Rehabilitating *Ilog Pasig:*

Resurrecting a culture, Developing innovations, Changing Lives

Project Title: *Water Quality Improvement in the Pasig River System*

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I. PROJECT SUMMARY

This project is designed to identify and demonstrate feasible technical intervention for water quality improvement of the Pasig River with a particular reference to small-scale drainage channels or esteros, which will be duplicated over other areas within the catchments of the river. The objectives of the project are achieved by (1) formulating a master plan that will identify and prioritize water quality improvement measures and their focus areas for intervention and feasible technical options (2) implementing small-scale pilot projects that will have immediate impacts and needs on two of the river system's esteros; and (3) fostering sound partnership among the regional bodies together with national level agencies. The master plan is expected to come up with various project options, along with expected overall costs in each targeted river section for water quality improvement in the Pasig River and its tributaries. To ensure sustainability and demand-service provision, a community-based approach that responds to local needs is one of the key strategies of the project.

The Pasig River System is composed of river tributaries and several creeks and esteros. Water quality improvement efforts should be concentrated in these areas to generate maximum impact. Two small-scale projects will be conducted. This will involve putting up filtration and aeration systems along *Estero de Paco* and *Estero de San Miguel*. These systems will include the following: installation of aeration equipment with diffuser and floating island reactor.

The aeration and filtration systems aim to reduce Biochemical Oxygen Demand (BOD), increase Dissolved Oxygen (DO) and reduce Total Suspended Solids (TSS), which are the primary parameters measured for water quality. Water quality and sediment sampling will be done on a regular basis to determine the improvement made.

. The ultimate goal of the project is to help minimize the pollution load discharging into *Ilog Pasig* and Manila bay so as to comply with the mandates of the Clean Water Act of the Republic of the Philippines. With the improved water quality, it is expected that the project will contribute to river transportation, the real estate, tourism and commercial development in the Pasig River.

II. BACKGROUND OF THE PROJECT

One of the most culturally relevant bodies of water in the Philippines is the Pasig River. The river, which is commonly referred to as *Ilog Pasig* in Filipino, stretches over approximately 27 kilometers in length. It is known to connect Laguna de Bay to Manila Bay, passing through eight cities (Manila, Mandaluyong, Makati, Pasig, Pasay, Taguig, Caloocan, San Juan) and one municipality (Pateros) while doing so. The river is comprised of forty-seven (47) tributaries, with Marikina River and San Juan River being the major ones.

Ilog Pasig was once a potential source of drinking water for locals and also known to be a flourishing habitat for over twenty-five varieties of fish and thirteen distinct types of fresh water plants. Apart from this, it was also important economically since it once served as the major entry point of international traders who did business with the people of Manila.

However in the last few decades, the *Ilog Pasig*, along with other major rivers in the metro, has fallen prey to the rapid urbanization of Manila, which together with insufficient sanitation systems, led to the river's biological death. In 1990, the Danish International Development Agency (DANIDA) declared in a study that the Pasig River was already officially biologically dead. The major culprits for the river's decline were cited to be industrial pollution, waste dumping and urban migration.

Realizing the vast potential of converting the river into a clean area for recreation, tourism and recreational development, and as a means of decongesting Metro Manila water systems, this project aims to aid in reviving the Pasig River, along with its tributaries, back to its pristine conditions.

In order to accomplish this feat, supplementary assistance from partner organizations will be needed. Presently, the proponent of this project is collaborating with two major organizations, the ABS-CBN Foundation, Inc. and the Pasig River Rehabilitation Commission (PRRC). Both of these institutions have already made significant progress on rehabilitating the river, however, most of their focus has only been limited to community-based activities such as relocation of informal settler families and promotion of solid waste management.

Much work has to be made on the technical aspects of the rehabilitation. Additionally, it should be known that the great majority of activities previously conducted were only focused on the main river itself. Rehabilitation programs that will include the river tributaries, which are suspected to be the main sources of pollution in the river, have to be made. The project will then seek to resolve these issues. The resolution attempts involve putting up filtration and aeration systems along two esteros.

a.) Necessity of the Project

Concerted efforts by relevant authorities for water quality improvement of the *Ilog Pasig* were significantly constrained by limited funds for adequate sanitation, urban drainage, and proper solid waste management. Enactment of the Philippines' Clean Water Act (CWA) in 2004 has created an opportunity for improved water quality of the country. The Department of Environment and Natural Resources (DENR) has embarked on a reformation of the regulatory system for water quality improvement by adopting comprehensive management tools including, but not limited to, economic instruments, industry specific effluent standards, and wastewater charge system. However, it is still in its infant stage of implementation and will take many years to take effects over the country to materialize in the spirit of the CWA.

