

URBAN WETLANDS AND THE BUILT ENVIRONMENT

Eco-tourism as a strategy for sustainable co-existence and Management of Deepor Beel- a Ramsar wetland in India.

A THESIS

submitted by

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DOCTOR OF PHILOSOPHY



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Indian Institute of Technology

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CERTIFICATE

It is certified that the work described in this thesis entitled “***URBAN WETLANDS AND THE BUILT ENVIRONMENT; Eco-tourism as a strategy for sustainable co-existence and Management of Deepor Beel-a Ramsar wetland in India.***” by Niva Rana Mahanta for the award of degree of Doctor of Philosophy is an authentic record of the results obtained from the research work carried out under my supervision in the Centre for the Environment, Indian Institute of Technology Guwahati, India, and this work has not been submitted elsewhere for a degree.

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STATEMENT

I do hereby declare that the matter embodied in this thesis entitled “**URBAN WETLANDS AND THE BUILT ENVIRONMENT; Eco-tourism as a strategy for sustainable co-existence and Management of Deepor Beel-a Ramsar wetland in India**” is the result of investigations carried out by me in the Centre for Environment, Indian Institute of Technology Guwahati, India, under the supervision of Dr. Chandan Mahanta. In keeping with the general practice of reporting scientific observations, due acknowledgements have been made wherever the work described is based on the findings of other investigators.

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Niva

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Abstract

Today, amidst the rapidly expanding urbanized world, around 54% of the world's population lives in cities. The concept of 'Green Design' has now become a new trend for the development of sustainable cities. With the intervention of green infrastructure to save the cities, the urban planners and policy makers are addressing it in a much bigger way. Urban aquatic environments are a part of the green infrastructures that possess very high ecological value and play an important role in a healthy and functional ecosystem. It provides ecosystem services such as regulating the microclimate, maintaining biodiversity, regulating floods and providing recreational and educational opportunities, which is highly correlated with the human development. For a livable city with a better habitat quality, it is essential to protect and conserve all aquatic environment and their biodiversity. Together the green-blue infrastructure makes a better trend for holistic development in creating sustainable and humane cities.

Building a sustainable environment within the urban fabric, needs a special environmental consideration for conservation and co-existence of distinct ecologies. Eco Parks and Urban Wetland Parks are gaining popularity as a strategy for enhancing the tourism and providing an outdoor recreation while conserving these rich and complex urban ecosystems. Interdisciplinary design approaches by integrating scientific as well as Eco Political frameworks, are found to be beneficial for the wetland protection, restoration, conservation and management. Ecologists are involved in land use planning to develop in depth understanding of ecosystem structure and function, combining the information into usable form and communicating the ecosystem knowledge to civil engineers, architects, landscape architects, and planners who further jointly take decisions on urban land use plan. While taking such decisions architects and planners keep mainly three aspects in mind; content, container and context. Content (Space requirements and end users) and container (building envelope) are very much project specific, but context is largely dependable on the nature and ecological habitat around. Considering the fact that development and construction are inevitable; integrating built forms in the urban fabric, particularly in an environmentally sensitive area, needs some universal and local factors to be considered and should be addressed in the planning and designing stages so as to have zero / minimum impact to the environment.

Rich biodiversity and surrounding forest landscape of Deepor Beel, a Ramsar wetland in Guwahati, India is currently facing a crisis for conservation due to rapid urbanization, institutional conflicts and insignificant cooperation from the local communities. This research analyzes the challenges for planning failure, delay in projects implementations and effectiveness of participatory community system. The literature study was indicative for a better implementation of proposed development and economic activities aimed at protection and conservation of the wetland. For an in-depth study and analysis of all attributes for the design and planning of the proposed built environment, diversified data sources and several respondents were included in the study design method. The methods were qualitative and as such relied heavily on in-depth interviews, Participatory Rural Appraisal (PRA), Focus Group Discussions (FGD), field observation, secondary data, observations of the activities of the Government / Non-Government Organizations (NGOs) and Civil Society Organizations (CSOs). The same tools were used to validate the data from the communities where such organizations operated. Exploratory, observation and participatory methods were used in the numerous visits to the study location for data collection on human-nature relations from the communities living in the fringe villages. Guidelines from international and national organizations like Environment Protection Agency – USA (EPA), World Conservation Union–World Commission on Protected Areas (IUCN-WCPA), World Heritage Convention (WHC), and Convention on Biological Diversity (CBD) and RAMSAR convention, National Lake Development Authority (NLDA), Wetland Conservation and Management Rules (2017) were implemented in design decisions for better conservation and management of the wetland and the built environment.

Design Research was conducted for site specific physical properties (nature), demography (communities), wetland extend (flood plain and hazard zones), land-use-land-cover (LULC) and climatic conditions. Context specific concept maps were prepared before planning the recreational facilities from the outcome of Design Research and literature review. Based on the findings, design decisions were established to provide for the built environment and landscape of all facilities and areas proposed. This was then mapped in line with the proposed Detailed Project Report (DPR) by Guwahati Metropolitan Development Authority (GMDA), PRAs and FGDs recommendations. They were carefully planned and examined to minimize impact on wildlife and biodiversity by combining strategies from case studies for better execution of conservation and management. The social and potential values of identified resources as well as cultural landscape were also

considered in the planning stage for their appropriateness. Detail designs with added recommendations were prepared for all three major areas marked in the master plan by GMDA to achieve optimum Ecological, Economic, Educational and Research benefits, retaining the traditional design identity(entry nodes 1, 2&3 with a total area of 1.61 sq.km/397.8 acre)..

The design concept integrated the inferences about nature, communities, built forms and water using contextual simplicity, cultural dynamics, aesthetics and landscape regeneration as target indices. The design domains emphasized on eco-tourism, thermal comfort, efficiency (cost, energy and water), sustainable construction and landscape with water sensitive design principles like bio swales, riparian corridors etc. The design solutions were in line with the Sustainable Development Goals' (SDG) of United Nation's 2030 Agenda, Habitat III and The International Eco-tourism Society's (TIES, 1990)goal for restoring, conserving, local benefits, educating and reducing ecological footprints. The proposed education and research facilities include a Nature Interpretation Center, Aqua Culture Center, an Aquarium and a Museum for birds, flowers and butterfly species in the N-E region with interactive devices for bird monitoring in bird watching towers. Anticipated economic benefits are tourism and Bio rights; seasonal crops, flower cultivation, recycling of water hyacinth and fish farming to name a few. Probable cost models for the project realization were derived from GMDA's proposal and all add-on facilities were based on research findings and recommendations. A work breakdown structure was prepared for smooth realization of the project by dividing into phases with categorization of expenses from low, medium and high. They were strengthened with the model framework of stakeholders to comprehend the network of larger goals in smaller steps. To conclude, this project provided an opportunity to comprehensively address all issues involved and additionally create a frame work to be able to implement the project. This will help to restore the wetland, increase community support, re-establish an ecological balance and promote environmental sustainability with humane centric approach.

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List of abbreviations

ABS – Access and Benefit Sharing, Nagoya Protocol.
AHEC - Alternate Hydro Energy Centre
Arc GIS-Geographic information system (GIS) for working with maps
ARSAC - Assam Remote Sensing Application Centre.
ASTEC - Assam Science and Technology Council
BC - Black Carbon
BG lines – Broad Gauge Lines
BNHS - Bombay Natural History Society.
BOT - Build-Operate-Transfer
C&M - Conservation and Management
CFM - Community Forest Management
CPR – Common Pool Resource
CRM - Cultural Resource Management-
CWPRC - The Central Water and Power Research Center.
CWRA – Central Wetland Regulatory Authority
DFID - The Department for International Development
DPR – Detailed Project Report.
EDC - Eco-Development Committee
ECS - Environmental Conservation Sciences.
EDRA - Environmental Design Research Association
EKW - East Kolkata Wetlands
EKWMA - East Kolkata Wetlands Management Authority
EUCC - European Union for Coastal Conservation
EWS - Emirates Wildlife Society
FGD - Focus Group Discussion
GCA – Guwahati College of Architecture
GDP – Gross Domestic Product.
GIBA - Global Important Bird Area
GIS – Geographical Information System.
GMDA – Guwahati Metropolitan Development Authority.
GSCDAL - Guwahati Smart City Development Agency Limited
HTI - Habitat Threat Index
IBA – Important Bird and Bio diversity Areas.
ICT - Information, communication and technology
IIT - Indian Institute of Technology
IKONOS – First commercial satellite that provided high-resolution imagery
INR - Indian Rupees
ISRO - Indian Space Research Organization

IWMP - Integrated Watershed Management Program
JFMCs -Joint Forest Management Committees
LAWDA - Lakes and Water Development Authority
MIS - Micro Insurance Scheme
MIS - Micro Insurance Scheme
MMRDA - Mumbai Metropolitan Region Development Authority
MNP- Maharashtra Nature Park
MoEFCC - Ministry of Environment, Forest and Climate Change.
NABARD - National Bank for Agriculture and Rural Development.
NDSU -North Dakota State University, USA
NEDFiHaat - North-Eastern Development Finance Corporation ltd.
NEP - National Environment Policy.
NESAC- North Eastern Space Application Center.
NGO - Non Government Organization
NH - National Highways
NIO - National Institute of Oceanography, Goa.
NRM- Natural Resources Management
NRSC - National Remote Sensing Centre
NWCP – National Wetland Conservation Programme.
O&M - Operation and Management.
PPP- Public Private Partnership
PRA - Participatory Rural Appraisal
PWC - Price water house Coopers
PWD - Public Works Department
RAK - Ras Al Khaimah
RO - Reverse Osmosis
SAC - Space Applications Centre
SACON - Salim Ali Centre for Ornithology & Natural History.
SAFE - South Asian Forum for Environment
SCM – Smart Cities Mission.
SCP- Smart City Plan
SDA - Srinagar Development Authority
SDG - Sustainable Development Goals.
SHG - Self Help Groups
SPV - Special Purpose Vehicle
STCI - Sustainable Tourism Criteria for India.
STP - Spanning Tree Protocol
TEEB - The Economics of Ecosystems and Biodiversity
TIES - The International Eco-tourism Society.
TNN – Times News Network
UNEP - United Nations Environment Programme.

UNESCO - United Nations Educational, Scientific and Cultural Organizations
UNWTO - World Tourism Organization of the United Nation
VGR - Village Grazing Reserve
VPCs- Village Protection Committees
WRR - Waste Recycling Region
WWF - World Wide Fund



Chapter 1

Introduction

Wetlands are now recognized as important features in the landscape that provide numerous beneficial services for people, fish and wildlife. Some of these service or functions include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow, during dry periods. These useful services, considered valuable to societies worldwide are the result of inherent and unique natural characteristics of Wetlands (Chauhan, 2014).

Forests and Wetlands have added attraction when made accessible via managed recreational areas. (Guangqing Chi, 2013). Besides, they are a constructive component of natural green infrastructure in urban habitats. When cities and wetlands collide, the protective factors of environment for health improvement and sustainability fade away from urban ways of living. (Katcher & Beck, 1987) (Axelrod & Suedfeld, 1995). The Eco-parks and the Urban Wetland Parks are gaining popularity as a strategy for enhancing tourism and providing outdoor recreation to urban people, while conserving these rich and complex urban ecosystems at the same time. Natural wetlands are self-supportive and sustainable and other ecosystems spring up in conditions uniquely favorable to them till they are disturbed by any developmental activities. Though restoring the original function is crucial and challenging, efforts are being undertaken by several countries for effective management of these urban wetlands (David Lawrenz, 2012).

1.1 Urban Wetlands

Many mega cities have integrated natural water bodies into the cityscapes which attracts tourists, mainly for water recreation. The broads are Britain's largest protected wetlands (lakes are locally known as broads) the third largest inland waterways and one of Britain's 14 national parks. It is difficult to believe that the broads are in fact artificial features of the landscape; pits dug during the middle ages that were flooded and created natural wetlands ; now home to some of the rarest plants and animals, a multitude of birds and of course a heaven for boating holiday-makers and enthusiasts (Hiscock, 2007). The New York Green Infrastructure Plan, Green Paths

Network of Berlin, Copenhagen Finger Plan are some of the finest examples of urban green blue infrastructure, with enormous co-benefits to both humans and the eco-systems (Haase, 2015). Mahim nature-park, built on a dump-yard in Mumbai, India is an excellent example of green blue intervention in the city.

1.1.1 Built Environment Around Wetlands and Ecotourism as a Conservation Strategy

The green infrastructure network is preferable for physical and social interactions with neighbours and other local residents. It is one of the most important public spheres in towns and cities in which, public has physical and visual access. It facilitates the residents' ability to recreate, socialize and perform other regular transactional activities as it stresses the holistic relationship of outdoor open spaces with a range of human activities in unbroken continuity. Thus, green infrastructure attributes have the potential to induce a sense of belonging in a community (Mazlina Mansor, 2008). Among the green infrastructures in an urban fabric, both visitors and neighbours find wetlands in a natural landscape context significantly more attractive (Nassauer, 2004). Built environment around a wetland in urban area is subjected to the land-use pattern shown in the master plan of the city. The integration of the natural world into land use planning of cities, connecting culture with nature has been a challenge for architects and planners for urban development. It is now widely recognized that the sustainability of urban development depends on the provision and maintenance of forward-looking municipal and ecological infrastructures (Kai Xu, 2010). The task becomes even more difficult when important natural wetlands and forests are part of such urban spaces. Within the urban fabric, built environment around a wetland (with an avian habitat of native, migratory and wintering birds and other flora and fauna in particular) needs special environmental consideration for conservation and co-existence.

The “International tourism expenditure reached 1 trillion USD in 2011 (World Tourism Organization press release, May 7, 2012) With half of all international tourists travelling to wetlands, especially in coastal areas, and the added value of domestic tourism and recreational day trips, there is enormous potential in wetland tourism” (Secretariat of the Ramsar Convention on Wetlands (Ramsar, 2012). Eco tourism market is 6% of the GDP all over the world with yearly growth rate of 5% (Economy watch, 2010). The Wetlands Conservation and Management Rules 2010 formulated by the apex regulatory authority under the Union Ministry of Forest and

Environment in India also highlight the importance of wetlands for supporting many significant recreational, social and cultural activities, besides being a part of the cultural heritage (NWCP, 2014). “The Ministry of Tourism, Government of India has been promoting ecotourism, inter-alia by supporting seminars and events, focusing on the development of ecotourism, from time to time. It has formulated and adopted the Sustainable Tourism Criteria for India (STCI) for three major segments of the tourism industry, namely Accommodation Sector, Tour Operators’ Sector, Beaches, Backwaters, Lakes and Rivers” (Mr. Shripad Naik, Minister of State for Tourism on questions raised in the Rajya Sabha regarding development of Ecotourism, July 7, 2014, India).

In the past, there already have been many a successful attempts in promoting ecotourism in India. Even now, the future of ecotourism is bright as famous projects like Jim Corbett National Park, Ranthambore, Gir Lion Park, Houseboat Cruises in Kerala, Kaziranga and Sunderbans National Park and several tiger reserves are running successfully (Ghosh, 2010). Recently, six facilities of the Himachal Pradesh forest department have been given on rent via public-private partnership (PPP) to function as eco-tourism sites, under the revised policy (Chauhan, 2014). The UP tourism department has come up with Rs 5 crore plan to boost ecotourism in the state by overhauling Sur Sarovar Bird Sanctuary, which is home to over 100 species of local and migratory birds (Dev, 2014).

At the Rio+20 United Nations Conference on Sustainable Development held in 2012, green economy was one of the two overarching themes, with cities deemed to be one of the seven areas needing priority attention. United Nations Environment Programme (UNEP) has described green economy as “results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (David Dodman, 2004).

1.1.2 Integrated Design with Interdisciplinary Approaches

In the book, “Restoring Streams in Cities”, Ann Riley (1998) highlighted the involvement of interdisciplinary experts from the field of Ecology, Hydrology and Engineering in planning for most environmental restoration projects. Combined Mitigation–Adaptation approach towards improved urban resilience helps to achieve sustainable cities. A multidisciplinary approach, which integrates scientific as well as Eco political frameworks, is found to benefit this sustainability discourse (Mary Thornbush, 2013). Designing of urban spaces plays a critical role hand in hand with planning and management at different scales of a project on a defined site to

the territorial dimension of development. The agency of the disciplines of Architecture, Urbanism and Planning address urban development through a multidisciplinary perspectives. It comprises of housing, informality, community participation, heritage, conservation and the difficulties (often failures) of planning. Implementation of environmental issues like climate change, resilience, ecology and flooding using technologies like GIS is also essential (Shannon, 2011). Ecologists are involved in land-use-planning to develop in-depth understanding of ecosystem structure and function, synthesizing the information into usable form and communicating the ecosystem knowledge to civil engineers, architects, landscape architects, and planners, who jointly take the decision on urban land-use-plan. On the other hand, building designers keep mainly three aspects in mind; Content, Container and Context (W. Otie Kilmer, 1992). Content (Space requirements and end users) and container (building envelope) are very much project specific, but context is largely dependable on the nature and ecological habitat around. Considering the fact that development and construction are inevitable, integrating a building in the urban fabric, particularly in an environmentally sensitive area, needs some universal and local factors to be considered and should be addressed in the planning and designing stages so as to have zero/ minimum impact on the environment.

