the Mexican Institute of Water Technology. The diagnostic projects within Los Laureles Canyon included one paving project that developed a permeable paving program for public walkways and roads to reduce runoff and erosion (Tijuana River Valley Recovery Team 2012).

2.1.3 Feasibility and Challenges

Based on the information reviewed, it is feasible that some of the roads in Los Laureles Canyon, and perhaps other locations in the watershed, could be paved to reduce erosion and prevent sediment from migrating into the U.S. However, further analysis is required to determine which roads should be paved, who to involve in the project, and the specific requirements for paving each location (e.g., road width, grading, conflicts with existing utilities). PG is unable to complete such analyses at this time due to limited available data on road locations, conditions, and surrounding land use.

It is important to note that some roads in the Tijuana River watershed likely cannot be paved due to terrain and/or remote location prohibiting access with paving equipment. Additionally, the status of infrastructure such as water mains could delay implementation. Infrastructure in need of maintenance or repair should be addressed by the agency responsible for it prior to paving over or around the infrastructure. Additionally, threatened and endangered species' breeding seasons and the wet weather season may reduce the time periods when activities can take place in the Tijuana River Valley (Tijuana River Valley Recovery Team 2012).

2.2 Trash and Tire Collection, Processing, and Disposal

2.2.1 Source Control Strategy Concept

Trash and tire source control strategies evaluated by PG include:

1. **Trash full capture devices.** These devices are fitted to stormwater inlets or inserted into catch-basins to prevent trash from entering the conveyance system and ultimately being deposited in waterways (Regional Water Control Board San Diego Region, 2012). The full devices capture all trash greater than their mesh size (usually 5mm). These devices usually have metal screens, and if installed correctly, require little monitoring. They do require routine maintenance and cleaning before and after storm events. Studies have shown that a full capture device inserted into a catch-basin can catch up to 98% of trash that flows to the

inlet (Shimoda Group 2010). In 2006, the City of Los Angeles completed an assessment of catch basin inserts and found that the catch basin inserts captured 92% to 97% of the trash during a 10-year/1-hour storm event and 100% of the trash during a 1-year/1-hour event (City of Los Angeles 2006).

2. **Institutional controls.** This method includes increased trash and recycling collection areas and frequency, street sweeping, and placing trash collection receptacles in high traffic areas, including bus stops, outside of businesses, and in parks. Additionally, removing items from the waste stream through regulations, such as Tijuana's plastic bag ban, reduces waste generation. Another way to reduce the volume of trash entering the waste stream is by implementing recycling programs. Promoting recycling initiatives requires an initial investment but should produce a monetary return in the long run (HDR 2020).

3. **Collecting and/or reusing waste tires.** This method requires additional source control actions due to tire size, prevalence in the Tijuana River watershed, and economic value. Recycling tires prevents waste tires from entering the waste stream and waterways. Some examples of recycling options for tires include use as building materials for home construction, retaining walls in high erosion areas, fuel, or in road construction (Institute for Regional Studies of the Californias 2009). Tire disposal cost changes depending on the disposal method.

2.2.2 Activities Previously Completed

To address the issues of controlled trash and waste tires, numerous entities have taken on source control activities in Mexico. These programs have taken place in various locations and have involved different governmental, private, and nonprofit stakeholders. The following are examples of some of the trash and tire collection, disposal, and processing activities that have been implemented in Mexico:

- Mexico instituted a mandatory fee for waste tire disposal. The fee is dependent on the tire size and is used it to fund two waste tire disposal facilities and the government general fund (Border Region Solid Waste Working Group 2017).
- CalRecycle instituted a tire hauler registration program. Mexican haulers who collect tires in California must pass a training program and get a permit to haul tires (Border Region Solid Waste Working Group 2017).
- In 2006, Tijuana used a North American Development Bank (NADB) grant, a NADB loan, and other funding sources to start a solid waste collection equipment project. The project sought to improve solid waste collection and waste management by increasing the amount of equipment available for trash collection. The target collection rate was 82.4% service coverage. In 2014, the project reported the actual collection rate was 93% service coverage (NADB 2014). As noted in Section 1.2, more recent information suggests a decline in service coverage due to a lack of funds for equipment maintenance.
- In 2018, the City of Tijuana became the first city in Mexico on the U.S.-Mexico border to approve a ban on disposable plastic bags (UN Environment Programme 2018).
- Waste tires are used as fuels. Around 2006, an estimated 1.5 million tires were disposed of annually in Baja California, with about one-third used in Ensenada and Hermosillo as cement kiln fuel (Institute for Regional Studies of the Californias 2009).