Sanitation service in the metropolitan area has been improving, though in a much slower pace than expected, due to privatization of the service providers that began in 1997 with the high-profile award of two concession contracts for the Eastern and Western halves of Metro Manila. However, sewerage investment takes some decades to complete due to (1) limited funds, (2) limited affordability of users and (3) limited space for treatment facilities as against enormous amount of pollution loading discharging the *Ilog Pasig*.

Esteros provide interface between community and water. Due to the close proximity of residential homes around the river, poor water quality of esteros is markedly noticeable to nearby settlers in the form of poor transparency of the water, accumulation of garbage and foul odor. In other words, the water quality of esteros has more bearing on the quality of life and living standards of the urban settlers of the National Capital Region. The past investment for water quality in the region has only been given to the main river of the Pasig system. There are residents along the different esteros that have been left out in the past intervention. Hence, the implementation of this project becomes even more paramount.

b.) *Necessity of Cooperation from the United States*

In ensuring that the proposed project is able to reach its full fruition, the following key issues should be addressed: (1) information gap on the combination of technical options

and applicable areas for efficient intervention; (2) lack of the institutional linkage among the concerned agencies for efficient water quality improvement of the Pasig River system, which include their tributaries and esteros.

In the U.S., there are many expert institutions that can assist in the water quality improvement of bodies of water found in tropical developing countries. These institutions can recommend feasible strategic options, applicable technologies, and coordination skills for collaborating concerned agencies, all of which hoped to become vital in the improvement of the quality of water in the Pasig River system.

Because of the presence of these issues, it has been decided that apart from the technical solutions that are proposed by this project, it may be necessary to seek advice from particular institutions in the United States in order for the project to achieve most optimal results.

III. PROJECT DESCRIPTION

a.) Objective of the Project

The main objective of the project is to improve the water quality in the Pasig River and its tributaries by formulating a master plan that will determine applicable technical interventions which will provide optimal results. Two small-scale projects will be conducted. This will be accomplished by installing filtration and aeration systems in two minor esteros of the Pasig River, namely, *Estero de Paco* and *Estero de San Miguel*. Based on the results of these small-scale projects, a master plan can be formulated that will be able to provide relevant information as to how the other esteros and tributaries will be handled.

b.) Project Rationale

When Metro Manila experienced a rapid increase in population, a number of adverse effects on the Pasig River's water quality ensued. The rise in population, along with rapid urbanization and industrialization, led to solid waste and sewage (both domestic and industrial) being illegally dumped into the river at alarming rates. These include chemical compounds, medical wastes, asbestos, acids, paints, oils, lubricants, heavy metals and other volatile organic compounds. The presence of these materials has degraded the water quality of Pasig River consequently upsetting its ecological balance.

The worst condition of the river comes during the dry season when the river is practically in a stagnant condition. The sewage and solid waste makes the river

biologically dead. The absence of dissolved oxygen will give rise to anaerobic decomposition with the production of noxious gases and the aesthetic degradation of water quality.

The construction and installation of aeration and filtration system equipment will increase dissolved oxygen which is essential for the healthy functioning of aquatic ecosystems. Mounting these systems prevent the formation of undesirable toxic gases, hydrogen sulfide methane and ammonia and avert chemical release of Manganese, Iron and other metals through redox reactions under anaerobic conditions. These systems also boost biological activity in the benthic layer accelerating the decomposition of organic sewage at the river bottom and improve fishery as a result of enabling fish to live and feed all the way to the bottom of the water body.

c.) Areas to be covered by the Project

The project will identify and prioritize areas wherein the proposed technical options are applicable and feasible as a master plan phase of this project.

The relevant cities in the project area include nine (9) cities as summarized in Table 1 below.

Table 1. Geographical Jurisdiction of the Concerned City/Municipality

Region/Province	City/Municipality		Land area under the jurisdiction (km^2)
National Capital Region (NCR)	1	Makati City	27.36
	2	Mandaluyong City	11.26
	3	Manila City	40.46
	4	Marikina City	21.50
	5	Pasig City	31.00
	6	Pateros City	1.85
	7	Quezon City	161.13
	8	San Juan City	5.94
	9	Taguig City	45.38

The project will be focused on minor esteros and tributaries listed in Table 2. As an initial phase of the project, two esteros, *Estero de Paco* and *Estero de San Miguel,* as

highlighted below, will be the pioneer targets of the installation of filtration and aeration systems.

