Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila

BAGONG PILIPINAS

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DEPARTMENT ORDER)
)
NO. 97)
Series of 2024 dv 6/13/2024

SUBJECT: Guidelines for the Integration of Comprehensive Water Management in Flood Control Projects

In line with the President's directive to shift from traditional flood control to comprehensive water management in order to conserve and utilize water beneficially, the Guidelines for the Integration of Comprehensive Water Management in Flood Control Projects (**Annex "A"**) is now available for reference.

The issuance of the said guidelines, which includes typical drawings of flood control projects, i.e., small dams (reservoir/diversion) and detention basin **(Annexes "B", "C" and "D")**, shall guide District Engineering Offices, Regional Offices, Project Management Office Clusters and Engineering Consultants in the preparation of flood control projects with water management features.

For guidance and compliance of all concerned.

MANUEL M. BONOAN
Secretary

Department of Public Works and Highways
Office of the Secretary
WIN4R01649

Encl: As-stated

5.1 RFIL/BSR/DLB

Annex "A"

Guidelines for the Integration of Comprehensive Water Management in Flood Control Projects

I. Rationale

A Comprehensive Water Management is vital in the proper allocation and utilization of water beneficially. It presents complex challenges due to technical, financial, institutional, environmental, and climate considerations that require advanced expertise, substantial investments, and coordination among multiple agencies.

Flood control projects usually tend to retain water as a way to safeguard the target community from devastation caused by flooding. However, seldom do these projects include components that utilize the use of temporarily retained flood as a source for other meaningful use. Oftentimes, retained flood water is released to an outfall without further processing or synthesis which will collect usable water for applications such as irrigation, water supply, and power generation.

In line with the President's directive to shift from traditional flood control to comprehensive water management in order to conserve and utilize water beneficially, DPWH hereby developed a set of guidelines that for the District Engineering and Regional Offices', Project Management Office Clusters' and Engineering Consultants' reference in the preparation of flood control projects with water management features. These projects are expected to be multifunctional, encompassing flood mitigation measures paired with other water management related objectives.

The hereunder provisions are considerations in site selection, important design requirements, and typical drawings for guidance and reference. Typical flood control projects, which may be integrated with other applications, discussed herewith are small dams (reservoir or diversion) and detention basins.

II. Site Selection

DPWH together with National Irrigation Administration (NIA) and other concerned agencies shall conduct site inspection/verification to determine the location, and evaluate the applicability and feasibility of the proposed structure and the required connection to the irrigation canals or other related facilities. The location for the small dam and detention basin should be carefully selected to ensure its suitability. This is highly dependent on local conditions, but the following considerations may serve as a starting point in determining an appropriate location:

A. Topography

For small dams, it should be located at existing local constrictions, if possible. This will reduce the amount of construction required to form the dam. Consider locations with natural narrowing points, such as valleys or canyons, where the construction of a dam can efficiently impound floodwaters.

For detention basins, low-lying areas, depressions, or natural basins, specifically natural floodplain areas, are the suitable locations. The detention basin should be located where gravity-driven inflow and outflow are possible for more cost-effective and sustainable operation.

B. Reach Consideration

The impact of the small dam and detention basin on upstream/downstream flow conditions should be assessed.

A dam location may be unsuitable if it prevents existing downstream water uses, such as extraction for irrigation, from continuing.

For a detention facility, the location should be upstream of or as close as possible to an area requiring flood protection. The nearer the storage site to the flood-prone area, the greater the portion of the stormwater that can be controlled by the detention basin. Additionally, the target area for the detention basin should be placed as close as possible to the reaches on the watershed's downstream side (low profile areas) to control peak discharges on the tributaries located upstream effectively. It should be as close as possible to rivers to facilitate the release of stored flood water after storm events.

C. Groundwater Table

For detention basins, it is necessary to avoid locations where the groundwater table is even or higher than the projected elevation of the bottom of the basin making the project impractical or not technically feasible.

D. Acquisition Cost

The cost of properties to be acquired should also be considered to minimize project cost.

E. Environmental and Social Considerations

Minimizing environmental and ecological impacts is a key consideration in selecting sites. Areas with significant ecological or environmental value should be avoided to prevent habitat disruption. Moreover, the potential impact on water quality downstream must be assessed to ensure that the dam/basin does not adversely affect local ecosystems.

The extent of the reservoir/basins should also be assessed to ensure that it does not impact existing communities or infrastructure.

Consider measures to mitigate adverse effects, such as creating fish passages and implementing sediment management strategies for small dams, and design detention basins in a manner that respects and preserves the cultural heritage and practices of indigenous communities.

F. Land Use

It is not ideal to build dam above existing development as it puts the development at risk in case of dam failure. Prioritize sites that offer protection to densely populated areas, critical infrastructure, and valuable assets susceptible to flood damage, such as residential areas, industrial zones, agricultural land, and transportation networks.

Key considerations for detention basin include avoiding agricultural lands and built-up areas, aligning with local government land use planning (i.e., Comprehensive Land Use Plans, etc.), and prioritizing sites identified in an overall river basin Master Plan that designates areas for detention basins as part of flood control mitigation measures.

