

PROMOTE A CULTURE OF INTEGRATED STEWARDSHIP OF THE ESTUARINE SYSTEM, ITS WATERSHED, AND RELATED ECOSYSTEMS

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COMMUNITY ENGAGEMENT IN RESTORATION AND CONSERVATION

BASELINE

Community engagement is fundamental to the longterm success of conservation, restoration, reconstruction, and/or remediation in the San Juan Bay Estuary (SJBE). Restoration projects deliver the greatest ecological and social returns when local people are meaningfully involved. Residents contribute labor and local ecological knowledge, schools supply steady streams of youth participants and future practitioners, and community groups sustain stewardship and advocacy long after initial project funding ends. Estuario has engaged with over 6,000 volunteer participants and has a documented history of outreach including visitor center exhibits, public campaigns, large-scale planting events with volunteers, and multisector consultation, which provides a tested institutional foundation on which to build a more systematic suite of engagement programs. The 2016 Estuario Plan describes these prior public participation efforts and recommends longitudinal methods for measuring and expanding knowledge about the estuary and its ecosystems (Estuario, 2016).

To transform engagement into measurable conservation outcomes, program design must intentionally connect education, volunteer opportunities, and technical support. Outsideofschool Science, Technology, Engineering, and Mathematics (STEM) programs offer hands-on, flexible environments where students can develop confidence, deepen STEM skills, and explore career pathways in naturalresource fields. Research and practitioner reports show that outofschool STEM learning increases interest and attainment in STEM, particularly for girls and youth of color, while also addressing learning time constraints faced by traditional classrooms. Barriers to STEM programs exist, limiting access to these programs for many young people (Neitzey, 2021). Increasing access to STEM programs for all youth in the SJBE is key for the success of these programs. The Forbes analysis of outside-of-school and summer STEM programming underscores the role these settings play in building STEM identities and preparing students for careers that may not yet exist. This flexibility is crucial for training youth in emerging tools and techniques used in contemporary restoration science (Ottinger, 2024).

While classroom lessons can introduce essential scientific concepts, outside-of-school programs such as summer camps, guided field visits, and internships also give students hands-on opportunities to practice monitoring and restoration techniques. Frequent, sustained outdoor experiences are strongly correlated with the development of environmental stewardship. Contact with nature increases personal commitment to biodiversity conservation and fosters pro-environmental behaviors (Prévot et al., 2018; Alcock et al., 2020; Martin et al., 2020; Whitburn et al., 2019), while loss of interaction with nature discourages the attitudes and behaviors that support conservation (Soga & Gaston, 2016). Behavioral research further indicates that individual behavior change can meaningfully reverse environmental degradation, making applied, experiential programs a critical complement to classroom instruction (Nielsen et al., 2021; Jucker et al., 2018). Estuario's existing education initiatives demonstrate how curriculum materials and volunteer training can be designed so that learning produces tangible contributions to restoration work and creates pathways to further engagement (Estuario, 2025). These experiences help students move from awareness to applied skills and prepare a local pool of volunteers, citizen scientists, and future practitioners.

Citizen science, which creates and applies scientific methods through collaborative models between professional scientists and the general public, and structured volunteer monitoring, in which community members collect and analyze data, can supply highvalue ecological data and broaden the base of active stewards in the community. The National Oceanic and Atmospheric Administration’s (NOAA) community science and restoration guidance highlights how volunteer programs, when paired with standardized methods and technical oversight, produce data useful for adaptive management while engaging thousands of volunteers and generating substantial inkind contributions to restoration work (NOAA, 2024).

Estuario has a Citizen Scientist certification that allows interested participants the opportunity to train in one of four modules: (1) Water Quality Monitoring, (2) Participatory Bird Censuses, (3) Characterization and Reduction of Microplastics, and (4) Coastal Resilience. Each module includes both virtual workshops and field experiences that must be completed to receive a certification. A participant can become certified in one or more modules by successfully completing all requirements of each module. Since 2020, there has been significant participation in each module, as with over 1,017 participants in Water Quality Monitoring, 1,740 participants in Participatory Bird Census, 1,060 participants in Characterization and Reduction of Microplastics, and 2,672 participants in Coastal Resilience (Estuario, 2023).

This existing certification can be expanded to include an engagement strategy for K–12 students by providing outofschool programming with field experiences, workshops, or other educational activities. These elements reinforce one another, because youth who develop skills in out-ofschool programs may eventually become certified citizen scientists and later serve as volunteer leaders or restoration technicians, which produces both ecological benefits and local workforce development.

By embedding accessibility, data rigor, and career pathways into engagement programming, Estuario can convert community energy into measurable action, improved water quality monitoring coverage through citizen scientists, and a resilient local team of restoration professionals and stewards.

OBJECTIVES

- Ensure opportunities for communities to engage in restoration and conservation efforts.