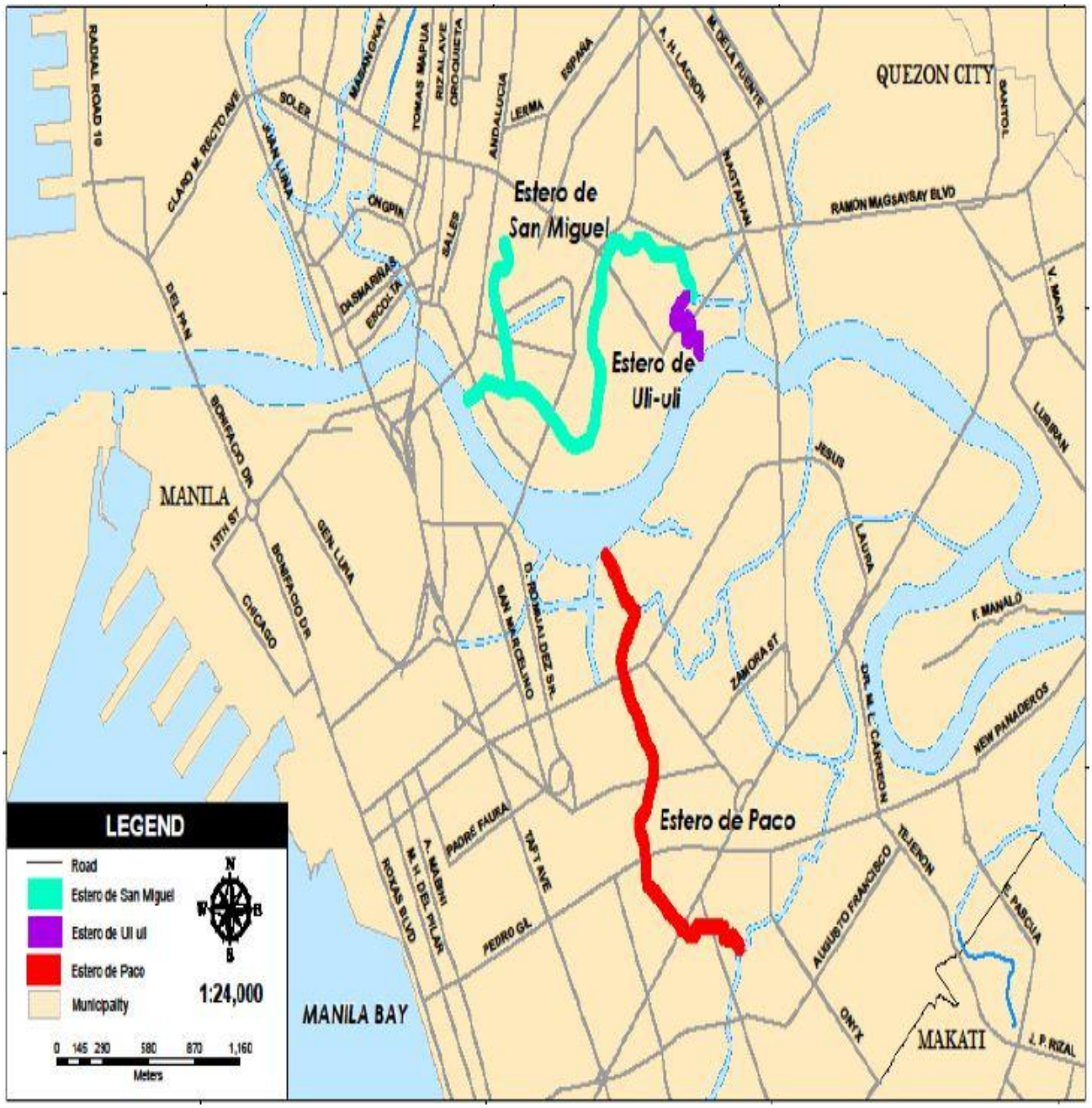
Table 2. Minor Esteros and Tributaries

CITIES	MINOR ESTEROS AND TRIBUTARIES
Makati	Guadalupe Nuevo Creek
	Balisan Creek
Mandaluyong	Buayang Bato Creek
Taguig	Taguig-Pateros Creek
Pasig	Pineda Creek
Manila	Estero de Vitas
	Estero Tripa de Gallina
	Estero de Magdalene
	Estero de San Sebastian
	Estero de San Lazaro
	Estero de Aviles
	Estero de Quiapo
	Estero de Concordia
	Estero de Provisor
	Estero de Santa Clara
	Estero de Pandacan
	Estero de Valencia
	Estero de Uli-uli
	Estero de Sampaloc
	Estero de Sampaloc
	Estero de Santibañez
	Estero de Paco
	Estero de Tanque
	Estero de Balete
	Estero de San Miguel
	Estero dela Reina
	Estero de Binondo