The success of reconnecting local people with their ecosystems lays within the people themselves and their empowerment. They must feel a sense of ownership of the restoration site. The traditional approach, with neighborhood residents periodically commenting on a plan developed outside of their community, is insufficient. Neighborhoods, government agencies, private consultants, and/or industry must all participate in planning, implementation, and evaluation of the restoration as equals. Otherwise, the local community is not likely to develop a sense of ownership (Casagrande, 1997). Private landowners may not see much value in protecting wetlands, even though there may be great social value in doing so (Tracy Boyer, 2004). Design for wetland restorations should provide cultural cues to familiar aesthetic values that can be constructed immediately (structures, signs, strategically placed areas of turf) to help viewers understand the stewardship intention and developing beauty of the wetland (Nassauer, 2004). Wetland management strategies often ignore cultural values and in some cases contribute to their loss. By integrating cultural and ecological diversity in wetland management, we can achieve a complete understanding of human ecological relations for a better management. (Nicholas, 2001).

1.1.3 Regulations for Conservation and Management of Wetlands

The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the Central Government for planning, promotion, co-ordination and overseeing of the implementation of India's environmental and forestry policies and Programmes'. With the aim of conservation and wise use of wetlands in the country, MoEFCC operationalized National Wetland Conservation Programme (NWCP) in close collaboration with concerned State Government during the year 1985/86. The ministry has notified the Wetlands rules for conservation and management in 2017 under the umbrella of the Environment (Protection) Act, 1986 and the Central Wetland Regulatory Authority (CWRA) was set up to ensure proper implementation of the Rules and perform all functions for management of wetlands in India. According to the country's Wetland Rules, a 'Wetland' means an area or/of marsh, fen, peat-land or water; natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water, the depth of which, at low tide does not exceed six meters and includes all inland waters such as lakes, reservoirs, tanks, backwaters, lagoon, creeks, estuaries and man-made wetland and the zone of direct influence on wetlands; that is to say the drainage area or catchment region of the wetlands as determined by the authority. It clarifies that wetland does not include main river channels, paddy fields and the coastal wetland. India is also a signatory to the Ramsar Convention of Wetlands (Signed in Ramsar, Iran in 1971) and has 27 listed wetlands under the convention (as of June 2019). The ministry has also established Salim Ali Centre for Ornithology & Natural History (SACON) with partnership of the Bombay Natural History Society (BNHS) in Coimbatore, Tamil Nadu. Operational since 1992, the Centre is assisting and promoting scientific (NWCP, 2016) research in Ornithology with the objective of Comprehensive Management and sustainable co-existence of avifauna in diverse ecosystems (NWCP, 2016).

Recognizing the importance of wetland ecosystems, the National Environment Policy (NEP), 2006, contains an unambiguous assertion of the need for a holistic view of wetlands, which looks at each identified wetland in terms of its causal linkages with other natural entities, human needs, and its own attributes. The NEP's six-fold 'Action Plan' in this direction comprises, among others, formulation of a regulatory framework, linkage with poverty alleviation, and programme for employment generation.

In India, as per their locations and surroundings, wetlands come under many regulations directly or indirectly (S.N. Prasad, 2002). Some of the key Indian legislations are given in Annexure 2.

1.2 Status of urban wetlands in India

Government of India operationalized the National Wetland Conservation Programme (NWCP) in close collaboration with the concerned State Government during the year 1985/86. Under the Programme, 115 wetlands have been identified till 2012 by the Ministry, which requires urgent conservation and management initiatives (NWCP, 2014) but 27 are listed as Ramsar site till 2019. *“Only few wetlands in India are covered under the Ramsar Convention for wetland conservation. Healthy wetlands are extremely important for achieving sustainable development. While there is a need to bring more wetlands under the Ramsar domain, unfortunately for us, we have not been able to effectively conserve even these listed sites”* (Sharma M. , 2012).

Montreux Record is a record of Ramsar sites where changes in the ecological character have occurred, are occurring or are likely to occur for the remedial measures and monitoring, maintained by the secretariat in consultation with the contracting parties concerned (Recommendation 4.8, 4th Conference of the Contracting Parties, Montreux, Switzerland, 1990). Here, only two out of 27 Indian wetlands of Ramsar Convention are included. They are Keoladeo National Park, designated October 1, 1981, Rajasthan, 2,873 ha, Montreux Record July 4, 1990 and Loktak Lake, designated March 23, 1990, Manipur, 26,600 ha, Montreux Record June 16, 1993 (Ramsar convention, 2017) (Center, China Internet Information, 2015). Chilika Lake, Orissa, India, designated October 1, 1981, 116,500 ha, Montreux Record June 16, 1993, was removed (November 11, 2002) and declared as best managed wetland with maximum funding (www.ramsar.org). It was made possible by the joint effort of Chilika Lake Development Authority, National Institute of Oceanography (NIO), Goa, The Central Water and Power Research Center (CWPRC), Pune and community based treatment for micro watershed in the catchment area.

Wetlands in India are not delineated under any specific administrative jurisdiction. The primary responsibility for the management of these ecosystems rests on the Ministry of Environment and Forests (Wetlands rules 2010). Some wetlands are protected after the

formulation of the Wildlife Protection Act (on being part of sanctuaries); others face an acute danger of degradation (Sharma M. , 2012). The major factor responsible for wetlands degradation in the urban areas of India is the anthropogenic activities including hydrologic alteration, pollution caused by agriculture and industry runoff, non-execution of policy, hunting and poaching, introduction of non-native species causing degradation and destruction of wetlands, ground-water depletion and instigating global climate change.

A comparative study of five (5) Ramsar sites in India was conducted to understand the overall status (Refer Annexure 3 for the summarized Table). The factors taken into account while selecting the wetlands are i. urban location ii. Avian habitat and iii. Nature Park. The Loktak Lake in Manipur state was selected for being the only floating national park in Ramsar wetlands of India. The inferences from the study show that the major threats to those wetlands, which are rich in biodiversity, especially with an avian habitat (both native and migratory) are more or less typical. They are hydrological abstraction due to construction of dams, pollution, eutrophication, siltation and infestation; reclamation and habitat loss due to the construction and agriculture; pollution from sewage, pesticides, industrial effluents and unscientific tourism activities and over exploitation of resources.

The wetlands in Assam (India) and neighboring states are classified under the Eastern Himalayan wetlands including the Beels in the Brahmaputra and Barak Valley. A survey conducted by the Assam Remote Sensing Application Centre (ARSAC), Guwahati, and the Space Research Centre, Ahmadabad, has revealed that 1,367 out of 3,513 wetlands in Assam are under severe threat due to the invasion of the aquatic weeds and other developmental activities (India environmental portal). The Beels of Assam and West Bengal are one of the most important inland resources and are facing eutrophication, clogged with floating vegetation and loss of both the wetlands and water quality (V.V.Sugunan, 2000). Among the natural hydronomy of Assam, the Beel or Hawar (natural body of water smaller than lake) is also one of the major elements. The floodplain lakes (locally called as Beels) comprise of an important component for the inland aquatic resources of India in general and the North-Eastern region in particular (Saikia P.K, 2011). In Assam, there are plenty of Beels in every district which, were mostly formed in the abandoned, and changing river courses, where meanderings were plenty. Beels generally retains the name of the respective rivers. Further, earthquakes in Assam are also responsible for

major geological, geomorphologic, physiographic and cultural changes like formation of some Beels (V.V.Sugunan, 2000) .

1.3 The Study Area: Deepor Beel

Deepor Beel ($90^{\circ}36'39''$ - $90^{\circ}41'25''$ E and $6^{\circ}05'26''$ $26^{\circ}05'52''$ N), the only Ramsar wetland in the state of Assam is located on the south bank of the river Brahmaputra and South-West of the Guwahati city (Figure 1.1). It is surrounded by Jalukbari hill in the North, Rani Garbhanga Reserve Forest on South, Barely River on the East and Kalmoni River on the West side. It was the Government Fishery Mahal till January 12, 1989, when it proposed as Wildlife Sanctuary vides Govt. Order No. FRW.1/89/26. It is the only major storm water storage basin for Guwahati city, which has, of late, been passing through the worst water logging during every monsoon. Construction of broad-gauge railway line and reclamation of area along the track has divided the Beel into pockets and has contributed to the shrinkage of the Beel area from 40 km² to 9.27 km² (Planning Commission, 2008).

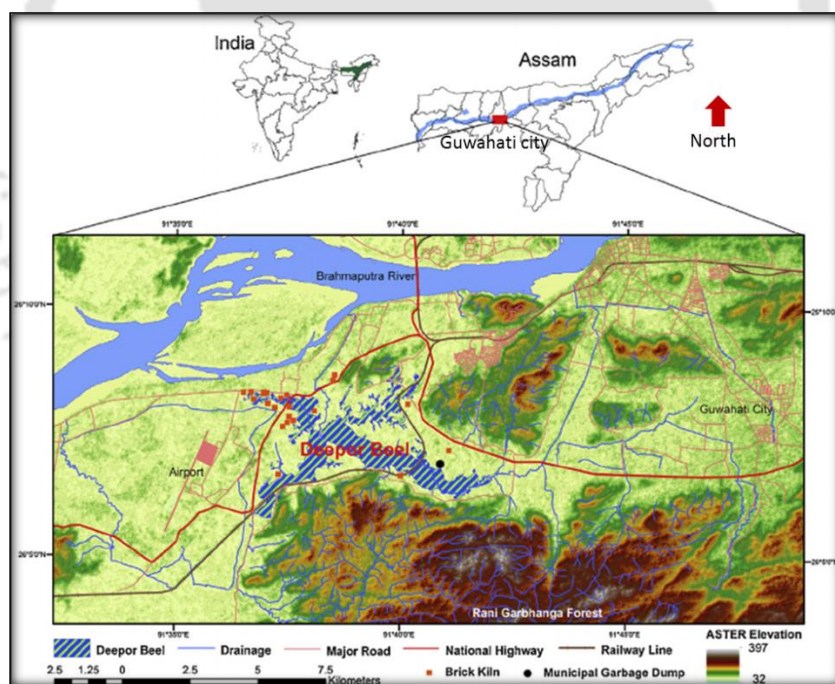


Figure 1.1: Location Map of Deepor Beel (C. Mozumder, 2014)

Deepor Beel, an old course of river Brahmaputra, is a wetland of immense significance, situated right within the city limits of Guwahati (Phukan, 2003). It is the lone Ramsar site of the

state under criteria of 1,2,4,7 & 8 with the significance of being one of the largest 40square km) and important representative wetland type found within the Biogeographic province of Burma Monsoon Forest (4.09.04). It supports some globally threatened bird and 50 fish species belonging to 19 families. It is one of the staging sites on the migratory flyways and some of the largest congregations of aquatic birds in Assam, particularly in winter (Ramsar information sheet IN1207RIS). By virtue of its location and natural resources, it holds an integral part of Guwahati's history and culture. It is a large natural wetland with an outstanding hydrological, biological and ecological role and has substantial socio-economic and cultural values within the framework of sustainable use and habitat conservation. Due to tremendous anthropogenic stress, pollution, eutrophication, railways and the construction of the National Highway in the surrounding areas, lack of co-ordination in the implementation of various existing policies and non-cooperation of few local villagers for their vested interest, the conservation status of Deepor Beel remains unchanged since it's declaration as Ramsar site in 2002. The Planning Commission team had also noted that -a lot remains to be done, for at least partial restoration of this wetland (Planning Commission, 2008). Deepor Beel, a Ramsar site, is in a deplorable condition and increasingly being threatened by construction activities on the fringes (TNN, 2012). Protecting Guwahati's numerous hills and wetlands from encroachers has once again emerged a tricky problem for the Assam Government.

1.4 Research Scope and significance

As a mode of wetland protection, conservation and management, students, academics, institutions and government agencies all over the world have performed ample research with case-studies on various facets of wetlands. Wetland ecosystems, biodiversity, wildlife habitat, nature parks as a conservation strategy, use of remote sensing and GIS, tourism development, policies and implementation, use of smart technologies are a few of the focused area of research on wetlands (refer Bibliography). Construction and development rules pertaining to the built environment near wetlands are being implemented globally as a part of sustaining the urban water bodies, especially in the coastal zone. It was evident from the literature review that these urban wetland parks play a very important role in the protection and conservation of wetlands through development of recreation zone. At the same time, revitalization and renewal of urban fragments like water-fronts can pose potential threat to the integrity of ecosystems with adverse

impact on the urban context. For the sustainable co-existence of built environment near such urban wetland of local and international importance, context specific design research becomes a necessity before implementation. Design research operates as a collective social process and comprehensive design research on intervention of the built environment around the already degraded wetland will help minimize the adverse effects on the eco system (Fraser, 2013).

At present, the Guwahati Municipal Development Authority (GMDA) is responsible for the conservation and management of Beels and other water bodies of Guwahati city. They have proposed a Detailed Project Report (DPR) for Deepor Beel, Sisako Beel and Borsola Beel with a management plan for the recreation and green areas marked in the Guwahati master plan 2025. The implementation of the DPR is also included in the proposal for Guwahati Smart City Plan (SCP) by the state Government after winning the challenge for the first 20 cities of India under the Smart City Mission of Ministry of Urban Development, India (Ministry of Urban Development, Govt. of India, 2016). For the implementation of protection and conservation strategies of these water bodies, there have been several challenges among planners, communities and agencies from 2002-2018, since it's declaration as a Ramsar site. In the line of continuous active participation from all stakeholders (*refer note below), there are ample opportunity for researchers to contribute towards the proposed built environment in the DPR and the context specific SCP. Playing their part of an interdisciplinary team, architects and planners can help developing strategies for a holistic approach through design research. Their contribution will help to provide functional distribution of spaces, institute comprehensive tourism experience and provide context specific and long term benefit to the divergent ecology.

Note: *All stake holders: Primary and Secondary stakeholders.

Primary stake holders or Key stake holders: local communities living in the fringe villages, mainly new settlers on the North side near highway, fisherman (West) and tribal communities (South).

Secondary stakeholders: department of fisheries, department of forest and wild life, water departments (Guwahati water bodies), Guwahati municipality, GMDA, local NGOs, researchers and scholars. References can be found in 4.4.2, page-43 & Chapter 2.4, Table 2.1, page-22.

Chapter 2

Overview of Deepor Beel – Literature study and analysis

2.1 History and Cultural Background

The name of Deepor Beel is stated to be derivative of Sanskrit word *Dipa*, translated as ‘elephant’ and *Beel* translated as ‘wetlands’ or large water body (in Assamese), inhabited by elephants (Phukan, 2003). David Scott records it as *Doboyjheel* or *Doohyejheel*, which was assigned to Dhuz, a prince of Rani by the Ahom king Rudrasinha for the distinguished services rendered at the time of Mughal invasion, reserving merely the right of two knots for fishing the lake for the temple of Kamakhya. According to Scott, the king of Rani’s residence was at the hill towards the south of the lake (Gogoi, 2007). The water area of the Beel covers 10.1² km and includes 40 km² swamp area. Depth of the Beel ranges from 6 - 1.5 m depending on monsoon or dry season (Planning Commission, 2008)

It is claimed that Beel was an important dockyard of the *Tai-Ahom* as well as the Mughals. There is a mention about how Lachit Borphukan, the commander-in- chief of *Ahom* army, had his boats hidden at Deepor Beel during the Ahom-Mughal conflicts in medieval history. He had a channel dug to *Brahmaputra* from the Beel, known as *Khondajan*. Through this tunnel, he sent the boats into the *Brahmaputra*; the surprise element in a battle, hallmark of an inventive tactic (Gogoi, 2007). It is also stated that *Kampitha* and *RambraiSyiemship* (the supreme political authority) is known as the Syiemship in Meghalaya had control over this area. One important example of Ahom-Mughal conflicts is the Battle of Saraighat, which was fought in 1671 between the Mughal empire (led by the Kachwaha king, Raja Ramsingh), and the *Ahom* Kingdom (led by Lachit Borphukan) on the Brahmaputra River at Saraighat, now in Guwahati. Although much weaker, the Ahom army defeated the Mughal Army by brilliant uses of the terrain, clever diplomatic negotiations to buy time, guerrilla tactics, psychological warfare, military intelligence and by exploiting the sole weakness of the Mughal forces,-its navy. The Battle of Saraighat (Figure 2.1) was the last battle in the last major attempt by the Mughals (total

17 times) to extend their empire to Assam. Though the Mughals managed to regain Guwahati briefly after a later Borphukan uninhabited it, the Ahoms wrested control in 1682 and maintained it till the end of their rule.