ACTIONS

IS-01 ESTABLISH LONG-TERM EDUCATION AND OUTREACH PROGRAMS TO PROVIDE THE PUBLIC WITH EFFECTIVE AND ORGANIZED VOLUNTEER OPPORTUNITIES TO FURTHER CONSERVATION, RESTORATION, RECONSTRUCTION, AND/OR REMEDIATION EFFORTS. ADAPTATION

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
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1. Strengthen and expand K-12 education and outofschool learning pathways focused on conservation, restoration, reconstruction, and/or remediation of ecosystems.	Increase participation rates in K-12 programming by collaborating with established environmental education organizations and/or other important partners.	Created at least one out-of-school educational program focused on conservation, restoration, reconstruction, and/or remediation.	Lead: Estuario Implementing partners: Puerto Rico Department of Education (PRDE), community stakeholders and organizations	Pending	5+ years	TBD	USEPA, PRDE
2. Create youth-to-career experiential programs that connect students with professional practice.	Increase collaboration with community stakeholders that provide career programming and/or mentorship opportunities for students.	Collaborated with academia and organizations to develop the program framework.	Lead: Estuario Implementing partners: PRDE, community stakeholders and organizations, academia	Pending	5+ years	TBD	USEPA, PRDE
3. Strengthen and expand the citizen science certification.	Increase the number of citizen scientists undertaking conservation, restoration, reconstruction, and/or remediation projects and identify their impacts.	Increased the number of certified citizen scientists.	Lead: Estuario Implementing partners: Puerto Rico Department of Natural and Environmental Resources (DNER), PRDE, academia	Pending	0-2 years	TBD	USEPA, PRDE, DNER
4. Establish an educator certification in estuary science and restoration.	Partner with stakeholders to recognize the certification for professional accreditation and obtain endorsements.	Created stipends and funding opportunities for educators to complete the certification.	Lead: Estuario Implementing partners: PRDE, academia, Department of Education	Pending	5+ years	TBD	USEPA, PRDE
5. Provide equitable access and sustained participation through financial support and inclusive outreach.	Measure enrollment and participation in ongoing programs and identify gaps in geographic and socioeconomic groups.	Created an inclusive outreach strategy to identify participants.	Lead: Estuario Implementing partners: PRDE, academia	Pending	5+ years	TBD	USEPA, PRDE

REGULATORY AND POLICY REQUIREMENTS

None.

**NEW* IS-02 IDENTIFY AND DEVELOP CONSERVATION, RESTORATION, RECONSTRUCTION, AND/OR REMEDIATION PROJECTS IN THE SJBE THAT CAN BE COMMUNITY-LED AND ORGANIZED.*

ADAPTATION

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Work with community leaders and/or members to identify and address areas that need conservation, restoration, reconstruction, and/or remediation and have the potential for community-led efforts.	Determine community interest and willingness to engage in conservation, restoration, reconstruction, and/or remediation efforts.	Performed detailed ecological assessments of potential conservation, restoration, reconstruction, and/or remediation areas with community members.	Lead: Estuario, municipalities Implementing partners: PRDE, community stakeholder groups, DNER	Pending	0-2 years	TBD	USEPA, DNER, municipalities
2. Engage and empower community leaders to organize and activate their local community to participate in conservation, restoration, reconstruction, and/or remediation projects.	Establish targets for the number of recruited volunteers for conservation, restoration, reconstruction, and/or remediation projects.	Organized community members that meet regularly to discuss Estuario's projects and the community's active participation.	Lead: Estuario, municipalities Implementing partners: PRDE, community stakeholder groups, DNER	Pending	0-2 years	TBD	USEPA, DNER, municipalities

REGULATORY AND POLICY REQUIREMENTS

None.

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EDUCATION

BASELINE

Education underpins Estuario’s ability to sustain conservation, restoration, reconstruction, and/or remediation into the future. To achieve this goal, a strategic education program is essential, as it builds local knowledge about how the estuary functions, explains human influences on ecological processes, and creates the skills needed for community members to lead and take part in restoration projects. Moreover, education can also strengthen adaptation measures and urban resilience by teaching residents and other stakeholders about key topics and equipping them with the knowledge to support and maintain nature-based solutions. Estuario’s prior planning and outreach work provides a foundation for expanding education across the watershed and aligning materials and programs with restoration goals (Estuario, 2016). Targeted training, such as for Estuario’s citizen scientists, helps connect learning to action, and produces data that can inform management and planning efforts.

One effective approach to engage the community is through place-based interpretation and signage, which serve as practical starting points for reaching a broad audience. Well-sited educational signs and a coordinated wayfinding system at bridges, parks, marinas, ports, waterfronts, and other locations make the estuary visible in everyday life. This visibility helps residents and visitors recognize the SJBE boundaries and understand its functions. Long term research on interpretive signs shows that messages tied to local context increase understanding and repeated exposure can prompt people to seek further information or participate in on-site activities (Cagle, 2025). When signs are integrated with visual art, historic storytelling, or interactive elements they can also reflect community identity and attract interest from people who might not otherwise engage with environmental topics (Cagle, 2025).

Moreover, public materials and communications must be designed for accessibility and continuity. Handbooks, brochures, and infographics should use clear language and be available in Spanish and English. While printed materials can work well for distribution at community centers and schools, a coordinated communications plan can extend reach through social media, local media partnerships, and on-site programming. In-person activities, such as conferences, volunteer trainings, educational fairs, and festivals, can also be opportunities for education. Estuario can serve as a convening organization to coordinate these channels and to help municipalities, schools, and community groups share consistent messages across the watershed (Estuario, 2016).

Finally, it is vital to incorporate evaluation and adaptive improvement into every educational activity. Simple metrics such as the number of participants, repeat attendance, materials distributed, guided tours conducted, increased public understanding and student projects completed will indicate whether programs are achieving their goals. Collecting feedback from teachers, students, and community members will help Estuario refine content and delivery and will support efforts to secure sustained funding.

By combining place-based interpretation, scaffolded learning pathways, accessible materials, and regular evaluation, Estuario’s education program can expand public understanding, create practical skills for restoration, and increase community capacity to care for the estuary for years to come.

OBJECTIVES

- Build capacity for communities to lead and participate in restoration and conservation projects.