It should be noted that a few programs have already been initiated by the project proponent's partnering organizations. However, these have only focused on improving the aesthetics of the river through community-based efforts, which are all devoid of any form of technical intervention. As mentioned previously, this was done through the training of river rehabilitation volunteers or 'river warriors' and solid waste management

efforts. Upon consulting the said organizations, the project proponent was informed that a rigorous improvement of the river's water quality has yet to be done. Both ABS-CBN Inc. and the Pasig River Rehabilitation Commission are seeking assistance from the proponent regarding these matters. Hence, there exists the need to ameliorate water quality conditions of the river through technical intervention. Realizing this need, such is precisely the ultimate aim of this project.

d.) Project Location and Area



IV. PROJECT DEVELOPMENT PLAN, PROCESS AND COMPONENTS

A. Infrastructure Component

The project design will consider the development of both land and water based facilities and programs with the objective of treating wastewater at the intermediate sources (i.e. canals, esteros, etc.).

i.) Land Based

The plan will include the development of the easements whenever feasible. Waterfront development, greening and solid waste management facilities will be considered to prevent re-occupation of cleared easements and to sustain environmental benefits.

ii.) Water Based

The plan will maximize whenever possible the treatment of wastewater flowing in minor tributaries. The design will also take into account the flood control functions of creeks and esteros.

B. Environmental Component

I. Water Quality Monitoring

Water quality monitoring, in tandem with sediment quality monitoring, will serve as the success parameter to be used in implementation. The ecological monitoring parameters specified in DAO 34 (Department of Environment and Natural Resources Administrative Order No. 34) will constitute as the specific standards for this goal. These include the (1) in situ physic-chemical parameters of the water i.e. salinity, conductivity, temperature, turbidity, dissolved oxygen (DO), biochemical oxygen demand (BOD), total suspended solids (TSS) and depth and (2) water's biological composition (chlorophyll and coliform bacteria) and nutrient levels.

Water collection. Collection of water samples will be done in identified stations. *In situ* physico-chemical parameters will be recorded *using YSI Water Quality Checker*. Three one (1) gallon of water sample will be collected and

brought to Laguna Lake Development Authority (LLDA) Laboratory for nutrient (nitrogen, phosphorus, nitrate, inorganic phosphate, and ammonia), BOD, and TSS analyses. A part of the water sample will be used for chlorophyll-a analysis. Approximately 250ml water samples will be collected separately for coliform bacteria quantification. These bacteriological samples will be tested in LLDA laboratory.

In order to determine the effectiveness of the interventions done on site, water quality monitoring will be done as follows:

a. Baseline Data Acquisition

For baseline data, all parameters stated in DAO 34 will be gathered before starting the construction of the facility at a point 20 meters upstream and downstream of the facility limits and a point inside the intended aeration chamber.

b. Post-Development Monitoring

For monitoring during project operation, two sampling sites will be analyzed on a monthly basis for the *in situ* physico-chemical parameters. However, regular water quality monitoring of the complete parameters based on DAO 34 will be conducted quarterly.

II. Sediment Quality Monitoring

Sediment Collection. Sediment will be collected using grab sampler. The sediment samples will be analyzed for metal and pesticide analyses. Triplicate samples will be placed in one (1) liter dark bottles for the analysis of heavy metals (cadmium, chromium, copper, lead, nickel, zinc and mercury). The samples will be brought to Natural Science Research Institute in U.P. Diliman for analysis.

In order to determine the effectiveness of the interventions done on site, sediment quality monitoring will be done as follows:

a. Baseline Data Acquisition

For baseline data, all parameters stated in DAO 34 will be gathered before starting the construction of the facility at a point 20 meters upstream and downstream of the facility limits and a point inside the intended aeration chamber.

b. Post-Development Monitoring

For monitoring during project operation, the same sampling sites will be analyzed on a quarterly basis.