To keep the Mughals out, the Ahoms built many defensive structures called "*garh*" locally across Assam to halt advancing enemy army. These structures were built with natural materials and characterized by water bodies on both sides, which is the common structural rule among *Tai's* across Asia. One such fortification has been referred to as *Garchuk/LachitGar* in Garchuk (Figure 2.2.)



Figure 2.1: Battle of Saraighat (Wordpress, 2013)



Figure 2.2: Images of Lachit Garh in Garchuk (Wikipedia, 2012)

This medieval *Garh* (meaning fort in Assamese language), now popularly known as Lachit Garh, is located in the South Western part of the Guwahati city and to the west of Ahomgaon. The fort constructed during the times of Lachit Borphukan around the year 1670 stretches from the northern Fatasil hills at Garchuk locality cutting across the National Highway (NH-37) at Garchuk Charali to the southern hills via Pamohi and Moinakhurung. The length of the fortification is about 3 Kms (Gogoi, 2007). Visitors can see the remains of this fortification built centuries ago, to deter the Mughal cavalry with two earthen ramparts and two water filled lakes in between and ditches dug in front. Unfortunately, illegal encroachment has taken toll of this heritage site.

2.2 Mapping and Evaluation of Existing Built Environment in the Fringe Areas (Includes Social and Cultural matrices)

Until the recent past (1989) Deepor Beel was owned by the Fishery Department of the Government of Assam. Now District Administration is looking after it. The surroundings are part of a private property, except for the Rani-Garbhanga Reserve Forest, which is state-owned. The Deepor Beel is surrounded by 14 villages with a total of 4137 families. They are grouped here as fisherman communities, tribal communities and the new settlers according to their locations (Figure 2.3). Details of population distribution and demographic analysis is covered in chapter 6.1 (Page 76-83).

Villages dominated by the fisherman communities are Ganakpara, Dharapur chariali, Azara and Kewtpara along NH-37 in the West. They conduct community fishing once a year and share the revenue among them, managed by the Deepor Beel Panch Para Samabay Samiti. The Assam Engineering College campus is situated in the North West. Padumbari, Nursery, Tetelia, Pachim Baragaon, Pub Baragaon and Garchuk along NH-37 in the North (Figure 2.3). In the South, from Garchuk on NH-37 a PWD road connects Pamohi to Rani Junction near Dharapur chariali. The villages include Pamohi, Maghuapara, Mainakhurung, Deochotal, Kalitapara, Chatargaon (otherside of the hill), Chakordo Mikirpara, Matiagaon. They come under the Jalukbari Mauza (source: field survey). Diverse communities living in these villages are Koch, Kalita, Karbi, Boro, Nepali, Rabha, Bengali Muslim and Assamese Muslim. There are plenty of *Manasa* (Snake Goddess) and *Shiva* (Hindu God) temples in the fringe villages.

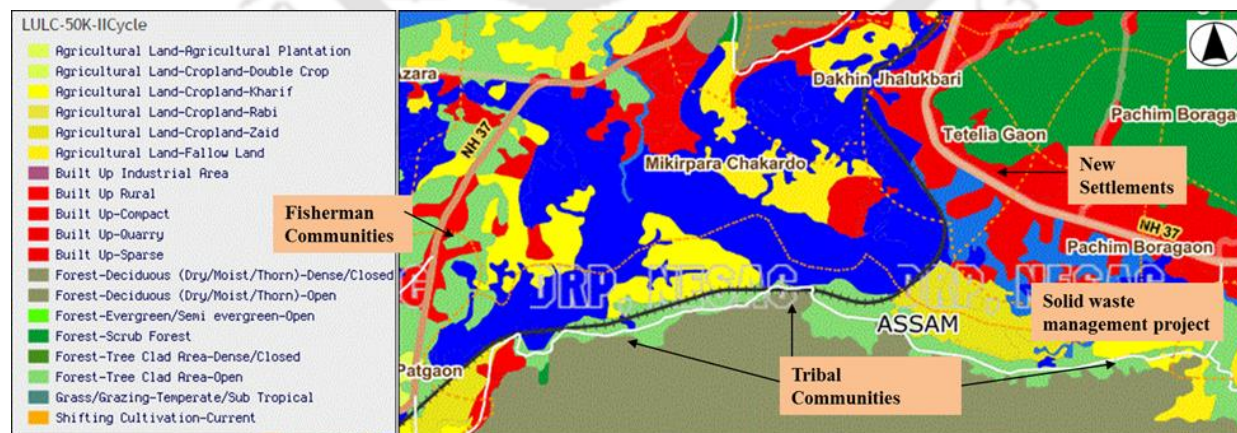


Figure 2.3: Land Use Land Cover map (NESAC, 2012)

2.2.1 Infrastructure and facilities

It was observed during pilot survey that in almost all villages, tube wells and dug wells are used for drinking water purposes. These tube wells are constructed for each households within their own compound/ premises. All the residents of Paschim Boragaon and Garchuk agreed that the water contains high concentration of iron. There is a middle level school but no primary health center in any of the villages. Therefore, for medical treatment and higher education, they have to depend on nearest towns like Jalukbari, Maligaon and Ajara. The overall housing condition has been found to be unsatisfactory. Besides having a large number of mud (*Kuchha*) houses, the living space for a sizeable section of the households has also been found to be insufficient. Electricity is available for all uses including domestic and commercial purposes in most of villages situated along NH-37. Facilities like electricity and mobile telephone services are available in the villages along Pamohi road too. More than half of the people interviewed feel that reclaiming the lands for construction activities are creating dust nuisance in the area.

Almost all people feel that trucks carrying stones are causing dust and noise pollution. 60.5% agreed that various health problems are caused due to carbon emission from the nearby industries and from the stone quarries/crushing unit of Paschim Boragaon and along the stretch of Rani-Garbhangha Reserve. It is also found that 100% residents of all the villages feel there are no special problems during monsoon. The area is flooded due to the water streaming out from the nearby hills. But this recedes quickly towards the wetland. The roads also remain well above the flood level during monsoon. They all agreed that the visual amenity of natural aesthetics in the area has decreased due to sporadic developments. The Beel is surrounded by the National Highway NH37 on the east and north-east (Figure2.3). The PWD road is skirting the northern fringe of the Rani and Garbhanga Reserve Forest on the south, the Dharapur-Kahikuchi section of the NH37 on the west and the Engineering College Road on the north. Besides, a few other minor roads and tracts also exist in the vicinity of the Beel. The newly established Mother Teresa Hospital is also situated in the north western border of the Deepor Beel. The recent developments include Pamohi as a part of boundary adjustment under special scheme area of master plan Phase-1, along with the addition of three new towns and a metro line proposed through the southern corridor of the wetland, leading to the airport from the city.

Before the construction work for the BG lines, there was no railway line in the vicinity of the Beel except the Rangia–Guwahati BG lines that touches part of the Borhola Beel on the north-east of the Deepor Beel and originally forming a part of it. A number of temporary farmhouses have been constructed in recent years all around the Deepor Beel. Besides, several settlements and industrial units, including the Border Security Forces housing complex and the Artfed industrial complex have come up in the swampy area of the Beel. A number of brick kilns was operating within the Beel area itself, but closed down now. The villages situated along NH37, like Pub and Paschim Boragaon, and Garchuk have bus stops located along the highway, near to the villages. However, for other villages, i.e. Pamohi, Deosotal, Chakordoi Mikirpara, and Maghuwapara, although connected by Pamohi road from Garchug to Rani Chowk to NH37, there is no bus services available (Ramsar info sheet).

There is an integrated municipal solid waste management project at Boragaon, about 1.5 kms away from Deepor Beel and 1 km away from NH37. Stone quarries are seen along the Rani-Garbhangha Reserve Forest along the south side of the Beel. Many upcoming industries and a medicinal plant nursery are part of the new construction in this belt. The human habitat around the Beel, especially villages along Pamohi road, need better healthcare, employment and education facilities.

2.2.2 Livelihood Activities

Communities living near Deepor Beel have numerous economic benefits from the wetland, which provides for food and agriculture, trade, transport from historical time. The village heads (sarpanch) of Keotpara (fishing) and Mikirpara Chakardeo (tribal) informed that few decades ago the wetland was the primary source of income, mainly for fishing, boating for water transport, collecting and selling of animal fodder (sometime with barter system of exchanging with paddy or vegetables) or cultivating rice (*Sali* and *Bao*) in the low lying areas near the Beel. The pilot survey (interviews, site visits) revealed that very few people are salaried and employed, especially in the interior villages. The majority of the male population are engaged in petty businesses like running roadside hotels, repair shops, telephone booths and other mercantile business activities along the highway and working as daily wage laborers. Females are mainly engaged in household chores. Agriculture as an occupation is fading away due to the lucrative jobs in factories and industries and rapid urbanization. The locals

traditionally utilize the Beel to harvest fish and mollusks and to collect fodder for domestic cattle, natural foods, such as vegetables, flowers, aquatic seeds, etc. In recent times, most of the agricultural lands are sold for construction and development. Present economic activities are a mix of agriculture, fishing, services and small businesses.

Fishing: Assam is one of the richest states in the country in terms of surface water resources, where Beel fisheries and pond and tank fisheries alone occupies about 140,000 hectares area. Yet at present, scientific fish farming/fishing is carried out in only 5 percent of the total water resource area (391,000 lakh hectare) (Department of fisheries, Assam, 2014). Deepor Beel was a Government Fishery Mahal till Jan 12, 1989 before it was declared as Wildlife Sanctuary and since then officially fishing is strictly prohibited.

Fish is a popular food in Assam. Besides being a source of food, fish is used in health-care practices among the Karbis. Poverty and limited access to modern medicine are the main factors for their dependence on traditional medicine, particularly in rural areas. In every village, fishing along with hunting and weaving are part of household chores by the women folk. Fish is also used in many rituals. There are few villages around this Beel that are entirely dependent on the Beel for their livelihood (the *Kaibortas*).

Pottery: Pottery making in Assam has always been a subsidiary occupation of agrarian communities. In hilly areas, earthenware has utilitarian value, but in the plains they are used both for utility and rituals. Three communities of Assam, namely *Kumar*, *Hira* and *Hari* are engaged in pottery making. *Hira* and *Haris* are known as one community for their commonalities. The *Kumars* are highly skilled, make pottery on wheels and are privileged to make pottery for temples. *Hiras* and *Haris* make pottery by hands (K.Medhi, 2003). The *Hira* potters of Barpeta and Sundaridia collect clay from Marnoi in Goalpara and Tetelia near Deepar Beel, Guwahati. The clay provided by the wetlands was transported earlier by boats via Brahmaputra River and now by trucks. Those potters gather clay during dry periods in winter and store them in pits. The stored clay is used for pottery making throughout the year. The *Kumars* of Rajapukhuri near Rampur and Tetelia and the *Hira* of Hirapara near Azara area obtain clay for pottery from their farm fields (K.Medhi, 2003).

Agriculture: The economy of these ethnic groups was basically agriculture surrounding the wetland and near the foothills of the Garbhange forest. The methods and quality of their

agriculture, differs spatially in between hills and plains depending on the nature of topography and the level of development of the society. Earlier, they cultivated two types of paddy, namely *Sali* and *Bao*, in the low lying areas near the beel. They also grew different seasonal vegetables, and mustard. The survey also revealed that agriculture as an occupation is fading away due to lucrative jobs in factories and industries and due to rapid urbanization. In an interview, the sarpanch mentioned that there are approximately 10000-15000 bigha land (1 bigha= 1,340 m²) in the three villages namely Pamohi, Chakardeo and Deosotal, but agricultural activities like, rice cultivation are now carried out in a low scale.

Preparing Rice Beer: The Bodo, Karbi, Ahom and Rabha tribes near Deepor Beel prepare traditional rice beer or liquor as an integral part of their socio-cultural life. Each type of such beer is a mixture of rice and different parts of various plant species, that have medicinal value (Biman Bhuyan, 2013).

Livestock rearing and Weaving: This is a subsidiary household occupation of all these communities. They weave their ethnic dresses and keep cattle, pigs and chicken for personal use.

2.2.3 Cultural dynamics

The 'Deepor Beel's Stakeholders Report' by North Dakota State University mentioned that no work has been done so far to conserve the cultural values of the tribal people living near the wetland (southern boundary). The cultural aspects and diversified livelihood of the villagers should be addressed prior to any intervention, to sustain communal harmony (NDSU case studies, 2007).

Religion and Language: Hindu communities living near Deepor Beel practice traditional religion, along with rituals and idol worshipping (*Shiva*) of Hinduism, which is animistic in nature. Many of them worship '*Manasa*', the serpent goddess, mainly for the prevention and cure of snakebites and infectious diseases like smallpox and chicken pox as well as for prosperity and fertility. She stands for both 'destruction' and 'regeneration', almost akin to a snake shedding its skin and being reborn. *Manasa* is also a very important fertility deity, especially among the lower castes, and her blessings are invoked during marriage or for childlessness. Her shrine may be found in the courtyard of many household. *Manasa* or *Maroi* puja is also held in Kamakhya temple in *Debaddhani* Festival once a year.

Nature Worship and 'Naturalism' are the basic concept of tribal culture, belief and practices, which reveals that they have a legacy of natural harmony or so-called preservation of eco-system or ecological balance within its surroundings. Every object of the nature like pond or lake, river or streams, trees or jungle, mountain etc. is considered sacred and worshipped. The tribal communities living in the fringe villages have their own tradition, religion and practices. For example, *Bodos* practice Bathhouism along with Hinduism and Christianity. Traditional religion of Karbis believes in immortality of souls and rebirth and honoring the ancestors (Valentina Teronpi, Ethnozoology of the Karbis of Assam, India: Use of ichthyofauna in traditional, 2012). Rabhas mainly pray to nature gods, though their main god is 'Rishivai', lord Shiva (Raha, 1989). The four main Hindu castes are *Brahmin*, *Kayastha*, *Kalita* and *Ahom*. There are many more sub-castes and tribes that are Assamese speaking and follow Hinduism (Thomson, 1948).

Language spoken by these communities is a perfect example of unity in diversity. The principal languages of Assam are 'Assamese' (with many dialects) and 'Bodo'. *Bodo* is known to be a branch of the Sino-Tibetan family of language, other than that there is no record indicating the origin of Bodo language. It is closely related to the Dimasa language. There are many tribal languages, some with scripts and some without. They are mostly non-Aryan tribal languages of Indo-Burman families (Kakati, 1941).

Festivals and ceremonies: The festivals or ceremonies can be classified into seasonal and religious. Among the seasonal festivals, all communities follow the three Assamese *Bihu* festivals linked to agriculture, *Bohag* or *RongaliBihu*, *Kati* or *KongaliBihu*, *Maagh* or *BhogaliBihu*, but in their own traditional way. The Bodos celebrate 'Bwisagw', 'Khathi-gasa' and 'Domasi' as the three Bihu festivals, at the same time and with the same significance (IITG, 2013). Amongst the Koch tribes, the noted festivals were associated with the worship of their traditional deities. These included Mechinikhela puja, Dharam Thakur puja, Humumdeo puja, Gorakhnath puja, Kherai puja etc. They also celebrate all three *Bihu* connected with agriculture (Nath, 1989).

2.3 The Wetland Ecosystem

The significance of Deepor Beel are many. Apart from being the only Ramsar site in the state, this natural wetland is endowed with rich floral and faunal diversity (Saikia P.K, 2011).

2.3.1 Biodiversity

The Beel is a staging site on migratory birds and some of the largest concentrations of aquatic birds in Assam, comprising of about 219 species of endemic and over 70 species of migratory birds. During the winters, it is very common to spot congregations of more than 20,000 migratory aquatic birds, including some globally threatened species (P.K.Saikia M. , 2011). The wetland provides habitat to a large number of migratory waterfowl each year, in addition to a vast congregation of residential water birds. 234 species of birds (137 residential and 97 migratory species) including 17 globally threatened species were reported in the Beel area. Using the Central Asian-Indian Flyway, all migratory birds arrive in Assam during late October to February stopping at various wetlands and return back to their original destination from March 1st to April 1st (all are winter migrant). Only few summer migrants in very small groups, 2-7 individuals at a time come to the wetlands here (Wagtails only). The migrating birds enter the open water in Deepor Beel from the Northern part of Brahmaputra River near the bridge and Pandu dockyard (both in bound and out bound). The flight path indicated in the map by arrows is over a part of the existing city with low to mid rise structures in this areas (refer fig). It also supports 61 fish species (including 5 exotic and 8 endangered species) (P.K.Saikia, 2005). The water bird family *Anatidae* are highest in number and abundance (Jyotishma Das, 2011); the highest number of single day count of water birds in Deepor Beel recorded is 19,000 birds (Ramsar, 2002).