III. Design Requirements

A. Survey

Topographic and hydrographic surveys are crucial components of dam/detention projects. Topographic surveys provide detailed information about the land and terrain surrounding the dam site, including elevation, slopes, natural features, and man-made structures. This data is essential for site selection, dam design, construction planning, and environmental impact assessment. Hydrographic surveys, on the other hand, focus on mapping the bathymetry (depth) and features of water bodies such as rivers, lakes, or reservoirs. These surveys provide critical information for designing dam intake structures, spillways, and outlet works, as well as assessing sedimentation patterns, flood risk, and water quality.

In accordance with Executive order No. 45, series of 1993, as amended by EO 321 and EO 280, series of 2000 and 2004, respectively, the Philippine Reference System of 1992 (PRS92) shall be the standard reference system for all surveys and mapping in the Philippines.

In addition, all survey data shall conform to the standards stipulated in the DPWH DGCS Volume 2B, 2015.

B. Geotechnical Investigation

Geotechnical Investigation shall conform to DPWH Department Order No. 75, Series of 2024, Re: Guidelines for the Conduct of Geotechnical Investigation for all DPWH Infrastructure.

A Geotechnical Investigation Plan and methodology report shall be prepared based on the actual field validation consisting of the following preliminary information:

- Data from nearby existing project/s, if applicable; and
- Geology, Topography, Vegetation, Right-of-Way, Accessibility, Land Use, Existing Structures and Utilities, etc.

The geotechnical investigation report shall be prepared and duly signed by a licensed Geotechnical Engineer, subject for review and subsequent approval. Please take note of the geotagged photos taken during the field investigation and laboratory testing shall be attached as annexes or shall be part of appendices of the geotechnical investigation report.

The preparation of the Geotechnical plan shall be in accordance with the latest Department issuance/s for the preparation of Detailed Engineering Design (DED) plans.

In addition, in some circumstances where the dam's height is relatively low (preferably with 3.0 meters structural height or below), the geological conditions are well understood and uniform, and the risk associated with potential subsurface variability is low, test pits alone may be deemed sufficient for dam design. If the geological conditions at the dam site are well-documented, predictable, and homogeneous, test pits may provide adequate information on soil types, stratigraphy, and groundwater conditions without the need for additional drilling methods.

The geotechnical investigation for detention basins must address at a minimum the following:

- Stability of the basin side slopes for short- and long-term conditions, taking into consideration location of permanent pool;
- Evaluation of bottom instability due to excess hydrostatic pressure;
- Groundwater table and its variability;
- Identification of dispersive soils;
- Potential erosion problems;
- Constructability issues; and
- Evaluation of seepage (natural clay liner and/or sealing agents, if needed).

Sufficient confirmatory soil boring shall be conducted along the alignment of the proposed structures prior to actual implementation.

C. Design Considerations

1. Small Dam (Reservoir/Diversion)

The design of dams is dependent on the local conditions, the material type and the proposed usage. For the Integration of Comprehensive Water Management in Flood Control Projects, the following parameters should be considered in the design of dams:

Selection of Type of Dam by Hydraulic Design

- **Reservoir (Non-Overflow) Dam -** are those designed not to be overtopped. This type of design extends the choice of materials to include earthfill and rockfill dams.

- **Diversion (Overflow) Dam -** designed to carry discharge over their crests or through spillways along the crest. Concrete is the most common material used for this type of dam.

Tabulated hereunder are the summarized minimum requirements for small dams (reservoir/diversion).

Table 1. Required Parameters for Small Dam (Reservoir/Diversion)

PARAMETERS	REFERENCE
Hydrologic and Hydraulic Data	Methods for determining the catchment inflows and water surface level into the dam are provided in Section 3 and 4 of DPWH DGCS Volume 3, 2015 Edition, respectively. It is also recommended to use streamflow data (daily flow or discharge) of the identified gaging stations under the National Hydrologic Data Collection Program (NHDCP) which are published in Streamflow Management System (StreaMS) website.
Meteorological Data	Rainfall Intensity-duration-Frequency (RIDF) data from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) are used in determining the intensity of rainfall in a particular place.
Size	The volume of water required to be retained in order to reduce the severity of downstream flooding will govern the dam size.

	Normally, the height of a dam is determined by the depth of water in the reservoir based on the design flood level plus an allowance for freeboard. Actual dimensions shall be based on the hydrologic, hydraulic, stability, structural analyses, and other analyses such as seepage, settlement, etc. as deemed necessary. Refer to Section 5.7 of DPWH DGCS Volume 3, 2015 Edition for further details.
Freeboard	Minimum of 1m freeboard is provided for less than 2km Greatest Straight Line Distance over Water on Reservoir. (Refer to DGCS Volume 3, 2015 Edition, Table 5-12 Minimum Freeboard for Small Dams)
Easement	Easement requirements along the shores of a man-made lake or reservoir shall conform to Articles 50 and 51 of the Water Code of the Philippines.
Inlet and Outlet Works	Positions of the in-take are typically close to the invert of the creek or channel. Inlet controls – controls on the inlet such as gates and other regulating structures. Outlet protection works – these are required to prevent scour at the discharge point. There are numerous potential alternatives, and these will be a function of site specific constraints. Cut-offs or filters – outlet works generally represent a weak point in the dam structure, and may result in piping failure of the dam if not designed appropriately. Concrete cut-offs or filters will likely be required to prevent this from occurring.
Overflow Control/ Spillways	For non-overflow dams, the controls of overtopping flows are managed by two typical methods. The first is an emergency spillway which is designed to convey overtopping flows in case that the dam storage capacity is exceeded. This prevents the overtopping flows from damaging the dam wall, and confines them to a single location. Second, introduction of diversion conduit to manage outflow of water. This helps in releasing water for various purposes such as irrigation, water supply, or other uses. By providing a controlled outlet for water stored in the reservoir, the diversion conduit enables regulated release of water according to the demands of downstream users.