- The YANTEK system in Tijuana uses waste/scrap tires for civil engineering projects such as retaining walls and erosion control (Institute for Regional Studies of the Californias 2009).
- Alter Terra, a binational conservation group, started a trash repurposing program that uses trash to create other items, such as ceiling and light fixtures, wallets, purses, and local public art. This project is estimated to have reduced trash entering the Tijuana River estuary by 30% (Sanchez 2015).
- WILDCOAST, a nonprofit organization, has utilized a $100,000 grant from the Border Regional Council to conduct a one-year demonstration project to remove used tires from four locations, identify markets for products made from used tires, and evaluate the effectiveness of partnerships formed across borders and sectors to address tire waste (Border Region Solid Waste Working Group 2017).

2.2.3 Feasibility and Challenges

Because trash and tire collection and processing programs already exist in the Tijuana River watershed, expanding upon them and adding new programs appears to be feasible. However, some trash and tire collection and processing activities appear to be more feasible than others. For example, trash full capture devices can only be used in places with storm sewer catch basins.

Due to limited data regarding the current programs—including the location of current infrastructure, who maintains it, and how it is maintained—additional analysis is required to provide recommendations for specific expansions to current programs and develop new programs. Note that pilot projects commissioned by the California-Mexico Border Relations Council have identified the need for permitting and enforcement, tire recycling and market development, and programmatic infrastructure dealing with waste tires (Border Region Solid Waste Working Group 2017).

While trash and tire source control is feasible, its primary implementation challenge is the need for long-term planning and implementation. Improperly maintained trash cans and trash capture devices can exacerbate the problem. Without proper public outreach and education, trash receptacles in public areas could also be exposed to abuse and used for items other than trash generated in transit. For example, in Mexico City, the City Metro officials removed all trash cans from the system's 195 metro stations (and the city's Metrobus stations followed suit) due to dumping of household and business trash in the receptacles, causing them to overflow quickly (Mexico News Daily Staff 2019). Recycling programs also require processing facilities as well as a demand for the recycled product. Additionally, enforcement of illegal dumping regulations can reduce the amount of improperly disposed trash and tires (Tijuana River Valley Recovery Team 2012).

2.3 Public Education, Outreach, and Participation Programs

2.3.1 Source Control Strategy Concept

Public education, outreach, and participation programs aim to change behaviors among target groups to achieve environmental and social goals. Public education and outreach involve creating and distributing informational materials (e.g., fliers, websites, webinars) to create the foundation for the desired change in behavior. Public participation involves providing opportunities for the public to participate in hands-on activities that work towards the program's goal (e.g., picking up trash in Los Laureles Canyon).

Data collected by EPA about implementing municipal separate storm sewer system public education and outreach programs in California suggest that a program designed to serve a population the size of Tijuana's would cost a total of $250,000 to $500,000 annually, including staffing, materials, and equipment (U.S. EPA no date 1). Capital costs for such a program are minimal, and efficiencies can be gained over time as the program evolves to more effectively reach target audiences. Additionally, targeting the program to specific regions or neighborhoods in Tijuana, rather than throughout the whole city, can reduce costs.

2.3.2 Activities Previously Completed

Public education, outreach, and participation programs are implemented in the watershed for a variety of environmental initiatives by government agencies and environmental organizations. These programs have been effective in raising public awareness and changing behaviors to reduce waste or achieve other environmental outcomes. To address source control of trash, waste tires, and sediment, various entities have implemented public education, outreach, and participation programs in Mexico. Some examples of those programs are:

- Every year in September, the Tijuana River Action Network organizes Tijuana River Action Month (TRAM). During TRAM, a series of volunteer activities and informational workshops are held. In 2015, TRAM activities resulted in over 3,802 volunteers collecting 43,676 pounds of trash throughout the watershed over six weeks, both north and south of the border (WILDCOAST 2015).
- Environmental education activities in schools in the Mexicali region (Border Region Solid Waste Working Group 2017).
- In 2012, EPA and Mexico's Secretaría de Medio Ambiente y Recursos Naturales developed the Scrap Tires Handbook on Recycling Application and Management for the U.S. and Mexico (Border Region Solid Waste Working Group 2017).
- Using a $70,000 grant from EPA through the U.S.-Mexico Border Environmental Cooperation Commission, the Tijuana environmental group Proyecto Fronterizo de Educación Ambiental, is helping a dozen Tijuana restaurants minimize disposal of items such as straws and polystyrene foam containers (Dibble 2016).