V. PROJECT LOGISTICS

To achieve fulfillment of the project objectives, a patrol boat will be needed. The patrol boat should be, as a minimum, of shallow draft, high maneuverability, high-low speed, fuel efficient and equipped with night-time patrol capabilities. The proponent of the project has already consulted with ABS-CBN Foundation Inc. and PRRC, and was made aware that an acquisition of a boat has already been made. The same boat will then be used in this project.

1. River Patrol Team

The Patrol Team will be deployed on a daily basis, 365 days a year, to effectively discourage dumping of wastes and re-colonization of cleared easements.

2. Water Quality Field Equipment

The Patrol Team will be equipped and trained on field water quality sampling and analysis to evaluate suspected contaminated discharges from industries.

3. . Scope

The Patrol Team will be on the look-out for the following:

a.) Returning informal settlers;

b.) New construction along easements;

c.) New construction within the river;

d.) Status of Facilities;

e.) Solid waste dumping by citizens and industries;

f.) Contaminated wastewater discharges from industries;

g.) Vandals;

h.) Waste dumping by other river crafts;

i.) Blockage in channel flow; and

j.) Distressed vessels;

I. Description of Project Phases

A. *Pre-construction / Pre-development Phase*

The project will first develop and implement a campaign that informs the communities directly affected by the project on issues of clearing the easement, relocation, solid waste and wastewater management for the development and sustainability of the program. These include development and distribution of information, education and communication materials; and conduct of coordination meetings, consultations and dialogues with local government units (LGUs), community-based organizations (CBOs), peoples organizations (POs), other indigenous organizations and residents of the community.

B. *Construction / Development Phase*

i.) The project will inform the general public about the progress of the program through regular press releases, media conferences and project site visits.

ii.) The project will mobilize the community through identified CBOs and POs in the area to cooperate with the Department of Interior and Local Government (DILG), the local police and the Patrol Team in the implementation of the provisions of the Philippine Ecological Solid Waste Management Act of 2000 (RA 9003), Philippine Clean Water Act of 2004 (RA 9275), Toxic Substances, Hazardous and Nuclear Wastes Control Act (RA 6969) and The Environment Impact Assessment Law (PD 1586) for the sustainability of the CRZ program.

iii.) The project will mobilize the community through identified CBOs and POs in the area to develop income-generating projects out of the solid waste materials collected from the aeration and filtration facilities.

C. *Operational Phase*

The water treatment process will include the materials description, purpose, operation and maintenance of the following:

a. Garbage traps

b. Floating Barriers

c. Slope Protection

d. Aeration Devices

e. Lighting

f. Greening

II. Plant Operations / Activities

The operation involves desilting works, riprapping (bank improvement), slope protection, linear park development, and installation of surface artificial island reactors (aeration and filtration), phytoremediation and bioremediation.

Desilting/dredging. It is an excavation activity or operation for deepening or widening of a channel with the purpose of gathering bottom sediments contaminated or non-contaminated which are then relocated to a containment area. This procedure is used to keep waterways navigable.

After desilting, *bank improvement and slope protection* will be done. These two processes prevent the banks from scouring and erosion. Bank improvement, through riprapping which is made by the aid of tough, durable and dense stones, provides a rock armor that resists weathering or actions of water and air. For slope protection, weave coco fibers (coco logs and coco nets) are placed along the banks. These coco logs help establish a favorable condition for plants that are capable of phytoremediation and bioaccumulating pollutants which help in the improvement of river water quality.

To address the deteriorating water condition mainly due to sewage and solid wastes, an *artificial surface island reactor* will be installed. These will increase dissolved oxygen which is essential for the healthy functioning of aquatic ecosystems. These systems also prevent the formation of undesirable toxic gases (e.g. hydrogen sulfide, methane, ammonia) and avert the release of manganese, iron and other chemicals through reduction-oxidation reactions under anaerobic conditions. Aerators also boost biological activity in the benthic layer accelerating the decomposition of organic sewage at the river bottom and improve fishery as a result of enabling fish to live and feed all the way to the bottom of the water body.

Another process to be done to solve the water problem is through *bioremediation technology* whereby organic wastes are biologically degraded under controlled conditions to an innocuous state or to levels below concentration limits established by regulatory authorities. Living organisms, primarily microorganism, are used to degrade

the environmental contaminants into less toxic forms. To safeguard the success of the rehabilitation works done particularly in improving the water quality, it is very crucial for the sewage systems and waste management to be tackled first since aeration and bioremediation function well under controlled environment (i.e. finite pollution load is properly accounted).