ACTIONS

IS-03 POST EDUCATIONAL AND INTERPRETIVE SIGNS AT HIGHLY VISIBLE, HEAVY TRAFFIC AREAS THROUGHOUT THE SJBE WATERSHED (BRIDGES, ROADS, PARKS, MARINAS, PORTS, WATERFRONTS) TO EDUCATE THE PUBLIC ON THE SYSTEM'S COMPONENTS, FUNCTIONS, AND VALUES.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Develop a wayfinding project in strategic locations using billboards, road signs, and other methods that increase spatial awareness about the SJBE and show how the public engages with and lives within the SJBE.	Install wayfinding elements within the SJBE watershed.	Identified key locations for wayfinding installations.	Lead: Estuario Implementing partners: community stakeholders, DNER, DTO, municipalities, Puerto Rico Ports Authority	Pending	3-5 years	TBD	USEPA, municipalities
2. Implement innovative approaches to educate and raise awareness about the evolution of the SJBE.	Increase in community participation in educational programs.	Identified key themes to include in educational opportunities for the public.	Lead: Estuario Implementing partners: local artists and organizations, municipalities	Pending	0-2 years	TBD	USEPA, U.S. Army Corps of Engineers (USACE), municipalities, community stakeholders
3. Design and offer supplementary workshops, guided tours, and on-site lectures that supplement and strengthen existing educational and interpretive signs.	Increase attendance and participation in supplementary educational activities.	Created promotional materials and outreach strategies to inform the community about new programming.	Lead: Estuario Implementing partners: community stakeholders, municipalities	Pending	3-5 years	TBD	USEPA, USACE, municipalities, community stakeholders

REGULATORY AND POLICY REQUIREMENTS

None.

IS-04 EXPAND THE SCOPE OF ESTUARIO'S PUBLIC EDUCATION AND OUTREACH ACTIVITIES.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
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1. Create a network of stakeholders to coordinate actions related to community education and outreach.	Increase collaboration on initiatives and projects launched within the network that address community education and outreach needs.	Identified needs within communities such as out-of-school programs and summer camps.	Lead: Estuario Implementing partners: municipalities, community organizations, academia	Pending	0-2 years	TBD	USEPA, municipalities
2. Collaborate with private sector groups such as hotels, restaurants, and port facilities on community education and outreach opportunities.	Increase collaboration with the private sector that addresses community education and outreach needs.	Created a signed memorandum of understanding that supports the collaboration.	Lead: Estuario Implementing partners: private sector, Puerto Rico Ports Authority, community organizations, municipalities	Pending	0-2 years	TBD	USEPA, private sector companies

REGULATORY AND POLICY REQUIREMENTS

None.

IS-05 DEVELOP A SERIES OF HANDBOOKS, BROCHURES, INFOGRAPHICS, AND OTHER EDUCATIONAL MATERIALS, RESOURCES, AND TOOLS FOR THE PUBLIC TO EDUCATE ON THE IMPORTANCE AND FUNCTION OF THE ENTIRE SJBE SYSTEM AND FACTORS THAT AFFECT WATER QUALITY. ADAPTATION

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Collaborate with scientists, educators, and local stakeholders to develop the content of educational materials.	Collect feedback from stakeholders.	Communicated with stakeholders and discussed the goals of the educational materials.	Lead: Estuario Implementing partners: PRDE, academia, local stakeholders	Pending	0-2 years	TBD	USEPA
2. Develop educational materials in various formats to provide proper accessibility and visibility.	Measure the reach of the materials across different formats.	Created visually appealing educational materials that are engaging and easy to understand.	Lead: Estuario Implementing partners: PRDE, academia, local stakeholders	Pending	3-5 years	TBD	USEPA, USACE
3. Develop a distribution plan for the educational materials.	Include sectors from across the entire SJBE watershed in the distribution plan.	Created a distribution plan that targets a variety of audiences.	Lead: Estuario Implementing partners: PRDE, local stakeholders	Pending	0-2 years	TBD	USEPA

REGULATORY AND POLICY REQUIREMENTS

None.

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RAISING AWARENESS

BASELINE

Raising public awareness is a critical step toward changing everyday behaviors that affect the SJBE. Increased awareness helps people understand how individual choices contribute to stormwater pollution, habitat degradation, and marine debris, and supplies clear, actionable steps that residents, businesses, and visitors can take to reduce harm. The 2016 CCMP recognizes public outreach and education as cornerstones of community stewardship, and it documents Estuario's past efforts to inform and involve citizens across the watershed (Estuario, 2016). Building on that foundation, a targeted awareness program can move people from passive knowledge to active responsibility.

Beyond information, awareness activities should make it easy for people to act. Tools that translate concern into concrete reporting and response pathways can increase civic participation and reduce the lag between observation and official action (Brown, 2025). A public reporting platform where residents can submit observations about pollution, illegal dumping, and/or habitat alteration helps document problems and connects community members to the right agencies for response. When designing such a system, it is important to provide clear guidelines about the types of concerns that can be reported, align reporting channels with municipal procedures, and set clear expectations about response times and priorities so users know how reports will be managed. Staffing capacity and response time can vary; therefore, it is important to manage public expectations with reporting tools. Evidence from municipal reporting platforms shows substantial public uptake but also highlights the need to manage legal and administrative implications and to coordinate protocols among agencies that will receive reports (Brown, 2025).

Effective awareness work must also be culturally relevant, accessible, and evaluated. Messaging should be developed with input from local communities so that content reflects place-based experiences and language preferences. Materials should be available in Spanish and English and distributed at venues where people already gather. Evaluation should track both reach and outcomes, including metrics such as number of reports submitted through the public reporting system, number of pledges taken, participation in related events, and qualitative feedback from community partners. Regular review of these metrics will allow Estuario to refine messages and channels and to demonstrate progress to partners and funders.