	For overflow dams, discharge is likely to be controlled through a spillway. The spillway serves to release surplus water from the storage and flood control dams, or to convey additional water that is not diverted from diversion dams.
Top Width/ Access	A sufficient top width to allow vehicular access (typically 3 m) shall be provided, if applicable. Other required provisions for access are outlined in Section 5.7.4.8 of DPWH DGCS Volume 3, 2015 Edition.
Maintenance	Maintenance plan should be developed for each structure to ensure that the dam continues to operate successfully and safely.

2. Detention Basin

Detention basins are temporary storage facilities that control stormwater runoff by intercepting flows and releasing the volume in a controlled manner over time. These basins remain dry during non-rainfall periods and release stored runoff through a hydraulic outlet structure, such as an outlet structure or sluice gate, which may serve as an emergency spillway. This guideline excludes underground detention systems for economic reasons and assumes no overtopping of the basin.

For the integration of comprehensive water management in flood control projects, the table below outlines the minimum design requirements to be considered in the design of the detention basin.

Table 2. Required Parameters for Detention Basin

PARAMETERS	REFERENCE
Hydrologic and Hydraulic Data	Methods for determining the catchment inflows and water surface level into the dam are provided in Section 3 and 4 of DPWH DGCS Volume 3, 2015 Edition, respectively. It is also recommended to use streamflow data (daily flow or discharge) of the identified gaging stations under the National Hydrologic Data Collection Program (NHDCP) which are published in Streamflow Management System (StreaMS) website.
Meteorological Data	Rainfall Intensity-duration-Frequency (RIDF) data from Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) are used in determining the intensity

	of rainfall in a particular place.
Size	The size of the basin will be governed by the volume of flow generated from the upstream catchment, and the amount of retardation required for the flow. It is preferable to utilize a computer model to size the basin, to properly simulate the hydraulic conditions at the outlet. Actual dimensions shall be based on the hydrologic, hydraulic, stability, structural analyses, and other analyses such as seepage, settlement, etc. as deemed necessary. Refer to Section 6.8 of DPWH DGCS Volume 3, 2015 Edition for further details.
Freeboard	Recommended freeboard requirements for basins are provided in Table 6-13 of Section 6.8.3 of DPWH DGCS Volume 3, 2015 Edition.
Basin Drainage	The outlet structure of a basin should be located at the low point, designed to restrict outflow under various storm conditions, and protected against debris blockages to ensure safety. The intake to the detention basin outlet should minimize safety risks, and pipes should have secured joints, sealed lifting holes, and appropriate bedding and seepage controls, with additional measures applied to downstream systems if pressurization occurs. Refer to Section 6.8.4 of DPWH DGCS Volume 3, 2015 Edition for further details.
Emergency Spillway	If the water stored in the detention basin, beyond its intended use as specified in the release timing, is redirected for other purposes such as irrigation, it is the responsibility of the concerned agency to manage and mitigate any associated disadvantages. Refer to Section 6.8.4 of DPWH DGCS Volume 3, 2015 Edition for the discussion on said matter.
Outlet Works	Protection must be provided as required at the basin outlet to prevent erosion and scour. Refer to Section 5.7.4.6 of DPWH DGCS Volume 3, 2015 Edition.
Release Timing	It is generally preferable for basins to be considered as a part of a catchment-wide analysis.

	Ideally, basins should recover 70% of storage within 24 hours and 100% within 48 hours of peak inflow, ensuring adequate capacity for subsequent storms and considering the timing of multiple control facilities to avoid downstream flooding. Refer to Section 6.8.7 of DPWH DGCS Volume 3, 2015 Edition.
Public Safety	Basins pose safety risks due to ponding water depth and currents, requiring a detailed risk assessment addressing basin grades, ponding depth, signage, outlet structure safety, and fencing, with specific measures for public access and egress. Refer to Section 6.8.9 of DPWH DGCS Volume 3, 2015 Edition
Maintenance	To ensure continued successful operation of the basin, a maintenance plan should be prepared as part of the basin design. Refer to Section 6.8.10 of DPWH DGCS Volume 3, 2015 Edition for more details.

3. Other Design Considerations

The design of small dams and detention basins must balance environmental and social factors to comply with relevant legislation and promote sustainability and equity. Environmentally, construction must adhere to the National Integrated Protected Areas System (NIPAS) Act (Republic Act No. 7586, as amended by Republic Act No. 11038), and include a comprehensive Environmental Impact Assessment (EIA) as required by the Department of Environment and Natural Resources (DENR) to identify and mitigate potential adverse effects on local ecosystems.