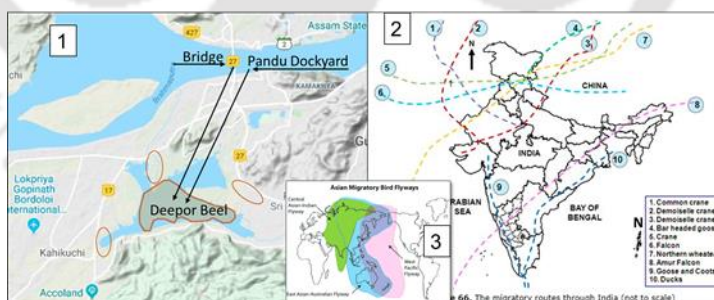


Figure 2.4: Flight path of migratory birds 1-Deepor Beel (1. source: map from birdlife international), 2-India (source: <http://wgbis.ces.iisc.ernet.in/biodiversity>), 3-Central Asian-Indian flyway in green colour (source: Wikipedia)

From the smaller phytoplankton to the giant water lily (*Euryale ferox*), the floating water hyacinth to deciduous forests rich in teak, sal and bamboo, the beel forms the 'lung space' that

constantly replenishes the increasingly choked metropolitan air. The wetland provides livelihood to the people living in the fringe villages through the collection and sale of fish, *Nymphaea* nuts and flower, orchids, medicinal plants etc. (Krishna G. Bhattacharyya, 2009). The rich floral diversity of this wetland includes 154 species of *Phylum Rotifera Plakton*, and has regional and global focus for their bio geographical importance (Sharma B.K, 2012).

The number of birds' population in Deepor Beel is declining. The major threats to the water birds of this wetland are encroachment, habitat fragmentation, hunting and trapping, soil digging for construction and land reclamation, over fishing and application of pesticides in the neighboring agricultural fields (Jyotishma Das, 2011). Migratory aquatic bird species in Deepor Beel shows a continuous decrease, from 92 species in 2009 to 64-76 species in 2010 and 53 species in 2011. Changes in fish species between 2009 and 2011 showed a 26% decline in species richness. (Saikia, 2013). Wetland ecosystem of the Deepor Beel comprised 33.5% in 1990 and there was then no aquatic vegetation. However the aquatic vegetation has been observed in subsequent years, i.e.; 1997 and 2002. The wetland area has decreased from 33.5% (1990) to 21.1% (1997) and then to 19.4% (2002). Overall, the wetland ecosystem has been reduced to 14.1% (405 ha) from 1990 to 2002 (Figure 2.5) which poses major threats to the wetland ecosystem due to anthropogenic factors (Sharma Nayan, 2006).

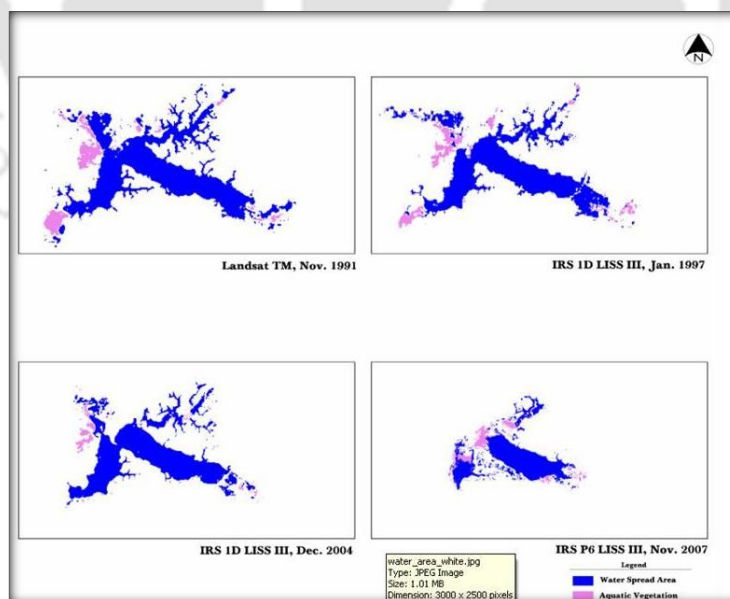


Figure 2.5: Map showing the reduced wetland area (Simanta Kalita, 2012)

2.3.2 Hydrology

The floodplain lakes (locally called as Beel) comprise an important component of inland aquatic resources of India in general and the North-Eastern region in particular (Saikia P.K, 2011). The Beel has an actual perennial water holding area of about 10.1² km and the total area extends up to 40.1² km when flooded (Saikia, 2013). The water of the Beel is overburdened with inorganic and organic pollutants, in many cases beyond the permissible limit. Presence of toxic materials in the water causes the bioaccumulation of contaminants in fish tissues, which enter the food chain eventually (Krishna G. Bhattacharyya, 2009). A part of the wetland (4.14² km) was declared as a Birds Sanctuary by Assam Govt. in 1989, and managed by the State Forest Department. Following the declaration, some security measures including prohibition of fishing within the protected area had been undertaken. Periodical meetings of government officials with neighboring village communities for creating awareness on conservation are also initiated.

Under The Guwahati Water Bodies (Preservation, Conservation and Protection) Act, 2008, three wetlands – Deepor Beel, Saru Sola and Bar Sola Beel and Silsako Beel – were notified as protected ones in 2008. In 2010, this legislation was amended to add section numbers five and six to it to notify the Bondajan water body as a protected one. The boundary demarcation of the Deepor Beel, could not be done because of lack of active support of the revenue authorities. Only its core area, that is, 4.1² km, could be demarcated by the Forest Department in May, 2014 (Patowary A. , 2014)(Annexure 1: Assam Act number XX of 2008 and amendment Act number XIV of 2010).

The Kamrup (Metro) district administration has prohibited filling up of water bodies under the Guwahati Water Bodies (Preservation and Conservation) Act 2008. The administration has also prohibited waste dumping and erection of structures and extensions or reinforcement of any buildings upon water bodies. In addition, the act forbids carrying out any kind of business except fish curing; aqua culture, conservation and flood control measure, that too with the specific previous permission of the competent authority. The administration also said that offenses committed under this act will be treated as cognizable offenses under the Code of Criminal Procedure 1973 and will be tried accordingly. However, despite the act been in existence since 2008, the damage has already been done to some of the biodiversity-rich water

bodies dotting the city. Deepor Beel, a Ramsar site, is in a deplorable condition and increasingly being threatened by construction activities on the fringes. (TNN, 2012).

Guwahati Metropolitan Development Authority (GMDA) has submitted a combined storm water drainage project worth around Rs. 700 Crores for Guwahati city to the Central Government in 2013. The GMDA's cost includes Rs. 130 Crores as the cost for restoration and development of Deepor Beel, with a provision of recreational and eco-tourism facilities (Patowary A. , 2013).

2.3.3 Landscape configuration

Two major landscape indicators of environmental quality namely land cover types and landscape configuration were reviewed here for planning recreational facilities and to initiate conservation measures. The dominant force of the built environment and the role of humans in creating and affecting landscape patterns and process were studied for this purpose. These include: wetland covers, forest covers, open areas, fringe villages in the catchment areas and their special relationships (Figure2.6). Agricultural land has maximum cover, followed by grassland and degenerated forest land. All habitat areas are tree clad. The forest belt in the south has abandoned 'Jhum' cultivated areas.

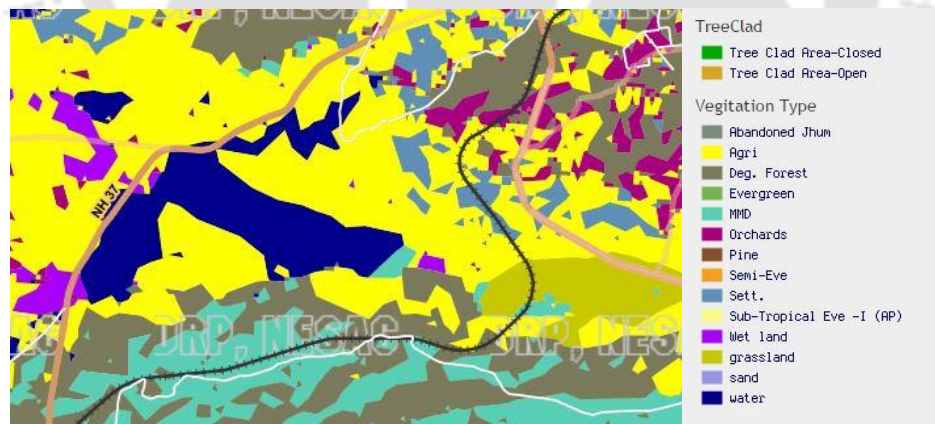


Figure2.6: Vegetation covers (NESAC, 2012)

2.4 Conservation and Management:

A part of the wetland (4.14² km) was declared a Birds Sanctuary by Assam Govt. in 1989, and managed by the State Forest Department. Protection and conservation measures taken

by the government and other stakeholders were reviewed for the period of 2002 (Ramsar declaration) and 2017. The chronological orders have been listed below.

Table 2.1: Protection and conservation measures undertaken during 2002-2017 (compiled by the author from the Literature Review)

Year	Authority/ Organization	Description
2002	Assam Science and Technology Council (ASTECC)	A comprehensive management plan for Deepor Beel was prepared but very few initiatives were taken by them with funding from GOI and the State Govt.
2004	Birdlife International	The wetland was designated Important Bird and Biodiversity Area. (IBA criteria A1, A4iii, code IN 379). A part (4.14 ² km) of the wetland was declared as a Bird Sanctuary, some security measures including prohibition of fishing within the protected area had been initiated.
2006	GOI and State Government	Deepor Beel was one of the venues for the 33rd National rowing competition
2007	North Dakota State University, USA (NDSU case studies, 2007)	A group of Environmental Conservation Sciences (ECS) students under the guidance of Dr. Achintya Bezbaruah, have prepared a case study report for environmental issues and management and submitted Deepor Beel campaign request for the Global response.
2008	Guwahati Water Bodies	Preservation and Conservation Bill, 2008, proposed development projects including water sports at the Beel. Deepor Beel, Saru Sola Beel, Bar Sola Beel and Silsako Beel – were notified as protected area. This bill was revised in 2010, prohibiting construction in the water bodies.
2008	Planning Commission, India	A team visited Deepor Beel under the National Wetland Conservation Management Programme of the Union Ministry of Environment and Forests and cited many factors as jeopardizing the wetland's survival, and recommended strong corrective measures by the State Government and the administration in its report.
2012	GMDA	Detailed project report (DPR) was prepared and a revised DPR was submitted in 2012 with a master plan. The report was vetted by IITG.
2013	State government	GMDA has submitted a combined storm water drainage project worth around Rs700 crore for Guwahati city to the Central Government. The GMDA's cost includes Rs130 crore as the cost for restoration and development of Deepor Beel, with a provision of recreational and eco-tourism facilities (Patowary A. , 2013). The proposal for Deepor Beel was approved and sanctioned.
2013 to 2015	State Government	Four Sluice gates were constructed in the outlet from the wetland near <i>Khanamukh</i> with seal traps for city water and to stop siltation entering from river Brahmaputra.
2015	State Government	Foundation stone laid for Assam Water Center for research and capacity building for comprehensive management and conservation of the water ecosystem in the North East.
2016	GMDA	Dredging near the wetland for retention pond started but had to be stop due to public protest.

2016	Government of India, State Government.	The Guwahati Smart City Development Agency Limited (GSCDAL) was appointed as Special Purpose Vehicle (SPV) to execute the Smart Cities Mission (SCM) in Guwahati City (May 11, 2016) during the period 2017-2022.
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2.4.1 Proposed Detail Project Report (DPR), Master Plan and Costing by GMDA

The main agenda of the DPR is to provide information related to the characteristics, site plan and estimated costs of the corresponding development of Deepor Beel, including the proposed Eco Park (145.4 Crores). The methodology of the study comprises of a literature study followed by data collection, analysis of data and derivation of strategies for conservation and zoning. The whole perception of conservation of a lake, water body is towards incorporation of nature in the lives of people, and checking further degradation, destruction and pollution. An activity zoning and matrix is provided, which divides them into domains, namely, ecological management, eco-tourism, economic activities and social infrastructure.

The implementing strategies include, a number of phases and thus phasing of the process is recommended (duration 5 years). Various guidelines for construction of permanent buildings have been provided which include aspects of site planning, energy conservation, renewable energy, solid waste management and rainwater harvesting. The project envisioned the restoration and development of water bodies of Guwahati against the rapid urbanization, growth and encroachment, often leading to destruction of ecosystems, continued urbanization to create a safer Guwahati resilient against floods. The first line of action is economic development planning, sustainable development and conservation including aspects of hydrologic systems. DPR further envisions the social cohesion and development by integrating local communities and fishing villages into the overall restoration and development plan and thus implement grass root level involvement. The analysis of the Eco Park has been done in Chapter 6 (6.2.).

2.4.2 Smart Cities Mission

The Smart Cities Mission (SCM) is an urban renewal and retrofitting program by the Ministry of Urban Development, Government of India and works in collaboration with the State Government of the cities. The focus is to promote infrastructure, quality of life, clean and sustainable environment and application of ‘Smart’ Solutions built upon the IoT (Internet of

Things). Guwahati was selected for implementation among the first 20 Indian cities in round one city challenges (Jan 28, 2016). The three broad components across both ‘area-based’ and ‘pan-city’ heads proposed in the Guwahati Smart City Plan (SCP) were (Ministry of Urban Development, Govt. of India, 2015)

1. Building ecological infrastructure along the contiguous network of storm water channels of *Bharalu*, *Morabhralu*, *Pamohi* and *Borsala* Beel to augment the measures for mitigating flash flood problem of the city.
2. Proposal for Development of Brahmaputra River Front Promenade.
3. Proposal for easing the traffic congestion by ICT based Traffic Information System and improve the service level of public mode of transport to increase the modal share of use of public transport.

The list of projects (Annexure1) in SCP includes Deepor Beel base work development (half-area) and construction of infrastructure (For point number 1 mentioned above, like solar powered walkways, shops etc.). The list of key components states Restoration and Conservation of Deepor Beel as per the DPR proposed by GMDA on PPP mode (AS-01-GHY, p-27, City-wise Proposal - Stage 2). The Guwahati Smart City Development Agency Limited (GSCDAL) was appointed as special purpose vehicle (SPV) to execute the SCM in Guwahati City (May 11, 2016) during the period 2017-2022.

2.4.3 Role of local Non-Government Organizations (NGO)

Academics, researchers, environmentalists, individuals and NGOs have long supported and sponsored activities for protection of the wetland and wildlife. They also encouraged community participation from the fringe areas. *Aaranyak* is a registered society working in the field of nature conservation in the North East India since 1989. The NGO is recognized by the DSIR (Director of Scientific and Industrial Research) of Ministry of Science and Technology, Govt. of India. The organization is continuously working towards research and development, education and awareness for nature conservation, organizing workshops and important celebrations like World Wetland Day. Guwahati-based NGO ‘Eco-Concept’ has come forward to help the people living in the periphery of the freshwater lake, providing them an alternative source of income through mushroom cultivation (IANS, 2012) and weaving. They also organize many community events and spread awareness for safe water. Parijat Academy at *Pamohi*

village, a non-profit school, which is funded by a group of individuals, ASHA for Education, Smile Foundation & Association for India's Development (AID), are helping the underprivileged children of nine tribal villages near Deepor Beel for education up to Standard VIII and primary healthcare since 2003. (Smile Foundation, 2012).

The Early Birds operate in twelve protected areas of Assam including Deepor Beel Bird Sanctuary, in order to create an immunity belt so that no diseases can be transmitted to the wildlife due to grazing in the same grassland. It also works for future of migratory birds, and various allied issues like cause of dwindling number of vulture and adjutant stork. The other NGOs and organizations working on Deepor Beel in different facets are IIT Guwahati, Guwahati University, WWF-North-east India, Rongman society, People for Animals (PFA), Bombay Natural History Society, Natures Beckon, Rhino Foundation, Appropriate Technology Mission of Assam, Explorers and Center for Environment Education.

2.4.4 Ecotourism as a conservation strategy

Ecotourism has been endorsed globally as a successful way to support conservation of wetlands economically since the beginning of 21st century. It is also the fastest growing market in the tourism sector (Das & Syiemlieh, 2009). All mega cities with wetlands are putting their focus on integrating urban wetland edges in social architecture to have multiple benefits from conservation to public open spaces. The Conservation and Biological Diversity Guidelines (CBD) on Biodiversity and Tourism Development also advocates activities related to sustainable tourism development near such sites of international recognition and importance. They also have guidelines for all stakeholders to manage tourism activities in an ecological, economic and socially sustainable manner (Secretariat of the Convention on Biological Diversity, 2004). Ramsar convention has also published many reports and case studies (projects) on ecotourism, often portrayed as a particularly useful approach for both wildlife and local communities if planned wisely to minimize negative impact on ecology, economy and the society (Ramsar, 2004).