Finally, awareness programs should be integrated into Estuario's broader education and engagement efforts so that learning, volunteering, and reporting reinforce each other. Clear signage and wayfinding can raise curiosity that is then satisfied by workshops, internships, and volunteer conservation, restoration, reconstruction, and/or remediation projects. A public reporting system can surface local problems that become the focus of community cleanups and education campaigns. When used together, these elements translate increased awareness into measurable actions that reduce pollution, restore habitat, and strengthen stewardship of the SJBE.

OBJECTIVES

- Contribute to the transformation of population behaviors to take responsibility for the estuarine system through education, community engagement, and other outreach strategies.

- Embrace a variety of mediums for communicating and raising awareness about the importance of restoring and conserving the estuarine system.

ACTIONS

IS-06 CREATE A LONG-RANGE COMMUNICATIONS PROJECT, INCLUDING SOCIAL MEDIA AND A METHOD FOR MEASURING KNOWLEDGE ABOUT THE ECOSYSTEM.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Assess the current communication methods, identify gaps, and implement a strategic approach that includes traditional media, digital platforms, and community engagement.	Increase the variety of communication channels used.	Created a comprehensive outreach strategy that outlines objectives and desired outcomes for each channel.	Lead: Estuario Implementing partners: community stakeholders	Pending	3-5 years	TBD	USEPA
2. Collaborate with local media outlets to feature stories and updates about Estuario's efforts.	Grow partnerships with local media representatives and outlets.	Increased media features highlighting Estuario and ongoing work.	Lead: Estuario Implementing partners: media outlets	Pending	0-2 years	TBD	USEPA
3. Incorporate strategies for content creation to increase viewership and public engagement through a variety of platforms such as Instagram, Facebook, LinkedIn, YouTube, and Estuario's website.	Increase in public engagement with Estuario's social media platforms.	Created content on a variety of platforms that increases public engagement, which may include support from influencers focused on environmental issues.	Lead: Estuario Implementing partners: community stakeholders	Pending	0-2 years	TBD	USEPA
4. Implement metrics and evaluation tools to track the effectiveness of communication efforts.	Collect feedback from stakeholders, via surveys or other methods, on their awareness and perceptions of communication efforts.	Established a schedule for regular monitoring of communication metrics.	Lead: Estuario Implementing partners: community stakeholders	Pending	0-2 years	TBD	USEPA

REGULATORY AND POLICY REQUIREMENTS

None.

**NEW* IS-07 CREATE A PUBLIC SYSTEM FOR COMMUNITY MEMBERS TO REPORT ENVIRONMENTAL CONCERNS AND DIRECT THEM TO CORRECT RESOURCES.*

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Design a platform where community members can easily report environmental concerns and receive updates on their reports. .	Increase in community members reporting environmental concerns, especially through the platform.	Engaged with community members to identify and address environmental concerns.	Lead: DNER Implementing partners: Estuario, municipalities, local community stakeholders	Pending	3-5 years	TBD	USEPA, USACE, DNER, municipalities
2. Partner with environmental agencies, municipalities, and organizations to ensure that reported concerns are directed to the right departments.	Increase in partnerships established to facilitate the reporting process.	Established protocols for how reported concerns will be tracked and escalated.	Lead: DNER Implementing partners: Estuario, municipalities, local community stakeholders	Pending	3-5 years	TBD	USEPA, DNER, municipalities

REGULATORY AND POLICY REQUIREMENTS

None.

**NEW* IS-08 UPDATE CURRENT CITIZEN'S GUIDES AND CREATE A TOOLKIT FOR COMMUNITY MEMBERS AND GENERAL PUBLIC THAT INCLUDES RESOURCES, TIPS, AND STRATEGIES FOR RESPONSIBLE BEHAVIORS THAT SUPPORT THE SJBE SYSTEM.*

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Identify key topics and content areas as well as current gaps that can be included in a toolkit to help encourage behaviors that support the SJBE system.	Assess community interest and needs that can be included.	Collaborated with academia and community stakeholders to identify essential knowledge areas.	Lead: Estuario Implementing partners: academia, DNER, municipalities, community stakeholders	Pending	0-2 years	TBD	USEPA, DNER, municipalities
2. Compile a directory with local resources and programs that support responsible behaviors that benefit the SBJE.	Develop a user-friendly format for the resource directory.	Defined key categories of resources and programs to include in the directory.	Lead: Estuario Implementing partners: academia, DNER, municipalities, community stakeholders	Pending	3-5 years	TBD	USEPA, DNER, municipalities

REGULATORY AND POLICY REQUIREMENTS

None.

**NEW* IS-09 INCREASE THE INVOLVEMENT OF SECTORS THAT HIGHLY IMPACT THE SJBE, SUCH AS HOTELS, PORT FACILITIES, AND RESTAURANTS.*

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Create a program where high-impact sectors can adopt a monitoring station and recruit their own volunteers to carry out monitoring activities.	Total number of monitoring stations adopted by high-impact sectors.	Implemented a recruitment campaign targeting high-impact sectors.	Lead: Estuario Implementing partners: High-impact sectors, Puerto Rico Ports Authority, DNER, municipalities	Pending	3-5 years	TBD	DNER, municipalities, high-impact sectors
2. Create a special fund that supports Estuario's efforts and is backed by high-impact sectors.	Develop mechanisms to ensure ongoing contributions to the special fund.	Created a clear governance structure for managing the special fund.	Lead: Estuario Implementing partners: High-impact sectors, DNER, municipalities	Pending	3-5 years	TBD	DNER, municipalities, high-impact sectors
3. Collaborate with stakeholders to support certification programs for high-impact sectors that meet sustainability standards.	Increase in businesses that are aware of estuary-related issues and participate in the program.	Incorporation of Estuario support into currently existing certification programs.	Lead: Estuario Implementing partners: High-impact sectors, DNER, municipalities	Pending	0-2 years	TBD	DNER, municipalities, high-impact sectors

REGULATORY AND POLICY REQUIREMENTS

None.