2.3.3 Feasibility and Challenges

As demonstrated above, public education and outreach activities are already in place in the Tijuana River watershed. Expanding on existing programs and adding new programs is feasible and would have much lower implementation costs compared to designing and constructing new infrastructure. However, further analysis is needed to understand existing programs' funding and effectiveness prior to identifying specific outreach and education opportunities. Generally, depending on the type of program, costs arise from printing educational materials, advertising, digital media rights and development, and basic equipment (e.g., clean up days may require trash bags, travel costs, or gloves). In many cases, implementation efforts combined with ongoing efforts by nonprofits and other community-based organizations can reduce cost.

2.4 Land Stabilization

2.4.1 Source Control Strategy

Permanent land stabilization addresses long-term erosion issues caused by stormwater runoff and wind. A common landscape stabilization method is using native plants to stabilize a previously disturbed area. The plants provide canopy interception of rainfall, increase infiltration, and stabilize soils with their root structures. Another method of land stabilization is using downstream sediment deposits to fill in and support upland eroded areas. Tires can also be used for slope stabilization projects. A 2008 study found that waste tires can easily carry tensile loads of 20 kN and can be stabilized in the hillside using backfill. Backfilling the tires could provide another opportunity to utilize downstream sediment deposits (Huat et al. 2008).

As with the other source control options, land stabilization costs vary greatly depending on the project. Some of the factors that impact cost are site topography, land use conflicts, utility considerations, soil type, and availability of materials. In general, vegetative land stabilization methods are more cost-effective than methods involving heavy machinery and sediment transportation. Using waste tires to stabilize soils could enable cost savings by providing source control for multiple pollutants with the implementation of a single project.

2.4.2 Activities Previously Completed

PG encountered fewer examples of land stabilization programs in the Tijuana River watershed than for the other source control strategies. Some examples are:

- In response to a California Coastal Conservancy-funded watershed diagnostic study, 96 acres of previously bare slopes were re-vegetated with natural drought-tolerant plants. The project utilized binational investments from local, state, and federal agencies (Tijuana River Valley Recovery Team 2012). However, it is unclear whether this project was implemented specifically to reduce downstream sedimentation.
- Using sediment deposits to fill upland areas has been implemented in the past in Los Laureles Canyon to reduce the cost of sediment disposal (Tijuana River Valley Recovery Team 2012).

2.4.3 Feasibility and Challenges

Based on information reviewed by PG, land stabilization appears to be feasible in some areas of Los Laureles Canyon based on soil make-up, slope, access, and current wildlife. However, a survey study completed by the University of California, Irvine, and San Diego State University determined that revegetation opportunities are limited in the Tijuana River watershed, partly due to the exposed area being primarily unpaved roads. As the study concluded, unpaved roads are the largest areas of exposed soil, so paving them would provide more stabilization of soils than land stabilization practices in those areas (Biggs et al. 2020). Additional information and studies would be required to determine who to involve in future projects, identify sites for stabilization, and determine the best land stabilization method for the area based on social and environmental factors.

With the surplus of waste tires in the region, it is feasible that waste tires could be utilized for land stabilization projects. This may necessitate implementing standards and/or an inspection program to ensure proper installation. Using waste tires could reduce the associated materials costs while also removing tires from the environment and/or waste stream. As with road paving, any stabilization projects would need to consider the highly erosive soils in Los Laureles prior to starting.

Land stabilization projects may also face challenges related to the need for coordination between federal, state, and local agencies, among other stakeholders. Coordination efforts can impact schedules and timing, or even preclude projects from occurring due to land use conflicts. Restrictions may also arise due to threatened or endangered species' breeding seasons (Tijuana River Valley Recovery Team 2012). Wet weather and growing schedules also limit the timing of remediation activities (Tijuana River Valley Recovery Team 2012).

2.5 Green Infrastructure

2.5.1 Source Control Strategy

Green infrastructure incorporates nature-based solutions for managing urban stormwater runoff by providing pollutant removal and runoff volume reduction. Rather than managing stormwater downstream with conventional grey infrastructure (e.g., detention/retention basins), the goal of green infrastructure is to manage runoff locally with onsite BMP installations such as rain gardens, bioswales, porous pavements, and rainwater harvesting systems (U.S. EPA no date 2). If implemented correctly, on-site management of stormwater with green infrastructure can reduce downstream erosion and flooding hazards. Green infrastructure can be constructed as part of new construction or as a retrofit to existing infrastructure. When choosing the best BMP for a given location, planners must consider factors such as soil characteristics, topography, and land use restrictions. Green infrastructure requires multi-disciplinary planning and cannot remove all pollutants (MacAdam et al. 2012).