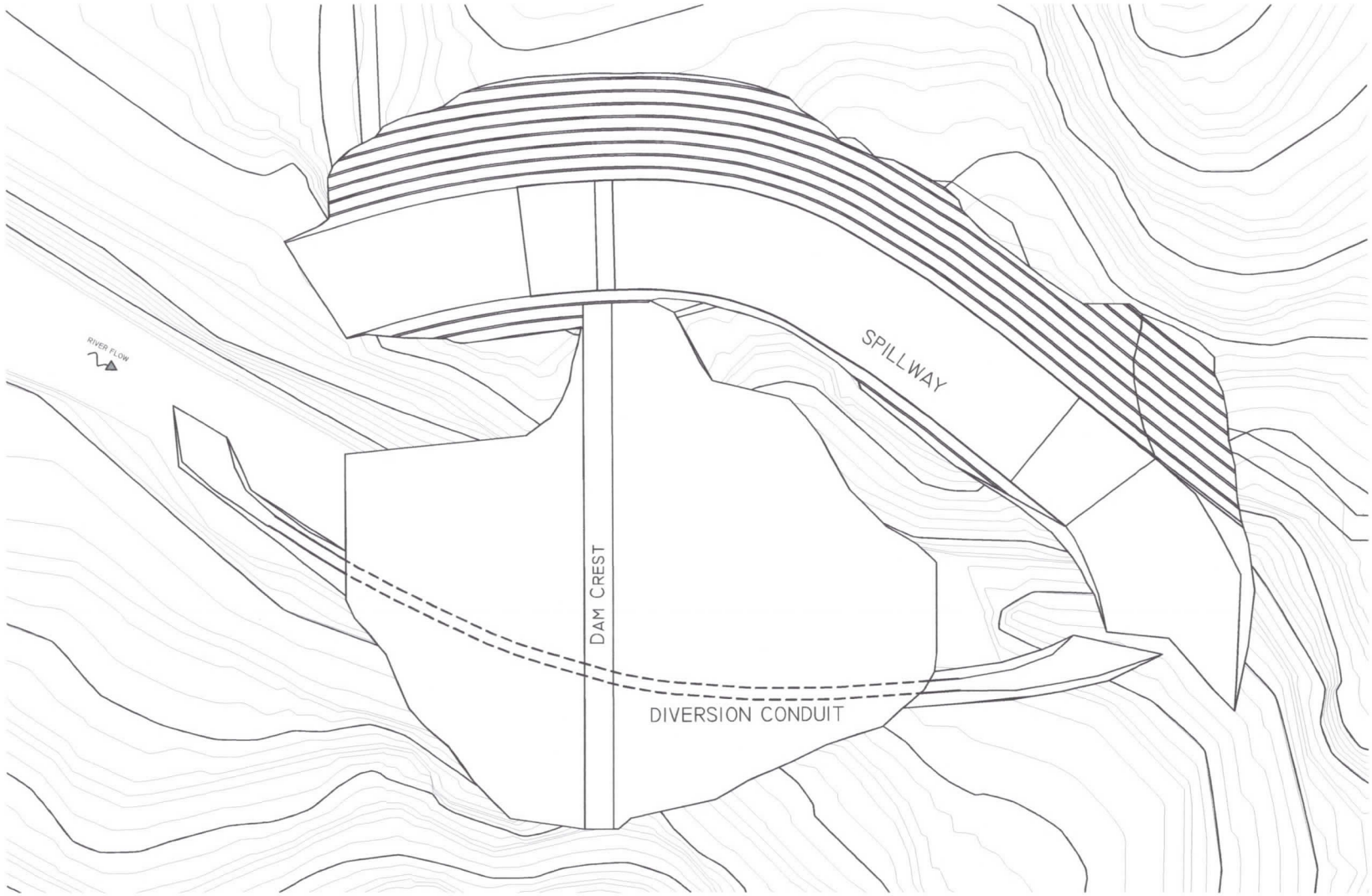
Socially, compliance with the Indigenous Peoples' Rights Act (IPRA) of 1997 (Republic Act No. 8371) is essential, requiring Free, Prior, and Informed Consent (FPIC) from the affected Indigenous communities, with meaningful consultations to respect cultural heritage and practices. Additionally, measures must align with the Philippine Clean Water Act (Republic Act No. 9275) to prevent water contamination.

The design must also consider public safety, facility access, landscaping, and aesthetics, encouraging detention basins in landscaped areas for ease of maintenance and enhanced site aesthetics. A monitoring mechanism is required to ensure proper planning, construction, operation, and maintenance.

IV. References

- Caltrans Geotechnical Manual (December 2014)
- Department of Energy and Water Supply – Queensland (2013). Queensland Urban Drainage Manual (3rd ed). Institute of Public Works Engineering Australia, Queensland Division Ltd., City East, Queensland 4200.
- DPWH BOD Manual: Design Procedure Manual for Flood Control (Intranet)
- DPWH Department Order No. 75, Series of 2024, Re: Guidelines for the Conduct of Geotechnical Investigation for all DPWH Infrastructure
- DPWH Design Guidelines, Criteria and Standards - Volume 2B, 2015 Edition
- DPWH Design Guidelines, Criteria and Standards - Volume 2C, 2015 Edition
- DPWH Design Guidelines, Criteria and Standards (DGCS) - Volume 3, 2015 Edition
- Indigenous Peoples' Rights Act (IPRA) of 1997: Republic Act No. 8371
- JICA/DPWH, 2010, Technical Standards and Guidelines for Design of Flood Control Structures.
- National Integrated Protected Areas System (NIPAS) Act: Republic Act No. 7586, as amended by Republic Act No. 11038
- Philippine Clean Water Act: Republic Act No. 9275
- Susdrain. (n.d.). Detention basins. Www.susdrain.org. https://www.susdrain.org/delivering-suds/using-suds/suds-components/retention_and_detention/Detention_basins.html
- United States Department of the Interior: Bureau of Reclamation [USBR] (1987). Design of Small Dams, Third Edition, Washington.
- Water Code of the Philippines (Amended): Presidential Decree No. 1067
- Wet Bottom Detention Basins with Water Quality Features (Harris County Flood Control District) 2014