Guwahati is the gateway to India's North-East. The domestic tourists visiting Guwahati doubled in 2004-2012 (approximate 23 lakh to 45 lakh). Around 32,000 foreign tourists visited Guwahati in 2017, which is double the number of tourists in 2011 (Department of Tourism, Govt. of

Assam, Accessed 2019). The estimated Tourists' projections of Guwahati city by GMDA is 46, 70, 735 (domestic) and 22,047 (foreign), total 46, 92,782 for the year 2025 (GMDA, 2009).

The state department of tourism also encourages Responsible Tourism (RT) in the state with a view to protect the environment. The state government's policies were updated recently (2017) to promote United Nation's sustainable development goals (number 8 and 9) that encourage ecotourism (5.12) and participation of local communities for economic and social benefits (5.18.1) (Department of Tourism, Govt. of Assam, 2017). The Smart city proposal for Guwahati city included Deepor Beel infrastructures development for Eco Park (annexure 1). The ecotourism profile and statistics of Deepor Beel are discussed in sections 6.3.1 and 6.4.

2.5 Current Status and need for the study

A SWOT analysis was done to understand the current status of the study area. The analysis (Table 2.2) clearly reveals the strengths and opportunities vis-a-vis weaknesses and threats in Deepor Beel that ensure need for conservation and sustainable development.

The water body needs immediate action for its restoration, considering the serious nature of threats and conflicting interests among various stakeholders. It's been 15 years since Deepor Beel was declared as a Ramsar site in 2002, Due to rapid pressures of urbanization, growth and conflicting interests, the natural patterns of Deepor Beel have been further disturbed and disrupted, threatening its very existence and it was removed from the Ramsar list. Actions by the Government authorities are in progress, albeit at a slow pace. The declaration of Ramsar site came after a gap of 13 years from the declaration of Birds Sanctuary by the state Government in 1989 (1989-2002) and sanction of the Deepor Beel Conservation and Management Plan with an Eco-park was successful after 10 years (2002-2012). Within another four years, it was included in the smart city plan (2016) for restoration and conservation, which needs to be completed during 2017-2022. Now is the time to contribute towards better implementation and holistic development of the lone Ramsar site of Assam by all stakeholders to avoid further delay and degradation; a fundamental social responsibility of all citizens.

Table 2.2: SWOT analysis of the study area- Deepor Beel ((Mahanta, Samuel, & Rajput, 2018)

Strengths	Weakness	Opportunities	Threats
<p>Within the Urban area.</p> <p>Kamakhya temple in the close proximity.</p> <p>Lone Ramsar site in the state.</p> <p>Rich bio diversity, flora and fauna. Supports 54 fish species belonging to 20 families. These include a high concentration of indigenous freshwater species.</p> <p>4000 families from the fringe villages depend upon this wetland and forest nearby for livelihood.</p> <p>Rani and Garbhanga hills in the north and south side forming a backdrop of rich natural landscape.</p> <p>Stopover for migrating avian population.</p>	<p>Community non-cooperation, diverse Tribal communities.</p> <p>Unavailability of animal fodder in their natural habitat, especially for wild elephants and monkeys.</p> <p>Poor awareness of environmental and socio-cultural benefits.</p> <p>Lack of basic facilities like public transport, employment and alternative livelihood.</p> <p>Inappropriate education and health facilities in the fringe villages.</p> <p>Lack of appropriate investment for sustainable tourism development and ecotourism.</p> <p>Conflicting approaches among various authorities and stakeholders (fisheries, forest, water departments, municipality, NGOs, Local communities)</p> <p>Changes in land use</p>	<p>Recreational opportunity.</p> <p>Special tourism market for eco-tourism, water sports, photography.</p> <p>Wise use of natural resources.</p> <p>Research opportunities.</p> <p>Preserving endangered species and cultural identities.</p> <p>Aqua culture development.</p> <p>Alternative livelihood for fiscal benefits.</p>	<p>Potential threats include: Endemic, Endangered Flora and Fauna and Overfishing.</p> <p>Anthropogenic activities causing water pollution, fish and bird deaths.</p> <p>Garbage dumping and Storm water discharge from Guwahati city.</p> <p>Infestation by the water hyacinth and other weeds.</p> <p>Eutrophication caused by inflow from untreated sewage water and industrial waste.</p> <p>Rapid and unplanned construction</p> <p>Indiscriminate cultural invasion</p> <p>Increasing Man animal conflict.</p>

Study of secondary data, visits to the location and the fringe villages, meeting with community representatives, nature workers, tourists, environmentalists, researchers and government officials have led the identification of urgent action plan to be initiated towards protection, conservation, development and management of the wetland.

- Proper coordination among all stakeholders to speed up the protection and development activities.
- Building consensus and ownership responsiveness among communities for overall growth, economic benefits and their involvement in planning and development activities.

- Demarcation of all boundaries.
- Validation of all proposed built environment by the GMDA near the wetland to mitigate further degradation and accelerate protection and conservation.
- Attention to coherent structures -wetland, forest landscape, socio-cultural identities and compensation measures for a holistic development.
- Develop supportive tool / guidelines for planners and developers, landscape planning, larger hydrological management and sustainable development of Eco-Park.

2.6 Research Statement, Aim and Objectives

Research Statement: Judicious planning and construction of Eco-Park (Nature Tourism) near wetlands in urban areas attributes to better co-existence of distinct and diverse ecology – a long term Conservation and Development solution.

Aim: This research is aimed at planning a holistic (protection, human development and environment) and sustainable approach for conservation and management of Deepor Beel wetlands with the concept of Eco-park as a nature based solution and the built environment around urban wetlands as a part of interdisciplinary approach. The expected outcome generated will help open avenues for mitigation of water based challenges in urban regions and open opportunities for further research. Further, for the appraisal agencies to enhance and find tangible solution for the conservation of urban wetlands like Deepor Beel.

A part of this research will be intended for analyzing the Detail Project Report (DPR) as proposed by the GMDA to facilitate the research based actions to be undertaken mentioned after the SWOT analysis. Attempt will be made to enhance the implementation by adding research on various segments that support the conservation and management and attributes to sustainable and responsible tourism. These include building trust and unanimity among the communities with a sense of ownership for the wetland and the fringe areas, challenges for addressing failure or delay in implementations, effectiveness of participatory community system for conservation and management, highlighting the integration of community participatory system and locational adjustment for a sustainable development of the proposed eco-park. The aim is to achieve a workable solution with holistic approach to conservation and management without disturbing the socio-cultural values of the fringe communities.

Objectives:

- To identify potentially affected indigenous groups impacted by economic conditions, environmental degradation and rapid urbanization (context specific)
- To investigate reasons for conflict among the various communities and non-cooperation in conservation and management efforts, lack of ownership for seeking community participation and bio-rights in order to move forward with community based ecotourism development (context specific)
- To examine the existing strategy and explore future strategies for better implementation of planning and development goals for the wetland based on the study period 2002-2017 (context specific)
- To work out mitigation -adaptation approaches for conservation against negative environmental impacts using sustainable and resilient construction guidelines and techniques. (against anthropogenic activities and natural degradation, prototype)
- To analyze tourism and recreation appreciation through design decisions for a balanced development (prototype)
- Identify ways to facilitate ecotourism through ecological research and education (prototype).

2.7. Limitations: Hydrology management, Bio-diversity Conservation and management plan for both wetland and the eco-parks were beyond the scope of this research. However, the design decisions and implementation contribute to the protection and restoration of the wetland and its bio-diversity.

Chapter 3

Materials and Methods

Based on the literature review, the scenario has emerged regarding the implementation of proposed development schemes and economic activities for the protection and conservation of wetlands. The objectives of the present study were carefully planned keeping an account of the parameters that call for an immediate attention of all the stakeholders. For an in-depth study and analysis of all the attributes for proper design and planning of the proposed built environment, diverse data sources and several respondents were included in framing of the design method. The methods were qualitative and as such relied heavily on in-depth interviews, group discussions, field observation, secondary data and observations of the activities of the Government / Non-Government Organizations (NGOs) and Civil Society Organizations (CSOs).

The same tools were used to validate the data from the communities, where such organizations operated. Secondary data was also collected from NGOs and CSOs and other governmental agencies including experts from these agencies, involved in Water and Sanitation for Health (WASH) service provision. Exploratory, Observatory and Participatory (EOP) methods were used in the numerous visits to the study location for data collection, focusing on human-nature relations from the communities living in the fringe villages. Guidelines from international and national organizations like Environment protection Agency – USA (EPA), World Conservation Union–World Commission on Protected Areas (IUCN-WCPA), World Heritage Convention (WHC), and Convention on Biological Diversity (CBD) and RAMSAR Convention, National Lake Development Authority (NLDA), The Wetland Conservation and Management Rules (2010) were implemented in design decisions for better conservation and management of the wetland and the built environment.

The IIT Guwahati library, Digital Library Databases at Amity University-Dubai and Manipal University-Dubai were sourced for the literature review and data collection. They include Ebsco host, IEEE, Oxford University Press, Taylor and Francis, TheFreeLibrary.com, TRAIL (Technical Report Archive and Image Library), Britannica Online Academic Edition,

Bibliographical Society of the University of Virginia, ACM Digital Library and InTech, to name a few. Arc GIS, AutoCAD and Photoshop software were used to prepare drawings for the design of recreational and conservation facilities. The resources from the library at the Department of Historical and Antiquarian Studies, Guwahati were used extensively for data on history, culture and people of Assam. Brief descriptions of different qualitative methods used are as below:

3.1 Case-studies

Five case-studies on urban wetlands were conducted and analyzed for their context specific problems, success stories and interdisciplinary approaches. The field based observation and exploration was done with carefully selected case studies in different parts of the world (refer 5.1). The integrated approach includes empirical and narrative method with essential inferences. Aspects of urbanization patterns, environmental change, community participation, wetland management and trends in policy responses were reviewed in each case for generalization of conservation and management strategies. Apart from being functional components of urban eco-system, analysis of East Kolkata wetlands gave better understanding on strong community engagement, balancing ecology with human needs in wetlands and bio-rights. Detail study of Ras-Al-Khor in Dubai and Lobregat Delta in Barcelona gave valuable insight to conservation of avian biodiversity. Analysis of Kunming Lake-Summer palace, Beijing was explanatory for tourism appreciation. The need of enhancing governance and management policy in wetland was obvious from the review of Dal Lake DPR, Srinagar. The detail analyses and findings are discussed in Chapter 5.

3.2 Interviews

Interview is a widely used method of collecting information from individuals in social sciences & educational research. The qualitative interviews are important part of natural resources conservation to understand the human-nature interface problems (Gregor Torkar, 2011). Unstructured and semi structured interviews were conducted with experts from different field for data collection, with voice recording. To acquire detailed information from the interviewee, many a time, more than one interview was carried out with the same person. The interview recommendations were used for design decisions and wetland conservation in Chapter 6. Following people were interviewed to address the complex and dynamic nature of the wetland issues (Please refer Annexure 4 for brief bio-data of Interviewees and a list of questions).

Table 3.1: List of Interviews performed

S.I. No	Name, Designation	Expertise	Date	Place	Interview type
1	Dr. Prasanta Kumar Saikia, Head of Biology, Guwahati University	Biostatistics, Ecology, Zoology	NOV 11, 2013	Guwahati	In -depth
2	Mr.Sarat Das, Head of village Keotpara (Gaobura) and Mr.Golok Das, Advisor to the president of Paspara committee.	Administration	July 24, 2014 and Feb 12, 2016	Keotpara village, Guwahati	In depth and semi-structured
3	Padmashree Mr.JadabPayeng (Moulai), Nature conservator	Landscape regeneration & wild life protection	Oct 14, 2014	Jorhat	In-depth
4	Mr.UttamTerron. Head and director of Parijat Academy.	Education, social worker	Oct 16, 2014 and Feb 12, 2016,	Guwahati	In-depth and semi-structured
5	Mir Naseem Ahmad. Vice Chairman (retired) of J & K Lakes and Water Development Authority	Town Planning, Wetland Management.	Nov 17and Nov 20, 2015	Dubai	In-depth and semi-structured
6	Mr.Punya Das. President Deepor Beel Paanchpada cooperative society (of fishermen)	Administration	Mar 13, 2015	Keotpara village, Guwahati	Semi-structured
7	Mr.LaxmanTerron. Environmentalist	Environment	Mar 15, 2015, Feb 13, 2016	Guwahati	In-depth and semi-structured
8	Mr. Ramani Mohan Das. Consultant, GMDA	Construction and planning	Jan 13, 2016, July 3, 2017	Guwahati	In-depth and semi -structured
9	Ms. Purnima Barman. Biologist, ASTEC. Whitley Award (Green Oscar) winner, 2017.	Wildlife Conservation	May 27, 2017	Telephonic interview	Semi-structured

Questions were based on the following parameters mapped with the study objectives. They were framed as per the field of expertise of the respondents.

1. Local facts and myths about conservation and management and overall awareness including validation/reasons of community conflict

2. Economic prospects: Bio-rights, animal fodder, edible plants, fishing, hunting
3. Conservation of wetland and forest: perceptions, experience if any, awareness about Wetland Park or Eco park in conservation, suggestions, traditional practices
4. Environmental issues: Eco sensitive zone, benefits, reasons for degradation, regeneration, afforestation, waste management, possible ways to contribute in conservation, water and bio diversity (to experts only – examples are elephant behaviour and fodder, migrating birds, man animal conflict)
5. Policy implementation: How successful / unsuccessful with justifications (Department of forest, Ramsar list, guidelines, GMDA, NGOs, any suggestions.
6. Socio cultural (religion): Equality, inclusiveness, access to government / non-government facilities, celebration, adaptation to urbanization and cultural sustainability.
7. Questions based on Village schedule forms (annexure 5A, page 141)
8. Research/study/workshop/activity undertaken or conducted and the outcome (for example, Deepor Beel festival, guiding tourists and biological researchers with local knowledge, forest trekking, etc.).

3.3 Focus Group Discussions (FGD)

Focus Group Discussion / Interview Method originated in sociology and was primarily used for market research. However, they are increasingly being used in many disciplines in Social Science as an exploratory research tool and as means of community empowerment, particularly in participatory paradigm (Sharma M. , 2015). Real time FGDs were held with different stakeholders for relevant opinions. The key objectives were to identify the reasons for community non-cooperation, delay in planning implementation and attitudes of the stakeholders towards conservation and management (C&M). The FGDs were held in a sequenced order to achieve better results for strategy building.

First FGD was held with the representatives of the fishing villages with the objectives of validating socio-cultural mapping by PRA method and to understand the attitudes of the villagers towards the government policies. The second FGD was held with the representatives of agencies and NGOs involved in the R&D and C&M of the wetlands, with the merits and challenges gathered from the first FGD. The third FGD was organized again with the members of the first

FGD to get more insight on infusing conservation and management strategies with community participation. This also resulted in a threefold benefits, including policy transparency among the participants from various background and generated more lateral opinions for community participation and benefits.

The FGD data gathered were examined to prepare baseline for a holistic wetland C&M by need assessment and raising awareness for cooperation. The data collected helped in decision making for the planning of Eco Park and other development policies proposed by the State government and were used in identifying the key stakeholders and their interest for different bio-rights activities (participation matrix and stakeholders interest), elaborated in chapter 6.

3.4 Participatory Rural Appraisal (PRA) and Survey

Participatory rural appraisal (PRA), as articulated by its practitioners, has an emerging normative Theory-and-Practice. This includes practical engagement with local communities and people, openness to complexity and diversity, a principle of decentralization and empowerment - “handing over the stick,” and sharing and lateral learning and spread. It establishes and supports methodological pluralism, rapid adaptive change, the analysis and expression of local people’s priorities, and democratic local diversity. “Decentralization and empowerment enable local people to exploit the diverse complexities of their own conditions, and to adapt to rapid change” (Chambers, 1994)

PRA with participatory action research (PAR) were carried out as part of socio-cultural appraisal and promoting economic sustainability and asset building. This was focused to gather information otherwise not available through any other tool. The learning-by-doing and teamwork spirit of PRA requires clear understanding of procedures. For that reason, a series of open meetings were held with the facilitators, common villagers and a group of 40 architectural students from Guwahati College of Architecture (GCA). Semi structured interviews and Focus Group Discussions (FGD) were held prior to the execution of PRA to build trust with the leaders of the community. Other common and simple tools used were mapping and modeling. Training was imparted to the author and the architecture students for briefing of methods and phases to carry out PRA activities. The training was conducted by Professor K N Bhatt from G B Pant Social Science Institute, Allahabad Central University on site (March 10-15th, 2015, Guwahati). Professor Bhatt also supervised the PRA exercises.