Cost considerations vary greatly depending on the BMP chosen for installation at each location. Larger retrofit installations that treat for quality and quantity will cost more than BMPs installed at the time of construction or BMPs that treat smaller areas. Conservation of land is generally the most cost-effective form of green infrastructure but can only be utilized during initial development of the area (Roseen et al. 2011).

A study conducted by the University of New Hampshire Stormwater Center, Virginia Commonwealth University, and Antioch University New England demonstrates the use of low-impact development (LID) and the economics and resiliency. Chapter three of the study, called "Economic and LID Practices," provides some cost estimates for installation of LID, including an example cost difference between conventional and LID implementation during construction of a subdivision. The example shows that the LID subdivision construction cost is less than the cost of a conventional subdivision.

2.5.2 Activities Previously Completed

To address source control of trash, waste tires, and sediment, various entities have implemented green infrastructure in the Tijuana River watershed. Some examples include:

- Alter Terra, with permission from local government, is creating a linear park that connects to a tire construction demonstration along a small canyon four miles north to the U.S.-Mexico border using semipermeable concrete (St. George 2015).
- The Border Environmental Cooperation Commission (BECC) created the Border Communities Green Infrastructure Initiative to support communities building green

infrastructure in public spaces (e.g., parks, medians, parking lots). The program reported (Giner et al. 2017) that the following projects were completed:

"a) two border wide forums with an attendance of almost 300 participants each; b) implementation of five pilot projects in the border towns of Sonora, Coahuila and Texas; c) incorporation of GI [green infrastructure] into municipal codes of three border cities; d) development of design guidelines for Mexico, leveraging U.S. experience, with input from the private sector, [;] e) binational stormwater master plan for 2 communities, [;] and f) development of a hydrologic model for a case study at a micro watershed level, replicable to other shared basins."

2.5.3 Feasibility and Challenges

Since a large variety of green infrastructure options can be customized for differing site conditions, it may be feasible to implement green infrastructure to mitigate erosion in select locations of the Tijuana River watershed. However, additional analysis is needed to determine what locations may be feasible for green infrastructure, who should be involved (short-term and long-term), and the potential reductions in transboundary flow sediment loadings. Wide-scale implementation of green infrastructure is likely impracticable.

Compared to traditional grey infrastructure, green infrastructure is a relatively new concept in urban planning and design. Successful implementation requires a shift in thinking and may necessitate new training, changes to local codes, and outreach to local community members. BECC and NADB's Border Communities Green Infrastructure Initiative approach includes "four strategic pillars" that address those items (Giner et al. 2019). Additional challenges include placement and long-term maintenance of green infrastructure. For example, green infrastructure BMPs must be carefully selected for a given location based on site suitability factors. In areas with highly erosive soils, such as Los Laureles Canyon, the soils could quickly clog porous pavement and increase the need for maintenance. In urbanized areas, such as those upgradient from the Tijuana River channel, lack of available space may prevent green infrastructure from being installed. Additionally, a dry climate poses unique challenges associated with draught, large temperature swings, heavy rainfall, and native plant species.

3. PROJECT IMPACT

3.1 Environmental Impact and Benefits

In conjunction with the feasibility assessment, ERG is currently preparing an Environmental Impact Document (EID) that will describe the potential environmental impacts of the 10 proposed projects (including Project 10), focusing on impacts in the U.S. or caused by activities in the U.S. Based on a review of existing available information, Project 10 is not expected to trigger any non-water-quality environmental impacts of concern in the U.S.[1] The EID will include a more thorough evaluation of potential non-water-quality impacts in the U.S.