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RECREATION AND OTHER USES OF RESOURCES

BASELINE

Recreation and other sustainable uses of natural resources are both a cultural legacy and an economic opportunity for communities around the SJBE. For centuries people have drawn food, materials, and meaning from the island's waters and uplands. As our world has become more developed, natural areas have become a place for recreation and wonderment, but also a place for an industry known as ecotourism. The climate, beaches, biodiversity, mangroves, and reefs in the SJBE watershed make it an ideal destination for ecotourism, and these water-based resources are enhanced by unique urban upland environments surrounding the SJBE, such as San Patricio State Forest, Piñones State Forest, National Park Julio Enrique Monagas, Arboretum Park Doña Inés, and Luis Muñoz Rivera Park.

There are multiple benefits of ecotourism. Financial benefits are realized in the local community by creating accommodations, facilities, and shops and increasing jobs for local workers. Education and appreciation for the natural systems promote preservation and a more complete understanding of the importance and function of the ecosystem. Ecotourism success requires not only unique natural systems, but infrastructure and access, best practices employed by purveyors, marketing, and government support (World Tourism Organization, 2013).

In 2012, Puerto Rico passed the ecotourism law (Title 23, Part VI, Chapter 151 of the Laws of Puerto Rico). The law seeks to protect natural, environmental, historical, and cultural resources, and includes specific regulations and guidelines for tourists participating in ecotourism activities, ensuring that ecotourism is practiced responsibly and sustainably. Numerous government agencies are mandated to participate, including the Puerto Rico Tourism Company, DNER, and municipal governments. The law mandated the creation of a Master Plan for Sustainable Tourism and coordination across multiple state and local agencies as well as the private sector. The Tourism Company is also required to promote Puerto Rico as an environmentally responsible destination, prioritizing ecotourism and adapting marketing to global trends. The ecotourism law and the growth of the ecotourism industry align directly with the goals and objectives of Estuario.

Data-driven planning and coordinated governance are necessary for scaling recreation responsibly. Inventories of access, ecological sensitivity assessments, and number of visitors will guide where new facilities are appropriate and what mitigation is required. A central, searchable repository of site evaluations, permitting records, and zoning designations will reduce duplication and support evidence-based decisions. Performance indicators such as visitor counts, amount of time that volunteers spend on maintenance tasks, number of locally owned recreation businesses that promote ecotourism and low-impact recreation, and measures of ecological condition will enable adaptive management and demonstrate whether recreation is contributing to conservation and local prosperity.

When planned and managed well, recreation and ecotourism can strengthen the social and economic case for conserving the SJBE watershed. By combining habitat-sensitive infrastructure, support for local businesses, accessibility planning, and shared data systems, Estuario and partners can expand low-impact recreational opportunities that generate local benefits and foster long-term stewardship of natural resources.

OBJECTIVES

- Promote environmentally responsible actions in all sectors of society.

ACTIONS

**NEW* IS-10 ENSURE THAT ALL VISITORS IN THE SJBE ARE INFORMED ABOUT AND HAVE ACCESS TO BICYCLE TRAILS AND GREENWAY SPACES.*

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Conduct an accessibility audit to identify barriers and areas that require improvements.	Improve accessibility identified for alternative transportation corridors.	Collaboration with local advocacy groups and community members on the audit.	Lead: Puerto Rico Department of Transportation and Public Works (DOTPW) Implementing partners: Metropolitan Bus Authority, Transit Safety Commission, municipalities, local advocacy groups	Pending	0-2 years	TBD	DOTPW, Metropolitan Bus Authority, Transit Safety Commission, municipalities
2. Engage with local advocacy groups and community members to gather input on needs and preferences for access.	Improve accessibility identified for alternative transportation corridors.	Collected feedback on preferences for access from local advocacy groups and community members.	Lead: Puerto Rico Department of Transportation and Public Works (DOTPW) Implementing partners: Metropolitan Bus Authority, Transit Safety Commission, municipalities, local advocacy groups	Pending	0-2 years	TBD	DOTPW, Metropolitan Bus Authority, Transit Safety Commission, municipalities
3. Create an outreach program and/or campaign to inform the community about accessible trails and green spaces.	Improve access identified throughout the watershed.	Adopted an outreach program.	Lead: DOTPW Implementing partners: Metropolitan Bus Authority, Transit Safety Commission, municipalities, local advocacy groups	Pending	3-5 years	TBD	DOTPW, Metropolitan Bus Authority, Transit Safety Commission, municipalities

REGULATORY AND POLICY REQUIREMENTS

Modifications to local development codes and regulations may be required to incorporate accessibility requirements into alternative transportation infrastructure.