ANNEX "B"



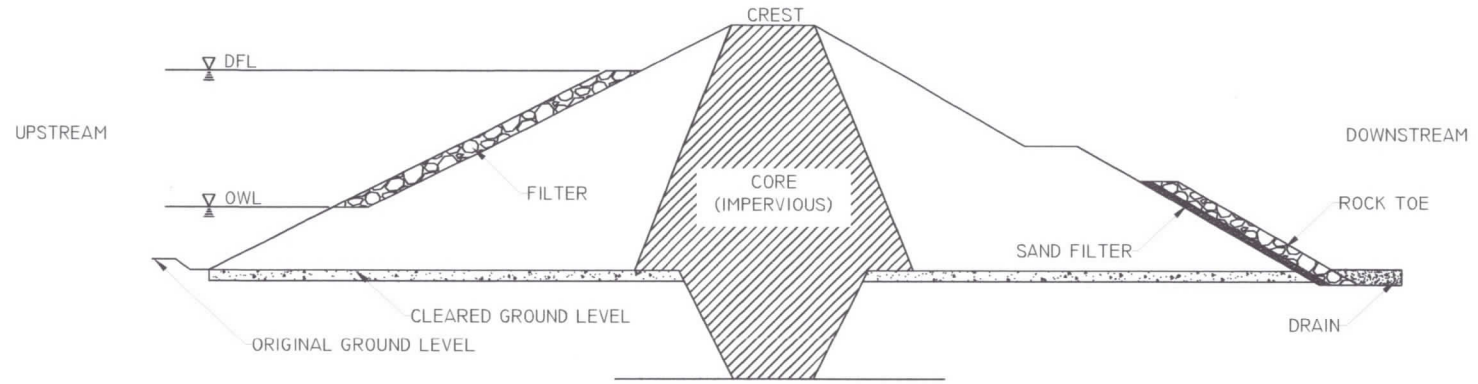
PLAN

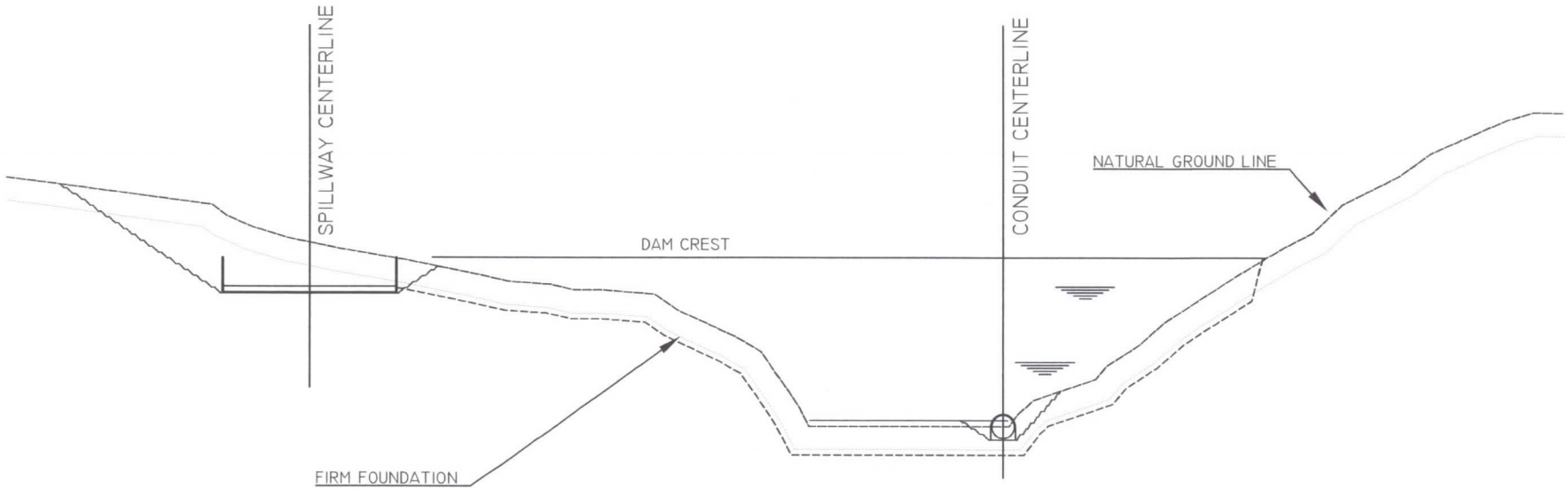
SCALE: NTS

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
WATER PROJECTS DIVISION
BUREAU OF DESIGN
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:	SHEET CONTENTS:	PREPARED:	SUBMITTED:	RECOMMENDED:		APPROVED:	SET NO.	SHEET NO.
SMALL DAM (RESERVOIR)	PLAN							-