Flows from the Tijuana River at any time can include sewage, stormwater, effluent from wastewater plants, industrial discharge, agricultural runoff, groundwater, sediment, and trash that cause water quality impairments, damage adjacent habitats, and impact recreational opportunities. Discarded waste tires can cause a variety of issues, including tire fires, providing a breeding ground for pests and vectors, and inhibiting the regrowth of native vegetation such as cord grass (Border Region Solid Waste Working Group 2017). Trash can clog channels, alter flow patterns, cause flooding by clogging existing collection infrastructure, and negatively impact the aesthetics of an area (HDR 2020). Reducing trash and waste tires would improve the above-mentioned conditions and reduce the potential for environmental impacts in the watershed. Reducing improper trash and solid disposal is also expected to improve O&M of conveyance and treatment systems designed to mitigate transboundary flows (see USMCA Projects 1, 2, 4 and 6), supporting the expected water quality benefits of those projects, which include reduced impacts on beaches and coastal facilities including the Navy SEALs training facility in Coronado, California. Providing source control for trash and sediment could also reduce the loadings in discharges to the Pacific Ocean, though additional information and further analysis are needed to estimate potential trash and sediment load reductions from implementing source control strategies. Source control is considered a cost-effective means of preventing trash and sediment from entering the waterways (Tijuana River Valley Recovery Team 2012).

Installation of green infrastructure, roads, and land stabilization projects could temporarily increase sediment erosion due to construction activities. However, construction runoff can be addressed with the installation of proper erosion and sediment control measures during land disturbing activities. Additionally, long-term stabilization projects using native vegetation improve the natural ability to flush sediments and other pollutants from the environment and reduce erosion while providing habitat for local wildlife. Paving also provides air quality benefits by reducing particulate matter in the air that has been linked to health issues (NADB 2003).

[1] ERG considered the following "impacts of concern" to be indicators of potentially significant environmental impacts that warrant detailed review during preparation of the EID, the subsequent National Environmental Policy Act process, and related consultations and resource-specific studies: disproportionate, adverse effects on minority and/or low-income communities; potential for adverse effects on federally listed threatened or endangered species or their critical habitat; adverse effects on tribal/cultural resources; adverse effects on important natural resource areas such as wetlands, floodplains, coastal zones, and significant fish or wildlife habitat; modification, diversion, and/or alteration of the main course of the Tijuana River; criteria pollutant emissions that exceed Clean Air Act General Conformity Rule de minimis thresholds; and significant public controversy about a potential environmental impact.

3.2 Social Impacts and Benefits

Under Project 10, long-term positive socioeconomic impacts to affected populations in both the U.S. and Mexico (e.g., reduced public health risk, improved aesthetics, improved property values) are expected to outweigh the negative, localized impacts during construction in Mexico (e.g., temporary increase in noise, equipment/dust emissions, and traffic) and during long-term operations (e.g., operation of new or expanded trash processing facilities). The EID will include a more thorough evaluation of potential transboundary socioeconomic impacts in the U.S.

By reducing contaminated transboundary flows of trash and sediment, Project 10 will help lessen the existing impacts to U.S. Customs and Border Protection operations and workforce resulting from exposure to contaminated transboundary flows of sewage near border infrastructure.

Source control of trash and sediment provides social benefits on both sides of the international border. By preventing trash and sediment from entering the waste stream, source control reduces the volume of pollutants that reaches the Tijuana River estuary and the Pacific Ocean. A reduction in pollutants could improve aesthetics and can lead to increased tourism and recreation. Additionally, reducing the volume of trash that crosses the border reduces the cost of maintenance of “end of pipe” controls (e.g., sedimentation basins, trash booms).

Properly implemented source control would also bring local social benefits in Mexico. For example, paved roads can increase property values, accessibility, and air quality. Additionally, source control strategies can create cost savings for consumers. For example, a public education program that motivates households to replace disposable items with reusable items removes a reoccurring cost from the household and reduces waste entering the waste stream. Also, reducing erosion through land stabilization or by paving roads mitigates the formation of gullies, which can destroy infrastructure and threaten property (Biggs et al. 2020).

Some source control strategies, such as increased trash collection and tire recycling programs, could also create jobs and boost the local economy. The Border Region Solid Waste Working Group estimates that the used tire industry supports approximately 24,000 Mexican workers (Border Region Solid Waste Working Group 2017). Lastly, paving roads and installing green infrastructure can increase opportunities for local contractors to bid on projects.

4. CONCLUSION

The purpose of Project 10 is to control trash and sediment at its source in Mexico to reduce the loadings of these pollutants in transboundary flows from Mexico to the U.S. via the Tijuana River and Los Laureles Canyon (Goat Canyon). All of the source control strategies reviewed have the potential to reduce trash, sediment, or both, though further analysis is needed to assess which strategy or combination of strategies is likely to provide the best value for source control. Although the scope of Project 10 focused on the Tijuana River and Los Laureles Canyon, the source control options presented in this report could also be effective in the other canyons. PG assessed the feasibility of five source control strategies and arrived at the following conclusions:

1. Road paving to reduce erosion and sediment entering the Tijuana River is feasible, but due to terrain and/or remote location prohibiting access with paving equipment, not all roads are suitable for paving. As stated previously, roads should be targeted for paving depending on their potential to contribute to sediment loadings, and any infrastructure damage around the area to be paved should be repaired prior to paving. The highly erodible marine and fluvial sediments in Los Laureles Canyon (Biggs et al. 2020) require stabilization prior to paving. Roads with a high potential to contribute sediment loading, but which are inaccessible for paving, should be considered for other source control strategies such as land stabilization or green infrastructure. However, the site characteristics that prevent paving (remote locations, steep slopes, etc.) will also increase the cost of implementing alternative source control strategies.