IS-11 PROMOTE THE USE OF ALTERNATE MEANS OF TRANSPORTATION, SUCH AS BICYCLES, IN THE CONTEXT OF SMART GROWTH.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Collaborate with partners to offer educational bicycle tours in the SJBE watershed.	Provide educational bicycle tours throughout the SJBE watershed.	Increased the number of educational bicycle tours.	Lead: Municipalities Implementing partners: DNER, local organizations	On Track	3-5 years	TBD	DTOPW, municipalities, DNER
2. Identify and highlight bicycle rentals and bicycle-sharing projects in the SJBE watershed.	Increase use of bicycles throughout the SJBE watershed.	Added bicycle users.	Lead: Municipalities Implementing partners: local organizations	Pending	3-5 years	TBD	DTOPW, municipalities, DNER
3. Create a campaign to encourage installation of bike racks at strategic points to allow use of bicycles throughout the SJBE watershed.	Implement an education campaign to support a bicycle friendly watershed.	Educated citizens and visitors about the use of bicycles.	Lead: Municipalities Implementing partners: DTOPTW, Puerto Rico Tourism Company	Pending	3-5 years	TBD	DTOPW, municipalities, DNER

REGULATORY AND POLICY REQUIREMENTS

None.

IS-12 DEVELOP LOW-IMPACT RECREATIONAL ACTIVITIES WITHIN SELECTED AREAS OF THE SJBE

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Identify, evaluate, and enhance existing recreational facilities and design and develop plans for new recreational facilities within the SJBE to promote ecotourism, low-impact activities, and recreational uses. Ecologically sensitive areas not compatible with recreational uses will be identified.	Identify recreational and ecotourism resources and opportunities.	Developed an interactive map that shows recreational spaces within SJBE that allow/offer ecotourism activities and a proposed plan for developing additional recreational spaces.	Lead: DNER Implementing partners: Department of Sports and Recreation (DSR), Puerto Rico Planning Board (PRPB), municipalities, local organizations	Ongoing	3-5 years	TBD	DSR, municipalities, DNER

2. Build incentives for and encourage development of local businesses based on recreation-oriented activities, such as but not limited to bicycle, kayak, and sailboat rentals, bioluminescent, and ecotourism-based boat tours.	Identify incentives and grants with municipalities, local businesses, and organizations.	Implemented incentives to increase recreation-based activities in development.	Lead: DNER Implementing partners: DSR, PRPB, Department of Economic Development and Commerce (DED), Puerto Rico Tourism Company, tour operators, municipalities, local organizations	Ongoing	0-2 years	TBD	DSR, municipalities, DNER
3. Promote the use of existing facilities and low-impact recreational activities in accordance with each site's potential such as birdwatching, hiking, bicycling, kayaking, fishing, sailing, swimming, snorkeling, bioluminescent and sightseeing by boat.	Increase the number of people who use existing facilities and engage in low-impact recreational activities.	Developed a comprehensive engagement plan to promote the proper use of facilities and encourage low-impact recreational activities.	Lead: DNER Implementing partners: DSR, PRPB, municipalities, developers, local organizations	Ongoing	0-2 years	TBD	DSR, municipalities, DNER

REGULATORY AND POLICY REQUIREMENTS

Support legislation to promote and fund low-impact and ecologically friendly development of new facilities and expansion of existing facilities.

IS-13 DEVELOP AN ECOTOURISM PROGRAM TO PROMOTE SUSTAINABLE, LOW-IMPACT ENJOYMENT OF SJB'S NATURAL RESOURCES TO FURTHER THEIR CONSERVATION.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Establish zoning for potential ecotourism projects or activity areas. These zones should be evaluated on a yearly basis as indicated in Article 5, Section E of the Ecotourism Law.	Assess potential ecotourism areas to include in zoning.	Established zoning rules for ecotourism areas and reviewed and amended annually.	Lead: Puerto Rico Tourism Company Implementing partners: DNER, PRPB, Puerto Rico Ports Authority, Estuario, municipalities	Pending	0-2 years	TBD	DNER, municipalities

2. Design ecotourism activities and provide the necessary infrastructure at chosen sites (such as but not limited to docks, trails, signs, and observation platforms).	Plan, design, and provide docks, trails, signs, observation platforms, and other access points and coordinate ground and aquatic transportation.	Completed plans, designs, and grants.	Lead: DNER Implementing partners: Puerto Rico Tourism Company, DSR, Puerto Rico Ports Authority, Estuario, tour operators, municipalities	Ongoing	3-5 years	TBD	DNER, municipalities
3. Develop educational materials (e.g., websites, social media posts, informational packets) to bring ecotourists to the area and promote recreational and educational opportunities.	Increase ecotourism and use of low-impact recreational and education opportunities.	Worked with local businesses, organizations, municipalities, and academia to create ecotourism content for Estuario.	Lead: Puerto Rico Tourism Company Implementing partners: DNER, Puerto Rico Ports Authority, Estuario, municipalities, academia	Pending	3-5 years	TBD	DNER, municipalities, USACE
4. Provide training to local guides to promote ecotourism within the SJBE system and its watershed.	Increase in provided training to local guides.	Used guides from the National Association for Interpretation (NAI), or similar resources, to develop trainings.	Lead: Puerto Rico Tourism Company Implementing partners: DNER, Estuario, municipalities, academia, NAI	Pending	3-5 years	TBD	DNER, municipalities

REGULATORY AND POLICY REQUIREMENTS

Coordination with local, state, and federal organizations to provide grant opportunities and ensure low-impact and eco-friendly recreational activities are compliant with ecotourism laws.