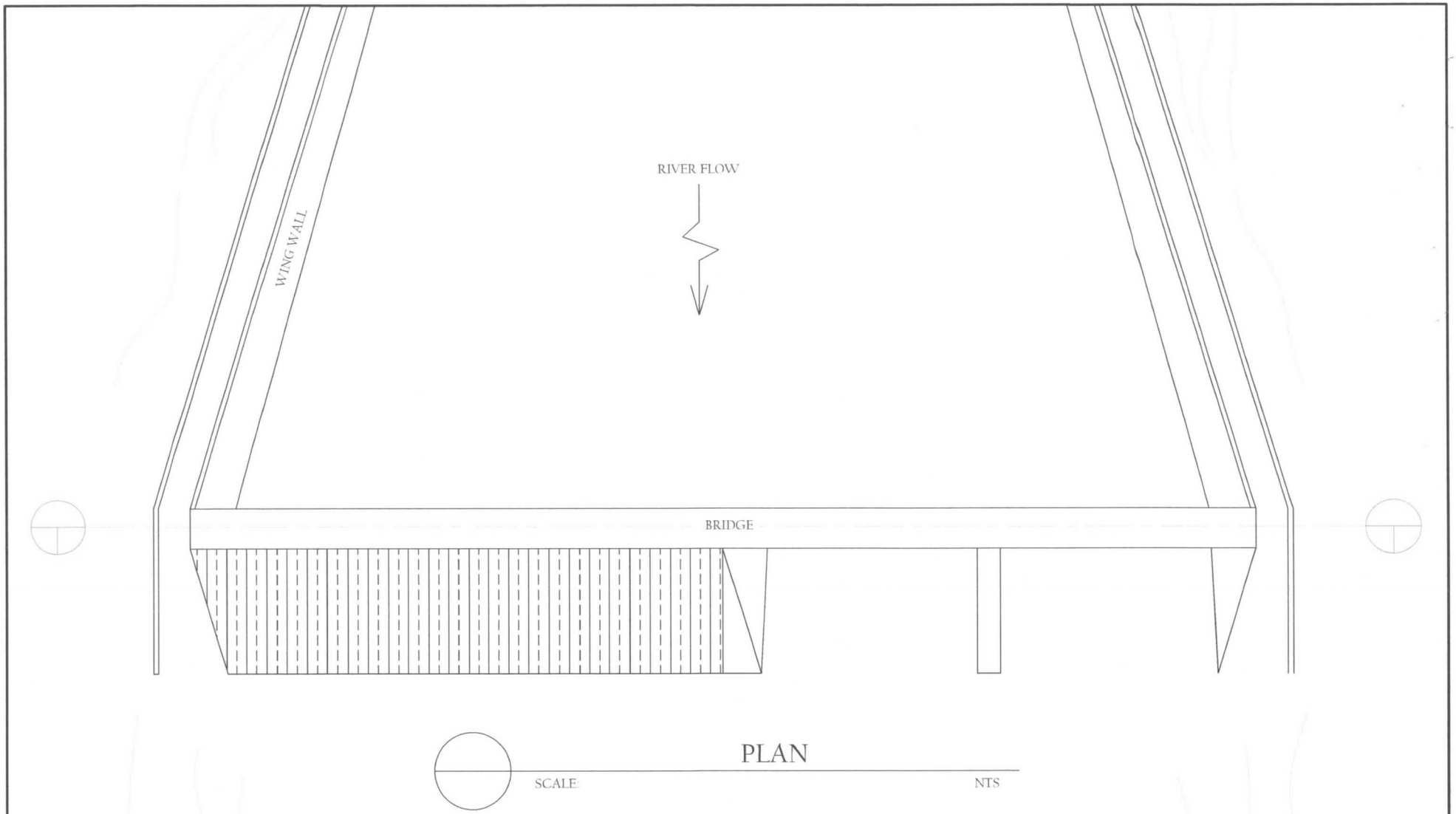
ANNEX "B"





REPUBLIC OF THE PHILIPPINES **DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS** WATER PROJECTS DIVISION BUREAU OF DESIGN BONIFACIO DRIVE, PORT AREA, MANILA	SHEET TITLE: SMALL DAM (RESERVOIR)	SHEET CONTENTS: LONGITUDINAL & CROSS SECTIONS	PREPARED:	SUBMITTED:	RECOMMENDED:		APPROVED:	SET NO. / SHEET NO.

ANNEX "C"