2. Trash and tire collection, processing, and disposal activities are technically feasible to reduce the amount of trash entering the waste stream. Some activities are feasible in only certain locations and all require long-term cost and planning. There appear to be opportunities to expand upon existing activities, as well as implement new activities.

3. Public education and outreach programs are generally the least expensive source control method. Public education and outreach programs are feasible throughout the watershed and can build on programs that already exist or be developed as new, targeted programs. Additionally, public education and outreach programs can support other source control programs by providing information needed to properly implement other source control strategies, and by providing context to the issues associated with trash and sediment in the Tijuana River to build public support for investment in other source control strategies.

4. Land stabilization, completed by revegetation or structural means, can reduce the amount of sediment that enters waterways. Specifically, streambank and hillside stabilization can prevent erosion during storm events. Land stabilization is technically a feasible option for some parts of the Tijuana River watershed. This source control strategy, along with green infrastructure, would likely provide the greatest benefit in the upper portions of the watershed to minimize pass-through runoff to the lower portions of the watershed.

5. Green infrastructure covers a wide variety of construction options to mitigate the flow of stormwater that can be adapted to specific locations. Due the ability to customize green infrastructure for an area, it is feasible that green infrastructure could be utilized to help reduce erosion and improve water quality in the Tijuana River and Los Laureles Canyon. Although green infrastructure is feasible, it does require long-term operation and maintenance, which needs to be factored into costing and design. Additionally, some types of green infrastructure would not be feasible in all parts of the watershed due to lack of

available land to implement green infrastructure practices. The semi-arid climate in Tijuana necessitates the use of native or drought-tolerant and low-maintenance plants to withstand extended periods of low moisture as well.

All five source control options are already implemented in, or have been implemented to some extent in, the Tijuana River watershed. As Mexico already uses the five source control strategies, it is feasible that they could continue to be implemented or be expanded upon, or new programs and/or BMPs could be implemented with the proper funding, design, and long-term planning. It is important to note that not all strategies are feasible in every part of the watershed. For example, trash full capture devices can only be utilized in areas with existing storm sewer infrastructure. Another example is that porous pavement, a green infrastructure BMP, may not be suitable for areas with highly erosive soil that can clog the pores quickly, requiring increased maintenance or failure of the BMP.

In general, the BMPs evaluated as part of Project 10 are scalable and targetable to locations of greatest impact. Implementation costs for the source control BMPs evaluated can range significantly depending on the scale of implementation and whether or not implementation is building on existing programs. Because specific implementation scenarios were not evaluated as part of this feasibility analysis, cost estimates have not been developed.

5. SUGGESTED NEXT STEPS

If EPA elects to pursue one or all of the strategies presented in this report, PG recommends the following next steps:

1. Conduct a review to validate BMP unit costs currently available, including identifying cost data gaps for BMPs that are likely to be implemented in Tijuana.

2. Conduct additional research, including interviewing stakeholders and coordinating with knowledgeable entities with Mexican or binational organizations, and determine if existing cost data are suitable for estimating the cost of future BMP applications within the Tijuana River watershed.

3. Obtain street- and parcel-level GIS data and integrate into a watershed-wide GIS database.

4. Using that database, attempt to identify "hot spot" erosion areas in Los Laureles Canyon where road paving and/or land stabilization methods could most effectively reduce downstream sediment loads. Also, identify the locations where trash excluding devices could be installed for optimized trash collection.

5. Using the BMP unit cost and location data, develop more comprehensive cost estimates for select BMPs.

6. Establish contact with local and state officials in Mexico to explore implementation of new or expanded trash and recycling collection programs, as well as new or expanded public education, outreach, and participation programs.

7. Develop a more robust feasibility estimate and corresponding cost estimate that identify BMPs of preference, their location, cost, and implementing agency coupled with a public education and implementation and maintenance plan.

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