IS-14 PROMOTE PUBLIC ACCESS TO THE SJBE'S BODIES OF WATER AND SANDY BEACHES.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Inventory existing access to the beach and rivers and identify priority areas to add access to waterbodies and beaches within the SJBE watershed.	Identify water access and proposals and projects with access features to beaches and waters of the SJBE watershed.	Created a database and map of all water access, existing and proposed.	Lead: Estuario Implementing partners: DNER, Permits Management Office, DOTPW, academia	Pending	0-2 years	TBD	DNER, DOTPW, municipalities

<p>2. Examine the possibility of rebuilding the dock at the Piñones se Integra Corporation (COPI) and building or rebuilding other docks to increase access to SJBE areas.</p>	<p>Engage with DNER and COPI to redevelop the COPI and other dock sites.</p>	<p>COPI dock rebuilt and increased public access.</p>	<p>Lead: Estuario Implementing partners: DNER, COPI</p>	<p>Pending</p>	<p>0-2 years</p>	<p>TBD</p>	<p>DNER, municipalities</p>
<p>3. Design activities to provide more opportunities for access to the SJBE's waterbodies and beaches.</p>	<p>Increase access to SJBE's waterbodies and beaches.</p>	<p>Worked with local businesses, organizations, municipalities, and academia to design activities.</p>	<p>Lead: Estuario Implementing partners: DNER, Puerto Rico Tourism Company, DSR, Puerto Rico Ports Authority, Estuario, tour operators, municipalities</p>	<p>Ongoing</p>	<p>3-5 years</p>	<p>TBD</p>	<p>DNER, municipalities</p>

REGULATORY AND POLICY REQUIREMENTS

None.

REFERENCES

2012 Laws of Puerto Rico Title 23 - *Public Planning and Development. Part VI. Tourism, Chapter 151, Tourism Development, Subchapter V. Sustainable Tourism Development.*

2023 Laws of Puerto Rico Title Nine - *Highways and Traffic (§§ 1-8 — 5725) Chapter 6 - Complete Streets (§§ 146 — 151) § 147 - Declaration of public policy.*

World Tourism Organization. 2013. *Sustainable Tourism for Development Guidebook - Enhancing capacities for Sustainable Tourism for development in developing countries*, UNWTO, Madrid, DOI: <https://doi.org/10.18111/9789284415496>.

COLLABORATIVE GOVERNANCE AND COMPLIANCE

BASELINE

Collaborative governance and strong enforcement are essential if Estuario is to move from planning to measurable conservation outcomes. The estuary's mixture of jurisdictions, institutions, and stakeholders means that no single entity can implement conservation, restoration, reconstruction, and/or remediation measures alone. A deliberate model of shared responsibility, routine communication, and accessible information strengthens enforcement, reduces duplication, and improves the speed and quality of decision making.

A resilient and collaborative governance model combines clear institutional roles with processes that support learning, accountability, and adaptation (Emerson, Nabatchi & Balogh, 2012). Theory and comparative research show that governance arrangements which create regular forums for cross-sector dialogue, clarify decision rules, and invest in shared data and analytical tools produce better coordination and higher performance on environmental goals (Emerson, Nabatchi & Balogh, 2012). For Estuario this means formalizing partnership structures that include municipal officials, DNER, regulatory agencies, community groups, academia, and the private sector. Regular interagency workshops, an annual data brief for elected officials, and standing technical working groups focused on enforcement and permitting will reduce confusion at the project level and create predictable pathways for escalations and dispute resolution.

Capacity building for regulatory and enforcement personnel must be practical and solution oriented. Producing a concise document that explains SJBE ecology and functions, relevant statutes, permitting pathways, and common compliance scenarios that staff might face will allow municipal enforcement officers and agency staff to apply standards consistently across jurisdictions. Hands-on training that couples legal concepts with field skills, communication strategies, and incident documentation strengthens collaborative governance capacity by improving stakeholder's coordination and ability to take joint action (Emerson, Nabatchi & Balogh, 2012). Embedding these materials in an accessible online library further supports continuity as personnel turn over and institutional memory fades (Estuario, 2016).

Transparent, discoverable data and document repositories are central to collaborative governance. A searchable digital archive that houses environmental impact statements, enforcement records, monitoring datasets, and legislative analyses reduces the transaction costs of collaboration and supports evidence-based decision making. Federal agency guidance underscores the value of formal data management planning and commonly accepted metadata standards to ensure data are searchable, usable, and verifiable over time (U.S. Geological Survey [USGS], 2025). Implementing data stewardship roles, formal data sharing agreements, and routine metadata standards will allow Estuario and partners to integrate monitoring results with permitting and enforcement workflows so that decisions rest on current, high-quality information.

Accountability and performance measurements keep collaborations productive. Establishing a set of jointly agreed upon performance indicators for governance and compliance, such as the number of inspections completed, time from report to agency response, proportion of enforcement cases resolved, and frequency of cross-agency training, creates a basis for evaluation and learning. Emerson, Nabatchi & Balogh (2012) emphasize that collaborative governance models become more

effective when participants use shared performance information to adapt processes and priorities. Implementing a transparent reporting cadence, including an annual Estuario governance and compliance bulletin for officials and the public, will document progress and provide a forum for course corrections.

Finally, legal and administrative reform may be needed to remove structural barriers to coordination. Where statutes, permitting rules, or institutional incentives create misaligned responsibilities, those gaps should be documented to develop targeted policy proposals or interagency memoranda of understanding to create clearer lines of responsibility. Institutionalizing routines for joint inspections, shared evidence chains, and common sanctioning practices will improve fairness and predictability while strengthening community confidence that violations receive consistent treatment.

By investing in clearly defined partnership roles, practical training and teaching materials, a robust digital repository, routine performance measures, and targeted policy fixes, Estuario can strengthen both governance and compliance. Those steps will reduce delays, improve enforcement outcomes, and ensure that conservation, restoration, reconstruction, and/or remediation actions are implemented effectively and equitably across the watershed.

OBJECTIVES

- Strengthen the Partnership and its capacity to restore and conserve the estuarine system.