PLAN

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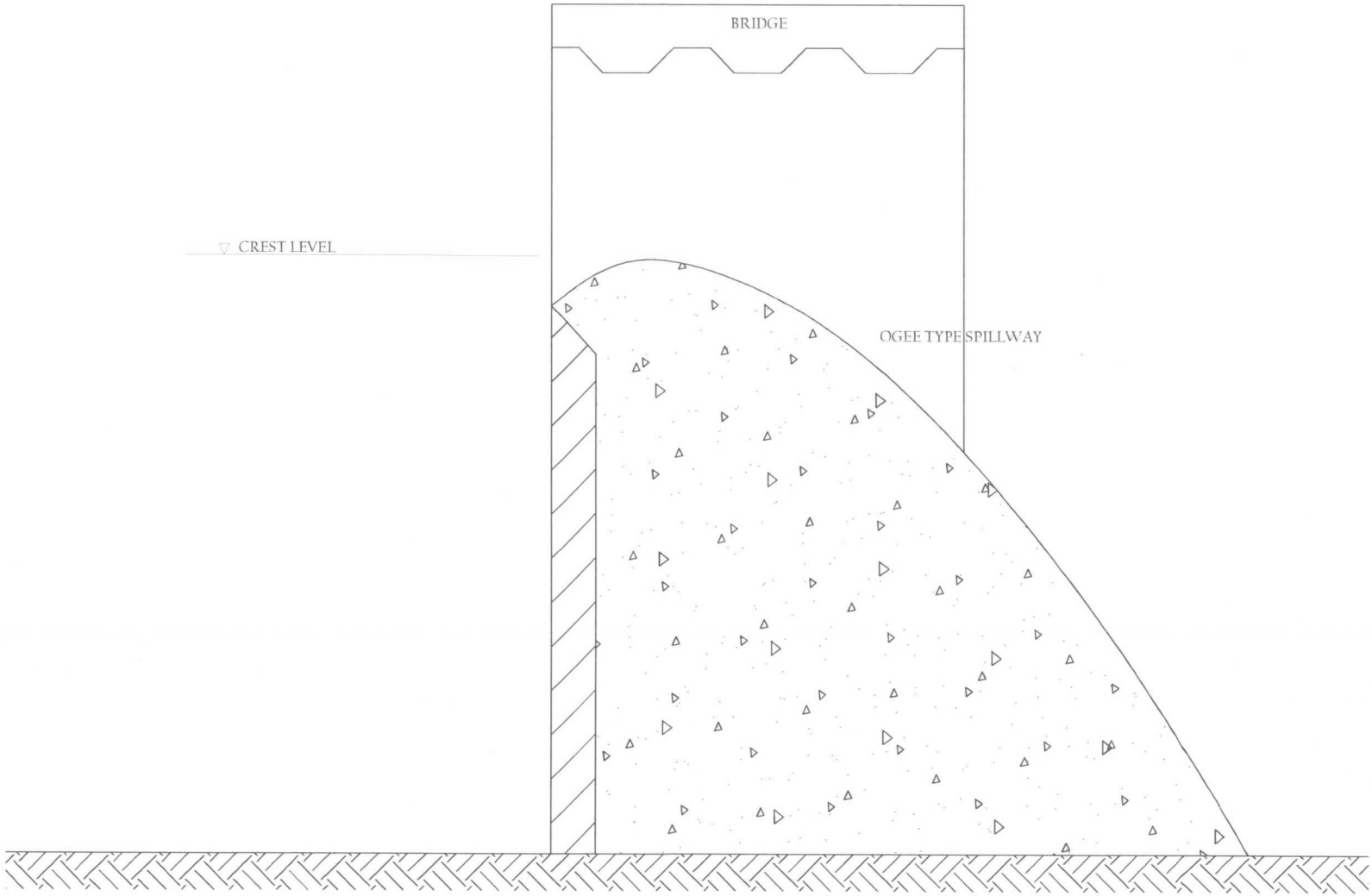
REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS WATER PROJECTS DIVISION BUREAU OF DESIGN BONIFACIO DRIVE, PORT AREA, MANILA	SHEET TITLE: SMALL DAM (DIVERSION)	SHEET CONTENTS: PLAN	PREPARED:	SUBMITTED:	RECOMMENDED:		APPROVED:	SET NO.:	SHEET NO.:

ANNEX "C"



LONGITUDINAL SECTION

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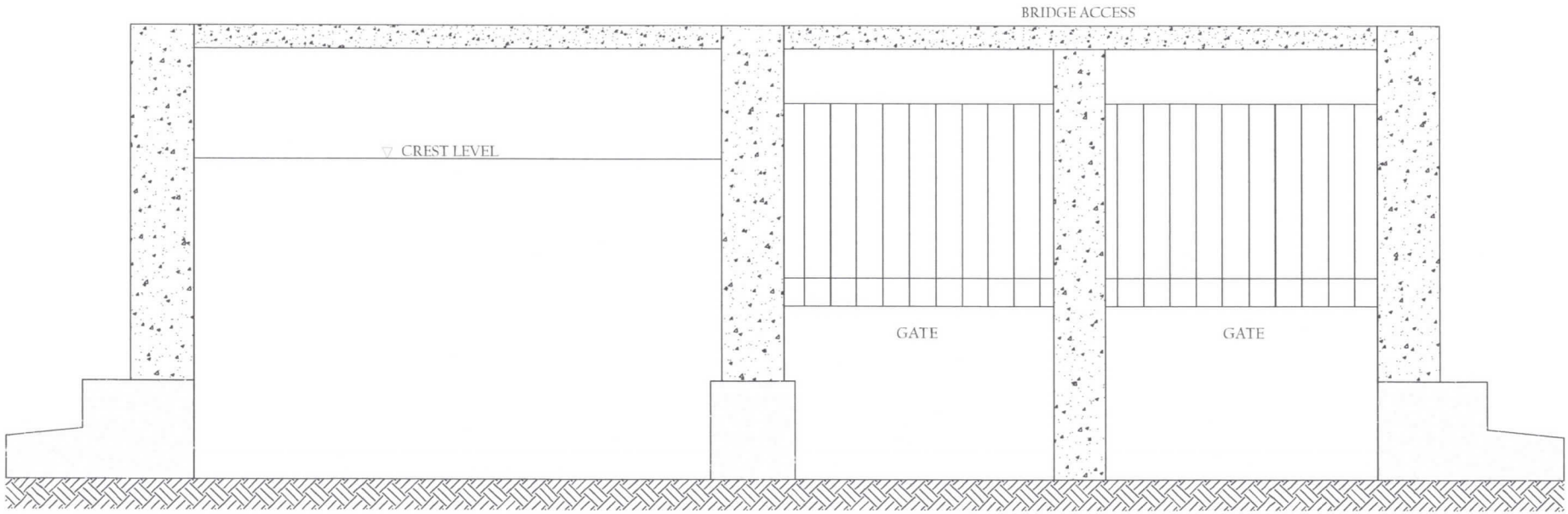
	SMALL DAM (DIVERSION)	LONGITUDINAL SECTION							-