Data was collected by conducting PRA exercises at household level using Social Mapping, Resource Mapping, Wealth Ranking, Seasonal Analysis, Trend Analysis, *Chapati* Diagram, diagram for availability of basic services, Matrix Ranking, Informal Discussion along with identification of problems, recommendation for Micro credits and Bio-rights, and general meeting, assessment of the facts, assigning responsibility among villagers.

Based on the characteristics of the population and the objective of the study, purposive sampling was used to select three fishermen villages and three tribal villages. Schedule was in the form of checklist i.e. “yes/no” responses and filling up information/data by the group administrators (Annexure 5-A) The 12 groups of facilitators with 6 members each were a mix of villagers and students including women respondents. A student and a village youth have administered these PRA groups and filled the schedules with the guidance of the other group facilitators. The data collected were further verified by the village heads. Data on demography, agricultural practices and access to facilities like roads, transport, electricity, irrigation, health, education, loans, etc. from all the fringe villages was also collected by the same format. The goals, major objectives, respondents of the group and the methods are described in annexure 5-B. The results of the data analysis and recommendations are discussed in Chapter 6.3.

3.5 Design Research

Design research is concerned with the responsibilities of design to the humanities (Bayazit, 2004). Leonard Bruce Archer (1922-2005) was a catalyst to design research associated with mechanical engineering and the roots of architectural design research can be found with the Bauhaus. As per Archer’s definition “Design research is systematic inquiry whose goal is knowledge of, or in, the embodiment of configuration, composition, structure, purpose, value and meaning in man-made things and systems” (Archer, 1979). Herbert Simon, one of the most recognized scholars in the field of Design research expressed design research as “courses of action aimed at changing existing situation into preferred ones” (Linda N Groat, 2013). On a wider scale, the Environmental Design Research Association (EDRA, 1970) focuses on evaluative studies of architecture and environmental planning. For a methodological design process, systematic procurement of primary and secondary data related to planning and designing of the architectural, recreational and landscape activities, qualitative design research was conducted using maps, planning and development byelaws, National building codes of India

and the present and proposed master plan of Guwahati 2025. Design decisions for the proposed recreational zones were carefully adapted using map based analysis, the steps of Architectural Design Research (Linda N Groat, 2013) and EDRA's reports (2015, 2016) in Chapter 7.

3.6 Concept Mapping

One of the biggest advantages of using concept maps in qualitative research is that they can be applied in multiple studies and with multiple data (Daley, 2004). The advantages are:

- Good reference tool during Literature Reviews
- Capacity to translate ideas into a manageable topic and generate questions to focus on the research.
- Reduces data and simplifies complex topics
- Effective tool for mapping interview transcript (linear) - represent the interview data in an interconnected and hierarchical fashion.
- Presents the larger picture in a concise format of hierarchical chart.

Concept mapping were used to simplify interviews and other complex data in Chapters 4, 6&7

3.7 GIS mapping (Arch GIS)

The dynamic nature of wetlands necessitates the widespread and consistent use of satellite-based remote sensors and low-cost, affordable GIS tools for effective management and monitoring. They facilitate planning for ecosystem restoration (Nayan Sharma, 2012). GIS is a valuable tool for construction professionals and researchers involved in sustainable planning (H. Wang, 2014). It helps architects and engineers in retrieving data from a database required for careful placement of any built structure and transport network (V.K.Bansal, 2011). Digitized Base maps for the wetland and surrounding study area was prepared using ArcGIS Desktop (version 10.1) to locate the built-up area, water bodies and green cover in the fringe areas of the wetland (visual interpretation and photo interpretation techniques) Spatial Temporal Dependency Analysis of three fishing villages Keotpara, Natunbasti and Hirapara was performed. This includes mapping of the entire building, footprint of all fringe villages using Digital Image data (Survey of India maps) with associated data like water extent, vegetation, buildings, roads etc. The collected data was validated with socio-economic survey for three fishing villages. National

Wetland Inventory Atlas prepared by Space Applications Centre (SAC) Ahmadabad was used for outlining and planning of recreational facilities. A training for the author was conducted by Dr. Faiz Ahmed, Assistant Professor, School of Planning and Architecture, Vijayawada, India (April 28th – May 2nd, 2015, Dubai). Digitized maps were prepared for this purpose with his guidance.

For mapped data validation, analysis and to expedite the proposed Eco park planning, valuable information about the locations were compiled from satellite data available on Urban and Infrastructure portal of North East Space Application Center (NESAC, 2012). Maps from Guwahati Metropolitan Development Authority were used to analyze the land use and proposed recreation facilities (GMDA, 2012)(Source: Data center of the National Remote Sensing Centre (NRSC) Under ISRO, Department of Space, and Govt. of India.).

3.8 Materials

- a IIT Guwahati library, digital library databases at Amity University-Dubai and Manipal University-Dubai were instrumental for literature review and secondary data collection. The resources from the library at the Department of historical and antiquarian studies, Guwahati were used extensively for data on history, culture and people of Assam.
- b PRA training manuals, village schedules formats were used from the trainer Prof. K.N Bhatt to train the facilitators (author, architecture college students and village representatives), develop the contextual village schedule and PRA forms with his guidance.
- c DPR prepared by Prem Choudhury & Associates Pvt. Ltd., Delhi for GMDA and vetted by IIT Guwahati in 2013 was analyzed. The revised DPR prepared by GMDA for 3 waterbodies of Guwahati city (2015) was also referred.
- d Census data on populations from Rani Revenue circle office.
- e Software: Arc GIS and Survey of India maps were used to prepare CAD map of Deepor Beel in existing conditions (2015), AutoCAD and Photoshop soft wares were used to prepare drawings for the design of recreational and conservation facilities, contour map creator was used to prepare the contour maps in and around Deepor Beel. Digital maps from NESAC and Bhuvan were used for data validation.

3.9 Flowchart of methodology

The research questions drafted from the objectives and methodologies were planned to achieve the stated objectives and prepare the flowchart in Figure 3.1

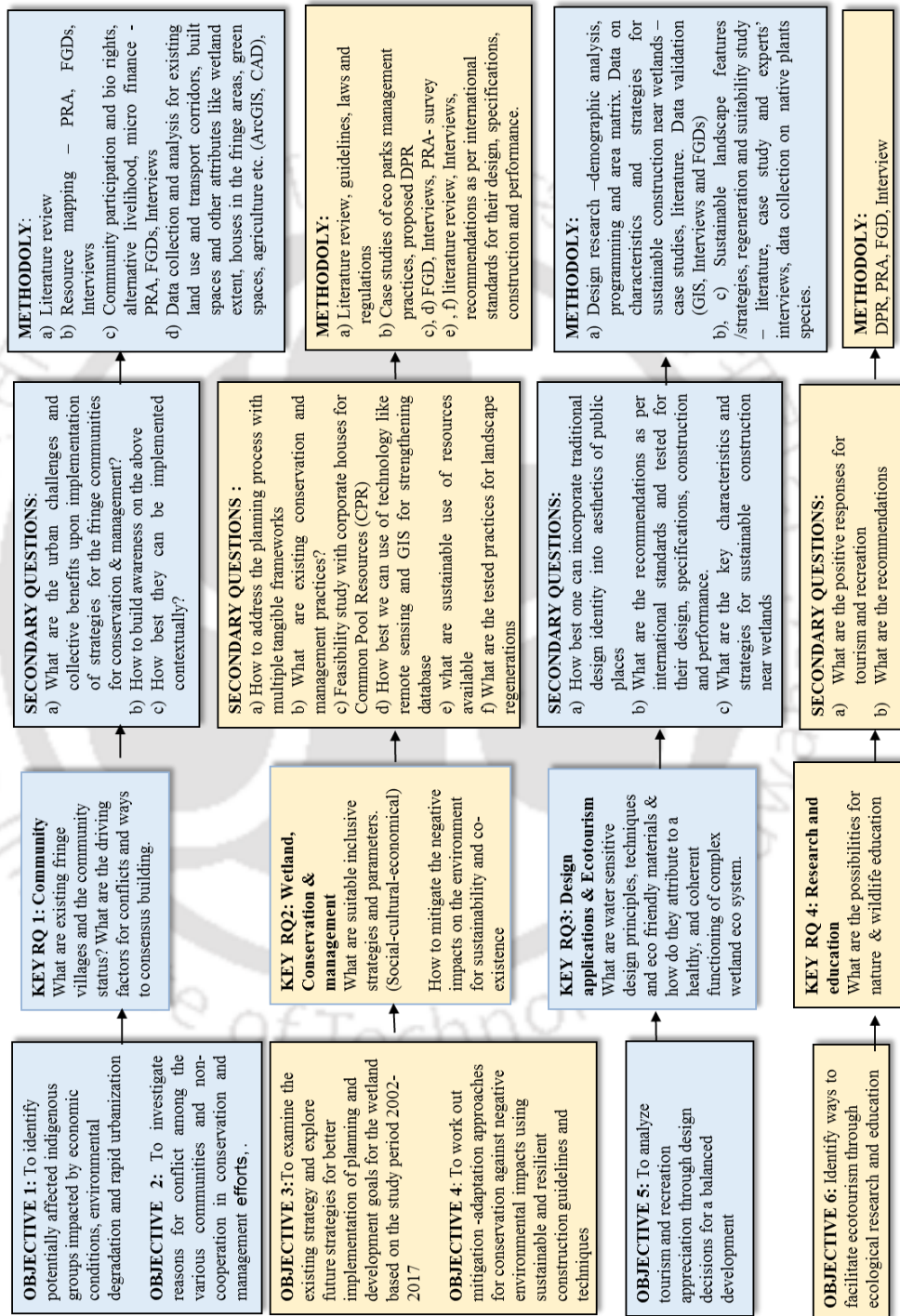


Figure 3.1: Flowchart of research questions and methodology mapped with the objectives

Chapter 4

Case Study Evaluation

Case studies of practical relevance were chosen from different part of the world with specific data driven intentions and were based on their significance related to the study objectives. The climate and context specific parameters were different in each case study, but that helped understanding the best conservation and management practices for long term benefits, and to identify the common goals for humane and utilitarian eco parks near urban wetlands or water fronts.

4.1 Conservation and Management (C&M) Strategies: Success Stories and Lessons Learnt

Contextual wetland protection, restoration, conservation and management and economic benefits were assessed from these case studies with deliberated evaluation structure as below:

1. History / Background, Socio-cultural Identity
2. Ecosystem Services and Biodiversity (existing information and values)
3. Key C&M Challenges and Governance Mechanism
4. Policy and implementations (for economic and eco system benefits)
5. Construction and Landscape
6. Benefits / Drawbacks

4.1.1 The Llobregat River delta (Delta del Llobregat), Barcelona, Spain (March 2014)

The delta of the Llobregat River lies to the south of Barcelona, just about 20km from the city and forms a valuable natural habitat close to Barcelona El Prat airport. There wetlands are part of the Ramsar network and play a critical role in the wintering of many migratory birds. This delta aquifer is an important freshwater reserve for the metropolitan region, used by numerous industries, agriculture, and cities. The fertile delta farmland supports intensive agriculture supplying the local market (Figure 4.1)

The natural areas of the Llobregat Delta are a complex of designated special protected areas (1987) of about 100 sq. km under the European Union Directive for the conservation of

wild birds. Barely 3% of the original Delta plain of 100² km survives and what remains is constantly under pressure from further expansion of the Barcelona airport (Rafael Marce´, 2012)



Figure 4.1: The Llobregat basin (Rafael Marce´, 2012) and Delta Del Llobregat in Barcelona

History / Background: Socio-cultural Identity

The delta of the Llobregat River is a naturally extended area in the city of Barcelona. Previously it was utilized for agriculture purposes and in the twentieth century for urban and infrastructural advancement. Before 1930 there were some issues of infringement of urban and mechanical uses along the edges of the delta and around settlements like Hospitalet and El Prat. In any case, this was in small scale, secondary to the cultivating part. Since the 1960s, the delta's lands have been under constant pressure from Barcelona's urban and industrial expansion. Most important logistics and transportation facilities in the region (port, airport, motorway network and railways) were built in this area taking advantage of the flat landscape. The recent port extensions even forced a southward movement of the river mouth.

Ecosystem Services and Bio diversity (existing information and values)

The delta complex covers six main habitats, the first three of which represent a classic Mediterranean succession (Iberia nature, 2014), namely Beach; Pinewoods; Marshes and Lagoons; River Llobregat; Farmland; the Mediterranean Sea.

It is situated midway in the bird's migration route from Northern Europe to Africa. In winter, one can spot and view (with a telescope) sea birds including Corys, Balearics and Mediterranean shearwaters, three types of Skuas and gannets. A significant part of the shoreline territory is Catalonia's second biggest settling zone for Kentish Plover. Huge perches of Auodin's Gulls in spring are another feature, with a shifting population of 60-600 water birds in 2006, recorded on a particular day. There is a rehabilitation center for injured marine creatures nearby. The Delta attracts 4000-5000 ducks of up to 15 species every winter (Iberia nature, 2014). At one time or another, it is home to Grey (Ardeacinerea), Night, Little, Squacco (Ardeolaralloides) and Imperial Herons along with Egrets, Kingfishers, Marsh Harriers and other 140 odd varieties. The marshes, reserved forest and the estuary is also home to wild reptiles and amphibians, including few invasive species.

The anthropogenic impact on the delta's natural system is massive and has shrunk a great deal in size. Being declared as protected area, the ecosystem was regenerated and relatively contained. This amazing delta is still one the most important birding sites in Catalonia. Birds have been wintering here rather regularly since 2000, after a gap of almost four and a half decades.

Key C&M Challenges and Governance Mechanisms

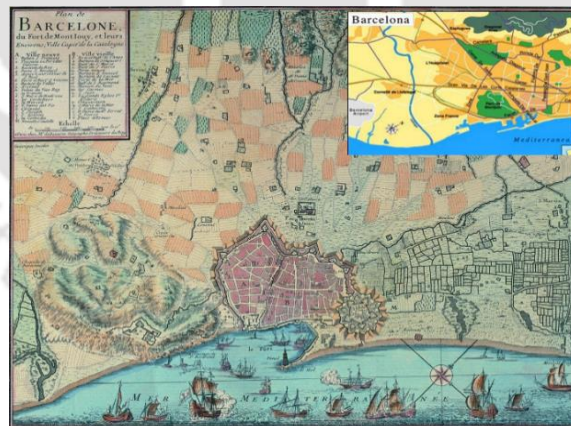


Figure 4.2: Loss of habitat and change of land use in Llobregat Delta, Barcelona

(www.wintagemaps.com)

The municipalities of El Prat de Llobregat, Viladecans, Gavà and SantBoi de Llobregat are the administrative authorities and civic bodies for these areas. The planning and

implementation is done under the guidance and supervision of the Urban Planning Department, Barcelona.

Some of the greatest threats to the Llobregat Delta include:

- Rapid urbanization and loss of natural habitat (Figure 4.2)
- Water pollution
- Over-utilization of resources (like groundwater)
- Change of land use, loss of farm land and fragmentation of the natural patches
- Presence of foreign species

Policy and Implementations (for economic and eco system benefits)

The Llobregat Delta Plan was planned and executed since 1994 and had two major infrastructure developments; (1) airport and (2) seaport master plan development. Part of the Delta was also declared as the Global Important Bird Area (GIBA) in 1999. Other actions undertaken within the region were - Construction of the Metropolitan Sewage Llobregat and the Aquifer Recharge project with treated water. The Barcelona Municipality constructed a waste water treatment plant near the mouth of the river (operating since 2012) that generates reclaimed water feeding the river situated 16 km away from the Mediterranean sea mouth, to cater to the ever-increasing demand of fresh water for the city (S. Pérez, 2012). Few compensatory environmental measures by them were directed to these major infrastructure development projects. The series of action plans to compensate include, creating a new beach sheltered harbor; declaration of some identified ports as protected areas; creating a public coastal park. However, the actions were far from being completed and implemented.

Construction and Landscape

Two birding parks were constructed for visitors in protected zones with viewing galleries, public resting places and facilities for research. The active mobility includes cycling tracks and walking paths - hovering a distance of 4 km from the entrance to the estuary (Figure 4.3). There is a Visitor's Center to assist students and researchers in conservation management and guidance. Vehicular circulation is restricted to securities, personnel and park authorities; public vehicles are not allowed inside. There are bird viewing towers, with wide platform at the beach and

observation hides all along the marsh land. These areas also host extremely valuable vegetation including a scarce population of *Kosteletzkya Pentacarpos* and *Stachys Maritima*. Additionally, more than 22 different species of orchids have been found here. This is the only metropolis in the Mediterranean that enjoys marshes of such international significance, with exceptional flora and fauna. A popular tourist place to discover the natural environment and to enjoy the green blue landscapes (Figure 4.4).