ACTIONS

IS-15 IMPROVE REGULATORY AND ENFORCEMENT PROCESSES BY SUPPORTING CAPACITY BUILDING FOR MUNICIPALITIES, AGENCIES AND THE GENERAL WORKFORCE.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Identify the essential concepts needed to understand the ecology and function of the SJBE system and the legal components established for resource protection.	Document key legal components pertaining to resources protection within the SJBE.	Determined essential concepts and legal components.	Lead: Estuario Implementing partners: academia, DNER	Pending	0-2 years	TBD	USEPA, DNER
2. Produce a teaching/learning resource guide and instructional materials on estuarine concepts and functions for key stakeholders such as rangers, policy makers, heads of agencies, and other enforcement personnel.	Develop educational materials and offerings, such as handbooks, workshops, publications, and symposiums.	Collected feedback from implementing partners on the content and messaging of educational materials.	Lead: DNER Implementing partners: Estuario, academia	Pending	3-5 years	TBD	DNER, USEPA, USACE

<p>3. Conduct training workshops on estuarine concepts and functions, legal frameworks that support estuarine ecosystems, communication skills, and other relevant concepts/information for key stakeholders in the SJBE system as well as other sensitive areas in Puerto Rico.</p>	<p>Develop a training curriculum based on developed materials and stakeholder feedback.</p>	<p>Organized training sessions for key stakeholders with developed educational materials.</p>	<p>Lead: DNER Implementing partners: Estuario, academia</p>	<p>Pending</p>	<p>3-5 years</p>	<p>TBD</p>	<p>DNER, USEPA</p>
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REGULATORY AND POLICY REQUIREMENTS

None.

IS-16 ENSURE THAT ELECTED OFFICIALS, HEADS OF AGENCIES, AND GENERAL PUBLIC ARE PART OF ESTUARIO'S DECISION MAKING PROCESS.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
<p>1. Send officials, heads of agencies, and others in Estuario an annual report with relevant data on the condition of the SJBE, events held, results of scientific research, main needs of the program, and any other information that contributes to decision making.</p>	<p>Ensure that reports are sent out in a timely and reoccurring manner.</p>	<p>Monitored how the distributed report influences decision-making and community engagement.</p>	<p>Lead: Estuario Implementing partners: elected officials, other key stakeholders</p>	<p>Ongoing</p>	<p>3-5 years</p>	<p>TBD</p>	<p>USEPA</p>
<p>2. Create and update a list of officials who are interested in keeping up to date with the progress towards SJBE conservation, restoration, reconstruction, and/or remediation efforts.</p>	<p>Complete an up-to-date list on a regular basis.</p>	<p>Implemented a feedback mechanism for officials to express interest, preferences, and suggestions regarding the updates they receive.</p>	<p>Lead: Estuario Implementing partners: elected officials, other key stakeholders</p>	<p>Ongoing</p>	<p>0-2 years</p>	<p>TBD</p>	<p>USEPA</p>

3. Develop alliances with volunteers and university entities interested in the decision-making process for Estuario.	Increase in levels of volunteer participation in Estuario-related decision-making activities, such as meetings, workshops, and advisory committees.	Developed a framework outlining the roles, responsibilities, and expectations for collaboration between Estuario stakeholders, volunteers, and university entities	Lead: Estuario Implementing partners: academia, community stakeholders	Ongoing	0-2 years	TBD	USEPA
4. Offer workshops about Estuario, its importance, governance structure, and progress in the conservation, restoration, remediation, and reconstruction of the SJBE system and its watershed.	Assess the relevance and quality of the workshop content based on participant feedback,	Created engaging and informative materials for the workshops.	Lead: Estuario Implementing partners: regulatory agencies	Ongoing	0-2 years	TBD	USEPA

REGULATORY AND POLICY REQUIREMENTS

None.

IS-17 RESTRUCTURE THE WEBSITE AS A REPOSITORY FOR INFORMATION AND MAKE IT AVAILABLE VIA ALTERNATIVES SUCH AS THE WEB ATLAS AND ESTUARIO LIBRARY.

ACTIVITIES

Activity	Performance Measures	Milestones	Responsible Stakeholder(s) and Partner(s)	Status	Timeframe	Estimated Costs	Potential Funding Sources
1. Recruit contractors, university students, or other volunteers to conduct a literature review and create an annotated bibliography for the Estuario website.	Increase in recruitment and volunteer efforts to participate in the literature review process.	Organized collected literature and the creation of an annotated bibliography for the website.	Lead: Estuario Implementing partners: academia, DNER, community stakeholders	Ongoing	0-2 years	TBD	USEPA. DNER
2. Hire librarians and university volunteers to create a digital database and to search for environmental impact statements, bills, location queries, and investigations to complement and strengthen Estuario's digital Public Policy Library.	Complete functional digital database on the Estuario website.	Implemented an orientation and training session for volunteers to discuss goals and objectives for the project.	Lead: Estuario Implementing partners: academia, community stakeholders	Ongoing	0-2 years	TBD	USEPA

<p>3. Create formal agreements with academic institutions, government agencies, and community organizations to keep the database updated and to be informed about each investigation, location consultation, or bill related to the SJBE.</p>	<p>Increase in library users through metrics such as but not limited to number of downloads and site traffic.</p>	<p>Established regular communication channels among partners to facilitate coordination.</p>	<p>Lead: Estuario Implementing partners: academia, DNER</p>	<p>Ongoing</p>	<p>0-2 years</p>	<p>TBD</p>	<p>USEPA, DNER</p>
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REGULATORY AND POLICY REQUIREMENTS

None.

REFERENCES

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