ANNEX "C"



CROSS SECTION

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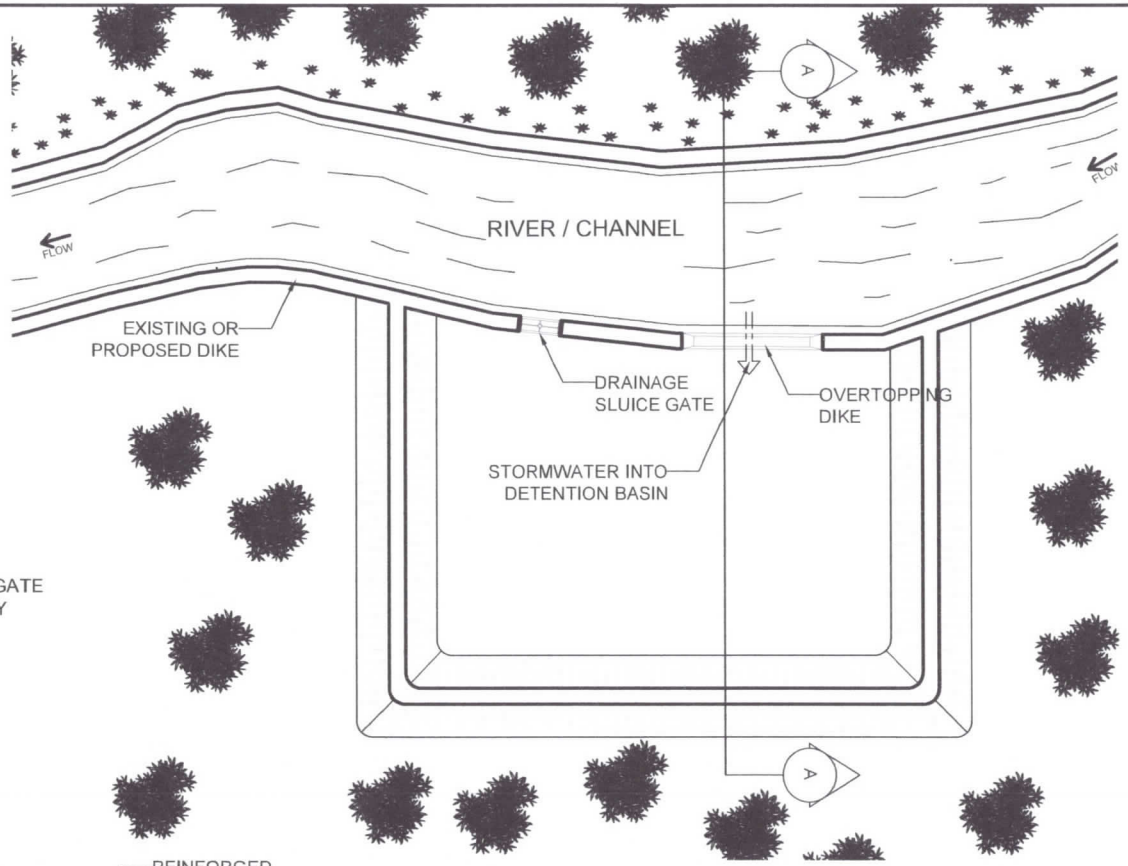
	SMALL DAM (DIVERSION)	CROSS SECTION					

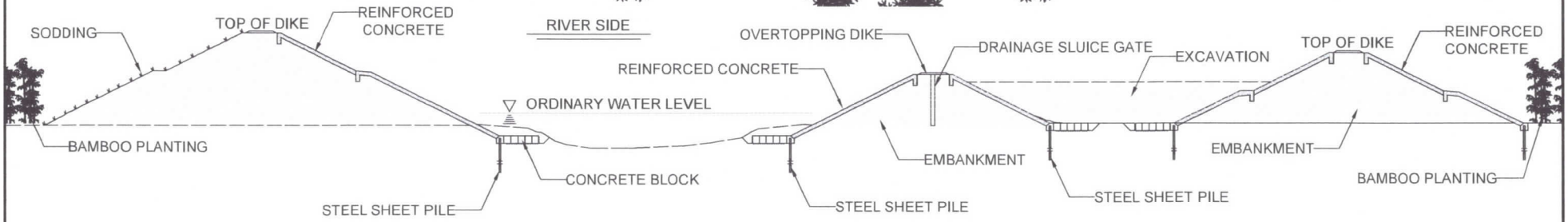
ANNEX "D"



NOTE : DRAINAGE SLUICE GATE SERVES AS AN EMERGENCY SPILLWAY

PLAN VIEW

SCALE NTS



SECTION "A"

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	DETENSION BASIN	PLAN & SECTION					-	-