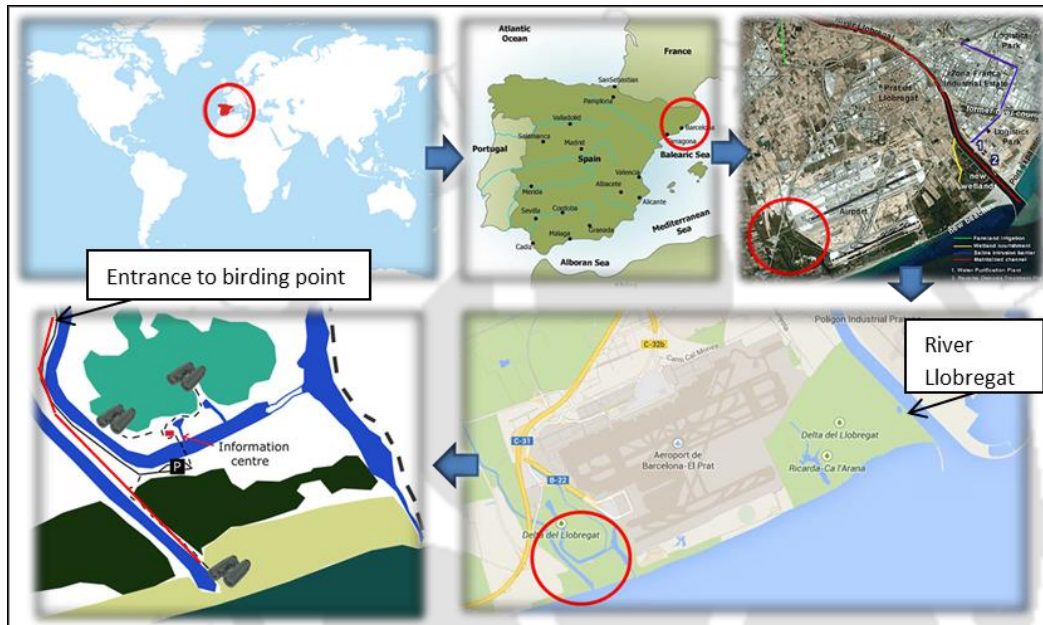


Figure 4.3: One of the protected area in Delta Del Llobregat. Showing the path (follow the red line) from the gate of Birding Point, through the Reserved Forest, alongside the water stream till the estuary ([www. maps.google.com](http://www.maps.google.com))



Figure 4.4: The blue green Landscape (photographs by author)

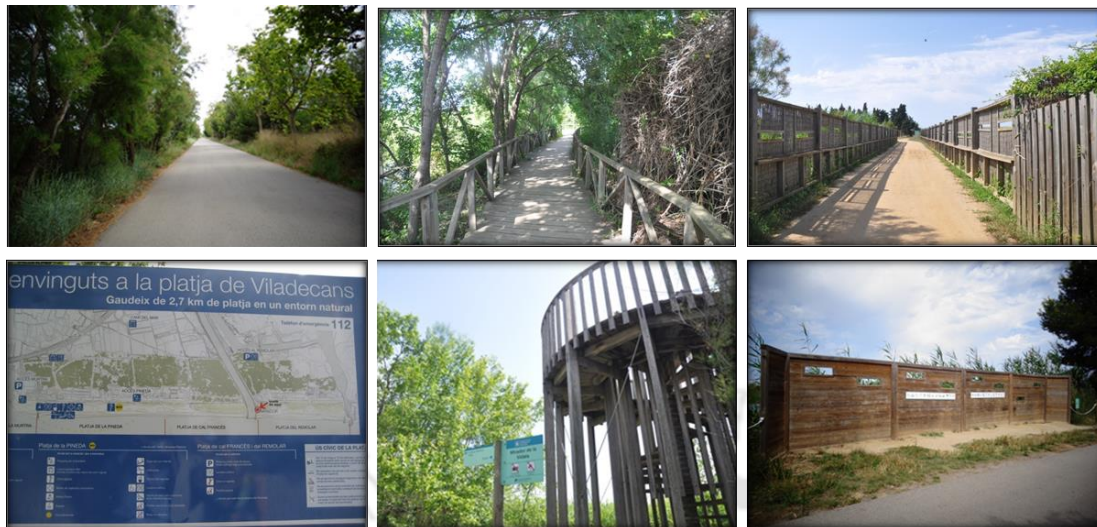


Figure 4.5: Visitors' facilities (photographs by author)

Benefits / Drawbacks

This confined nature site is facing continuous pressures of urbanization and infrastructure development. In the past, the enlargement of both the Port of Barcelona and the Barcelona airport has had important consequences on the loss of surface, biodiversity disturbance and connectivity. These projects were finally completed but compensatory measures had to be implemented. A stretch of new beach was created by the authorities and the airport management company; however they are yet to complete some other action. Plans Moreover, additional actions for preserving natural open spaces are still taking place. The recent initiative to this effect is the construction of a golf course between the beach and the airport.

However, the mega-casino project proposed recently by Euro Vegas, which was being planned in the buffer zone of the agricultural park Llobregat, was finally rejected by the Catalan Government. Besides legal reasons, there was a huge protest (SOS Delta Del Llobregat) about this project due to its perceived impact on the nature zone and potential social problems that it could bring (EUCC news, 2013).

4.1.2 Ras-Al-Khor Wildlife Sanctuary, Dubai, UAE (Conservation and Management)

Ras Al Khor Wildlife Sanctuary (RAKWS, 55° 20' E, 25°12' N) is the first Ramsar site in the UAE. Declared a Ramsar site in 2007, this is one of the most important bio-diverse areas within the city of Dubai. In addition, RAWKS has been identified as an Important Bird Area (IBA) by Birdlife International. It is a globally important coastal wetland lying at the crossing point between Arabian Gulf and AL Awir Desert. This arid zone wetland is spread across a 6.2 sq.km area and home for around 47 species of flora and 450 species of fauna under full protection of the Municipality of Dubai since 2003. Hunting, shooting and disturbing wildlife within this protected area are banned as a measure of conservation strategies. This rich biodiverse site has become significant of humanity's continual existence and a vital part of UAE's culture and heritage.



Figure 4.6: Location map of RAKWS in Dubai showing images of Bird watching towers (Dubai Municipality, 2008).

History / Background: Socio-cultural Identity

The Ras Al Khor wetlands today are the result of dredging done during 1960-1980 and made the creek navigable water ways for deeper sailing crafts. Prior to this, the wetland was a tidal inlet from the sea and mudflats formed at the head of the creek due to tidal forces. Aerial

photographs of Dubai in the 1930s kept in the Dubai Museum show no evidence of vegetation or mangrove in this area. The few individual attempts with trial and error method started in 1940 and later late Sheikh Rashid Bin Saeed Al Maktoum ordered an economic and technical study in 1954, realizing the significance of the creek. With this start and support from his son, Sheikh Mohammed Bin Rashid Al Maktoum, then the crown prince and ruler of Dubai now, the work was taken over by a specialized team comprised initially of staff from the Federal Environmental Agency, the Ministry of Agriculture and Fisheries and the Dubai Municipality's Environmental Department. An artificial island was constructed in the year 2000 and then onwards, due to urbanization, growth of built environment expanded many folds, but just beyond the perimeter of the buffer zone (Figure 4.7).



Figure 4.7: Satellite images showing the reducing wetland and development around Ras Al Khor, Dubai. (Sourced from private remote sensing lab - Dubai)

Ecosystem Services and Biodiversity (existing information and values)

The Sanctuary has significant ecological, educational, cultural and aesthetic value. The diverse ecosystem of RAKWS supports high concentrations of birds, reptiles, amphibians, fishes and invertebrate species, providing wide range of genetic resources. The Sanctuary covers an area of varied ecosystems of shallow mudflats surrounded by saturated salt flats (Sabkhas), mangroves and lagoons, reed beds and shrubs. Along with its abundant wildlife, the prominent fauna includes migratory and native birds like *Little Stint*, *Greater Flamingo*, *Common Teal*, *Ringed Plover* and *Kentish Plover*. At one time, the highest number of bird count was 10,000 in

2011 (Environment Agency-Abu Dhabi , 2011) and 25000 of 88 different species in 2014 (Dubai Municipality, 2008).

Key C&M Challenges and Governance Mechanisms

The Marine Environment and Sanctuaries unit of the Environment Department under Dubai Municipality is the official management authority of the Sanctuary since 2003. RAKWS is under constant supervision of safety inspectors of the Sanctuary and Dubai Police.

Policies and Implementation (for economic and eco system benefits)

Planning, operation and management are the main objectives implemented by the concerned authorities. Policies for protection, restoration and conservation of species and ecology are aided by the Emirates Wildlife Society (EWS), World Wide Fund for Nature (WWF), Wild Life International and concerned Environmental Agencies. They also look after legal enforcement, provide for education and interpretation activities on natural environment and conduct regular researches and studies.

Construction and Landscape

The boundary of the wetland, with the core and buffer zones, has been demarcated while the outer boundary of the sanctuary is fenced. There are three bird watching hides constructed for tourist with Viewing Galleries, Parking Bays and Information Center. 'Hide One' is located near the mangrove forest and named as 'Mangrove'. 'Hide two' is named Flamingo and is the most popular among all three with closest views of the Flamingo roost. 'Hide three' is situated near Jadaf and named as 'Lagoon or Al Buhaira' (Figure4.6).

Benefits / Drawbacks

A feeling of proximity to nature in a constructed wetland area with the closest viewing experience of migratory and native birds, mostly Flamingos, makes this site a tourist hotspot within Dubai. Threats to wildlife and their habitats in RAKWS have reduced enormously on account of adequate patrolling by both Dubai Municipality and Dubai Police and the effective implementation of the laws and regulations. Protection will further improve proper implementation of the sanctuary management plan.

4.1.3 East Kolkata Wetlands, India (Community Engagement)

The East Kolkata Wetlands (EKW), located on the eastern fringes of Kolkata city, sustain one of the world's largest and oldest integrated resource recovery practice based on a combination of aquaculture, agriculture and horticulture. These wetlands, spanning over an area of 12,500 ha, (Figure 4.8) form a part of the extensive inter-distributaries' wetland regimes formed by the Gangetic delta. The East Kolkata Wetlands system has become a research treasure because of its multifunctional importance, wise use of wetlands and being a Ramsar site.

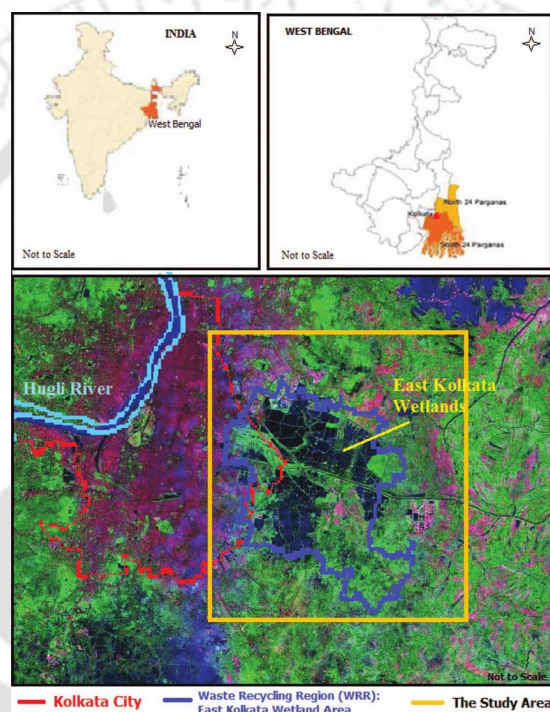


Figure 4.8: Location map of East Kolkata Wetlands (Seema Mehra Parihar, 2012)

History / Background: Socio-cultural Identity

The boundaries of the wetland system are currently defined as per the provisions laid under the East Kolkata Wetlands (Conservation and Management Act), 2006. Located amidst Rivers Hooghly on the west and Kulti on the east between $22^{\circ}27'N$ and $88^{\circ}27'E$, the wetland is a mosaic of landforms including predominantly water dominated areas (used as fish farms) to land centric usages for agriculture and horticulture. Settlements are interspersed between various land uses. As per analysis based on IKONOS Earth Observation Satellite Imagery of 2002 (November), 46% of the demarcated area is under water bodies, the rest being under permanent

agriculture (39%), garbage farming (5%) and settlements (10%). The use of sewage as the basis of aquaculture, agriculture and horticulture production systems provides the rationale for considering the entire system as a single management unit. EKW is also referred to as a Waste Recycling Region (WRR).

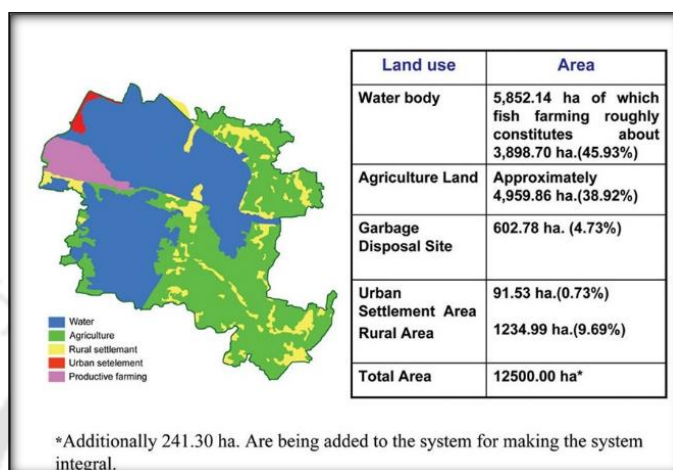


Figure 4.9: Land use map of EKW (IKONOS Satellite Imagery November, 2002)

Earlier, when the colonizers came in, they wanted to set-up a new metropolis and diverted the course of the river Hooghly and thus East Kolkata Wetlands were formed from the inter-distributaries meshes of the shifted river course. However, in course of time as Kolkata has emerged as the new metropolis of today, the city has grown faster towards its north and south, surpassing the optimum travel distance. As a result of this man-made forceful intervention, the city form of Kolkata came out to be linear with the growth direction towards the north and south.

Ecosystem Services and Biodiversity (existing information and values)

East Kolkata Wetlands serve as a natural sponge to filter the city's waste water and possess a rich Flora and Fauna. Numerous species of fish are farmed in the sewage fed shallow oxidation ponds called 'Bheris' in these wetlands. Sewage that is sent to the wetlands are subjected to solar purification followed by natural oxidation by which, the water become conducive for algal and plankton growth, which are the primary feed of fishes. These wetlands show an immense diversity of flora and fauna, both at the macro and micro level. About 100 plant species including several kinds of water hyacinths grow across these wetlands. Farmers and fishermen from the fringe communities use water hyacinth to create a buffer between land and

water to minimize erosion. They also grow rice and varieties of vegetables mainly for local consumption. The area is also home to large numbers of coconut and betel nut trees. 104 wetland species of diverse Fauna, both at the macro and micro level include common marsh mongoose and mud turtle, 52 endemic species of fish, approximately 20 types of mammals, few snake species and over 40 species of birds.

Key C&M Challenges and Governance Mechanisms

The East Kolkata Wetlands Management Authority (EKWMA) under the Department of Environment, Government of West Bengal, guided by the East Kolkata Wetlands (Conservation and Management) Act, 2006, the East Kolkata Wetlands (Conservation and Management) Rules, 2006, and the Wetlands (Conservation and Management) Rules, 2010 is responsible for Operation and Management (O&M). Since 2005, EKWM has started implementing the Management Plan of these wetlands with financial assistance from the MoEF, Govt. of India. In the initial phase of the project, the primary focuses involved efforts to restore the fast shrinking wetlands and prevent habitat loss. A conservation partnership has been successfully developed through this project based on community-ecosystem approach in the area. Dwellers have been involved through a participatory partnership in the project, as it has an integrated community-ecosystem approach. The whole community shares the responsibility of validating and evaluating the scheme, and are a part of the decision-making system in an adaptive project management. Effort has been taken to improve livelihood of the people by micro enterprise development, viz; vegetation based micro enterprise development, ornamental fish culture, fish cum duck rearing, goatery and piggery.

It's an exemplary Public Private Partnership (PPP model) along with community participation. The formation of Self Help Groups (SHG) that SAFE could establish with the supports from NABARD has further strengthened this project. The fisherwomen have been exposed to training and visit program and youths have been trained with marketing skills. This capacity building has brought confidence to the fringe communities. TATA-AIG group has designed a Micro Insurance Scheme (MIS) for the people so that the little contribution remains an investment and the premium money is returned with bonus on completion of the tenure of the insurance. Price water house Coopers (PwC) and Cognizant have carried out huge plantation programs at the Bio rights project site in partnership with SAFE (Dey, 2010).

Currently, Hindustan Unilever is interested in scaling up the project under corporate social responsibility with South Asian Forum for Environment, SAFE. In wetland fishermen cooperatives, the plan has been implemented and members are trying to design similar mechanism of alternate earning. NABARD has supported the second agro-development project in East Kolkata Wetlands on Conservation of Endemic Fishes which, also has Bio rights component. Nearly 523 families (2615 persons) from the fishermen's community of East Kolkata Wetlands, working in these two cooperatives are the direct beneficiaries. All are below poverty level people having a monthly income of INR 850 per family.