Linear park development. A three meter environmental preservation area (EPA) will be established at both banks of all tributaries of the Pasig River. These EPAs will be developed into landscape linear parks to serve as buffer zones between the river and resident population to protect them from flooding, enable environmental management and reduce the direct discharge of untreated liquid and solid wastes to the river, provide recreation areas and provide access to the river for emergencies, maintenance, river transport and amenities.

III. Manpower

Table 3. Proposed Manpower for the Project

MANPOWER	Estero de San Miguel	Estero de Paco
	(for 60 calendar days)	(for 30 calendar days)
1. Project manager/ Supervisor	1	1
2. Project Architect	1	1
3. Mechanical Engineer	1	1
4. Foreman	1	1
5. Time Keeper	1	1
6. Painter	1	1
7. Skilled Helper	10	10
8. Landscaper	2	2

As for the manpower required for the project, please refer to Table 3 above.

VI. ENVIRONMENTAL MANAGEMENT PLAN

Project Phases	Activities	Impacts	Mitigating Measures
Pre-construction / Pre-development phase	Permit acquisition		
	Preparatory of work		
Construction / Development phase	Construction of containment area	Due to sediment disturbance, an increase of total suspended solids (TSS) will be observed in the water column	Monitoring of water quality to verify the effects
		Spills of concrete may alter the pH of the surrounding waters; acidity of water is critical in the maintenance of aquatic life - can tolerate only a narrow pH range change	Monitoring of water quality to verify the effects Inform laborers of the importance of the proper/safety construction of the containment site
		Possible adverse effects on the habitat of fish and other aquatic organisms	Monitoring of water quality to verify the effects Inform and educate the receiving communities.
		Navigational traffic may be affected	Putting up of signage and warnings informing the nearby communities and river/bay users of the on-going activities in the area
	Removal of debris	Elimination/decrease discharge of oil pollution, illegal	Partner with LGU and nearby communities to protect the area from

		dumping of waste oils and hazardous materials	further dumping/disposal of debris Water quality testing before and after the activity to assess the effects
		Location and method of disposal	Must be properly coordinated with concerned entities/agencies
	Desilting/ Deepening	Noise generated by desilting may cause inconvenience to river users and nearby community	Informing the receiving community beforehand Putting up of signage and warnings informing the nearby communities and river users of the on-going activities in the area
		Extreme caution when navigating in the desilting area especially at night as there may be floating pipes, debris, etc.	Informing the receiving community beforehand Require laborers to implement the proper safety measures at all times Putting up of signage and warnings informing the nearby communities and river users of the on-going activities in the area
		Enhance turbidity and sedimentation rate which can affect aquatic life in the river	Inform the laborers the possible effects of turbidity/clarity of the water to aquatic plants and animals Train laborers of the proper/safety handling of the dredged materials to ensure minimal dispersal and suspension of

			materials in the water column Water quality monitoring to determine the impacts on aquatic life
		Release of toxic materials i.e. heavy metals and polychlorinated biphenyls (PCBs) from bottom sediments into the water column	Inform laborers of the possible effects of the discharge of these toxic materials to human health and in water quality Train laborers of the proper/safety handling of the dredged materials to ensure minimal dispersal and suspension of pollutants in the water column Water quality monitoring to determine impacts on aquatic life and water
		Leaks of fuel and lubricants from desilting equipment	Install emergency fuel spill containment kit for deployment if necessary
		Release of sediment materials into the river due to desilting activity	A double silt curtain with a fish exclusion zone will be placed around the perimeter of the desilted area
		Generate additional traffic by the trucks hauling the dewatered sediment off the site	Construction of dewatering site Putting up of signage and warnings informing the nearby communities and river/bay users of the on-going activities in the area

	Investigation and monitoring works	Water quality condition	Assessment of impacts of desilting works in water quality and aquatic habitat
		Monitoring the performance of the contractor and its workers	Ensure strict compliance in accordance to the permit conditions specified by the regulatory agency
	Reporting	Reporting the actual effects of desilting/deepening works is a requirement to contain impacts within the acceptable stage	Implement necessary actions as soon as possible if environmental and human health concerns are at risk
Operational Phase	Water quality monitoring	Water quality condition	Determination and evaluation of the water quality monitoring results provide easier identification of the effect of desilting/ deepening activities