Policy and Implementations (for economic and ecosystem benefits)

The revenue collected from ecotourism would be an alternative economic opportunity for sustenance. A portion of the excess revenue would go for premium of group micro-health insurance coverage for the wet lenders who struggle in stinking sewage waters for their livelihood and produce fish for the metropolis. The innovation is that here environmental awareness would explicitly act as a marketing tool for the revenue generation system and Bio rights acted as an incentive for conservation. This would therefore endorse the bio rights component and that was the policy uptake. The main objective of the project was to initiate an effective partnership for conservation amongst the stakeholders; the strategy for influencing public management aspect was in developing a win-win situation by assuring revenue returns from nature services. Though unfortunate, but it's a fact that environmental services in developing nations of global south gains priority through conservation only when it widens the economic opportunity within a short term cycle. Direct payments of ecotourism have direct impacts in policy implications and public management.

Construction and landscape

In the developmental process, improvement of basic civic infrastructure facilities is inevitable, but need special considerations for such wetlands and their ecosystems. Since its declaration as Ramsar wetland in 2002, the pace of changing the land use may have reduced but the encroachments of wetlands continued for transport infrastructures in the form of expansion of a major arterial road, the metro railway or for elite residential complexes like Salt Lake City. In the recent past, several fishers from the wetland area have converted their fish farms into

amusement parks, water sports parks, boating and picnic spots. Visitors have a good time while the fishermen make some extra profits. Usually, such places function actively during winter months. There is a strong need to acknowledge and appreciate the importance of these wetlands and work towards wise use and conservation. Decent functioning of the local authorities and a comprehensive land use planning are indispensable to curb wetland degradation for upgrading the civic and economic life of the fringe communities.

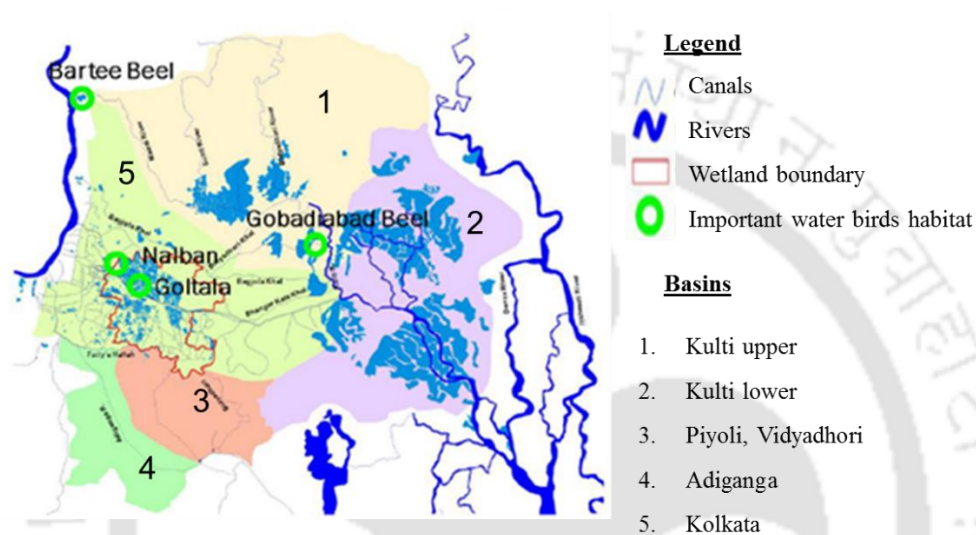


Figure 4.10: Water Bird Areas for Habitat Improvement (EKWMA, 2014)

Benefits / Drawbacks

The management plan by EKWMA under implementation includes water management, habitat management, sustainable resource development, livelihood improvement and Eco-tourism development (Figure 4.10). However, like many other urban wetlands in India, the typical threats to EKW are rapid urbanization and change of land use, especially unauthorized constructions. The change in the quality and quantity of the solid waste and sewer is adding to the ecological problems and human health. The key issues that need immediate attention are heavy metal content on fish consumption, upstream-downstream hydrological conflicts and linkage with coastal processes for conservation and ecological benefits.

4.1.4 Mahim Nature Park, Mumbai, India (Landscape Regeneration, November 2013)

Mahim Nature Park, also known as Maharashtra Nature Park (MNP) is situated near Dharavi, largest slum of Asia, in Mumbai. It is located on the Bandra-Sion Link Road running along the southern bank of Mithi River. The Mahim Nature Park serves as a fresh breakthrough space for the citizens of Mumbai living amongst the hustle and bustle of the city life. This is an excellent example of Brownfield sites converted into a Green Blue civic infrastructure.

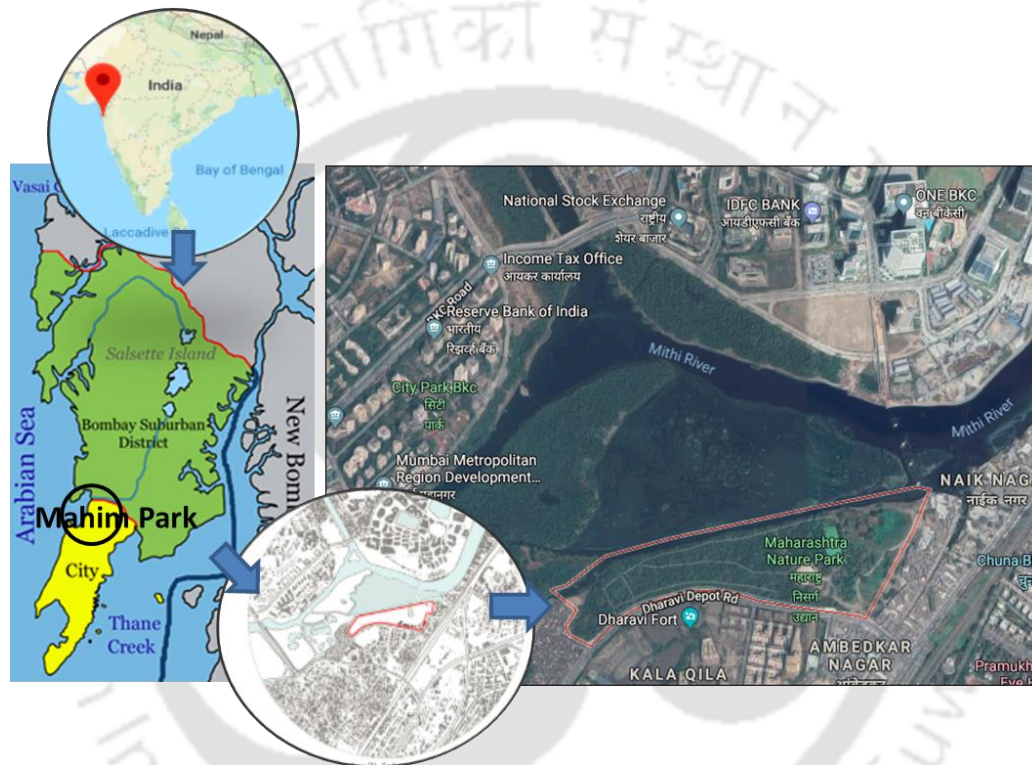


Figure 4.11: Location map of Mahim Nature Park, Mumbai (www. maps.google.com)

History / Background: Socio-cultural Identity

The Mahim Nature Park in Mumbai, India was previously a dumping ground for city waste. The wasteland was decided to be restored and developed as a Nature park by Mumbai Metropolitan Region Development Authority (MMRDA) in the 1970s covering an area of 37 acres. While the urban landscape of Mumbai is a large portion of its landmass, a few green pockets stand out as ecosystems vital to the city's health. The first tree (they chose evergreen trees to attract birds) was planted in 1983 by late Dr. Salim Ali, Indian ornithologist and naturalist and then began the process of converting the dumping ground into a park.

Ecosystem Services and Biodiversity (existing information and values)

Though the waters of the Mithi River are polluted, the MNP and the surrounding mangroves provide resting spots for thousands of birds. This lush vegetation and the surrounding mud flats are a popular roosting spot for migratory and aquatic birds from the Indian subcontinent. The MNP is home to about 38 species of butterflies, 22 varieties of reptiles and amphibian, 30 species of spiders, more than 80 species of birds and 580 species of plants from which, many were planted by birds and insects (Eco India, 2013). Running along the edge of the Mahim Nature Park, is the Mahim Creek, which supports a lush evergreen mangrove forest with a rich biodiversity.

Key C&M Challenges and Governance Mechanisms

The Government of Maharashtra formed MNP society for the welfare and care of the park under MMRDA. This society is responsible for day-to-day management and activities of the Park. The team had two major targets – creating an educational theme park for children and developing a mangrove forest. To irrigate the vast vegetation in the park, a rooftop rainwater harvesting system has been built, which stores around 2,000-kilo liters of water every monsoon. The water collected is stored in an open pond, which is home to several aquatic plants and provides a backdrop for the park's Rain Education Centre. Since the trash in the landfill makes it difficult for trees to access groundwater, the management has to keep planting new trees to replace dead or fallen ones. To help them along, the authorities fill water in irrigation pits close to the trees in winter.

Policy and Implementations (for economic and ecosystem benefits)

After nearly 20 years of remediation, it was opened to the general public in 1994. Now the park supports an abundant evergreen mangrove forest of over 18,000 trees and serves as the thriving home to hundreds of plant and wildlife species ranging from birds to butterflies and spiders, and a variety of reptiles and amphibians. The park's great success, as noted by the managing director, is its ability to curtail urban encroachment and bring a natural environment to Dharavi, Asia's largest slum. In turn, it provides a wildlife refuge that also serves an educational purpose for its visitors and a recreational space for environmentalists and bird watchers. Environmentalist and project coordinator Shanta Chatterjee, who was the Chairperson of WWF

when the project came to fruition, favors a hands-off approach to the park's continued development. The activities permitted within the park are limited as an effort to sustain the delicate ecological balance.

Construction and Landscape

The education center, amphitheater, and adjacent event ground located at the widest part of the park and occupy over three acres carved out of the forest-like core zone. The sun-inspired education center of the park is visibly ageing and multiple annual structural audits by the MMRDA have confirmed that it is indeed in a poor condition and needs to be razed. Of the 37 acres on which, the park stands, 13 acres on the eastern side are currently unused and have become grounds for open defecation and soft encroachments.



Figure 4.12: Landscape and facilities (Vir Mueller Architects, New Delhi)

Benefits / Drawbacks

At Maharashtra Nature Park, an effort has been made for preservation to take precedence over environmental tourism. In terms of public usage and accessibility in MNP, the main idea of setting up this park was not limited to enjoying natural beauty, but to create a natural habitat within the city.

4.1.5 The Summer Palace and the Kunming Lake, Beijing, China (April 3-9th, 2015)

Located in the northwest suburbs of Beijing, the Summer Palace (N39 54 38, E116 8 28), popularly known as China's Versailles, is a world heritage site and one of the finest examples of garden architecture in China. The Summer Palace on the Longevity Hill, Kunming Lake (constructed) and the park form the summer Palace complex. The 100-odd examples of traditional architecture in the park include pavilions, terraces, temples, pagodas, waterside gazebos, covered corridors, stone bridges and the famous marble boat. The palace occupies a total area of 297 hectares, three quarters of which, is made up of shallow lakes (Center, China Internet Information, 2015). The Lake covers three fourths of the park area (Lake area- 220 Hectare, mean depth - 1.5 meters). Dragon boat cruise in the lake and waterway around the hill is a very popular tourist attraction. The tourists took special carts out on the ice instead when the lake froze in winter 2015. The Summer Palace became a public park in 1924 and has continued as such to the present day. UNESCO included the Summer Palace on its World Heritage List in 1998. The Summer Palace characterizes the philosophy and practice of Chinese garden design, which played a key role in the development of this cultural form throughout the east (UNESCO, 2013).

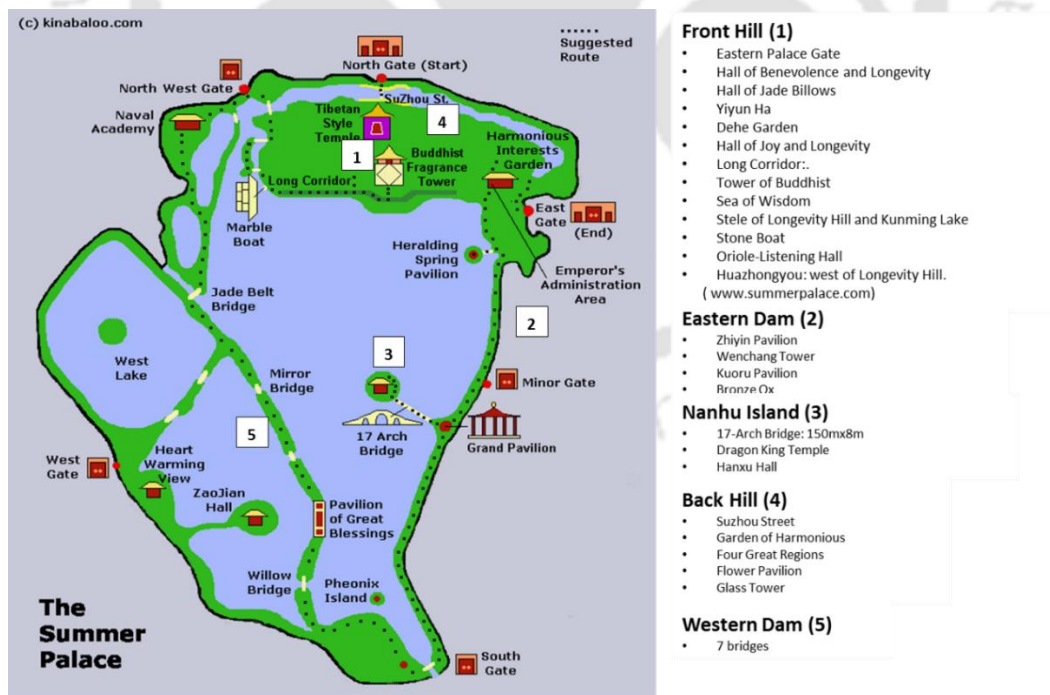


Figure 4.13: The summer palace and Kunming lake complex (tourist brochure at location)

History / Background: Socio-cultural Identity

Beijing was the capital during three dynasties (Yuan, Ming and Qing, 1271 to 1911 AD). In the Yuan dynasty, a reservoir, named West lake (area of 130 ha in the 1930s) was built to the west of Beijing, at the foot of Jar hills as a water resource for the city and to facilitate the transportation of grain. After the construction of the reservoir, three aqueducts were built to transport water from the Nanchang River into the city. These aqueducts increased the water supply of the palaces as well as the resident areas and continue to function today (Giovanni De Feo, 2013). Hydraulic engineer and observatory designer Guo Shoujing from Yuan dynasty designed this manmade lake. During Emperor Qianlong's reign (1736-1795), the lake was expanded to its current size with a work force of 10000 laborers.

The Summer Palace serves as a popular tourist destination and recreational park with its vast ensemble of lakes, gardens and palaces; is the largest and best-preserved imperial garden in China. The objective of this case study was to review tourism development and heritage conservation of a man made wetland in urban context.

Ecosystem Services and Biodiversity

Large scale urban greening program implemented between 2002 and 2015 in Beijing increased the surface area of water bodies along with green patches, but the functions were confined to aesthetic and recreational. Land use change due to conversion of buildings to green spaces and decreased farmland were considered to have higher threat to the habitat quality of urban water bodies (Nie, Yang, & Huang, 2016).

Key C&M Challenges and Governance Mechanisms

At local level, management is in the hands of the Summer Palace Management Office (created in 1949), an agency of the Beijing Municipal Bureau of Parks and Gardens, which works in collaboration with the Municipal Bureau of Cultural Relics. The Management Office, which, employs over 1500 people, 70% of them professional and technical staff, has a number of departments covering, inter alia, relic protection, gardening, park administration, construction and protection, and archives. (UNESCO, World Heritage List, 880, 1997).

Kunming Lake in Beijing is part of a natural river-lake system that once acted as a reservoir for the city's northwest, received water from the Miyun reservoir earlier. But in recent

years of drought, the city's first priority for Miyun water is providing Beijing residents with a supply of tap water. Instead, water from the heavily polluted Guanting reservoir (80 km away) is delivered to Kunming Lake through existing river channels since 2007 (Qing, 2008). Among the five monitored urban lake, 3 lakes including Kunming Lake was stated grade IV in 2012 (Category IV applies to water bodies for general industrial water supply and recreational waters in which there is no direct human contact with the water), which deteriorated from grade III in the previous year. The major pollutants were BOD 5 and Phosphorus; in 2010 the lake was mesotrophic (Liu, 2014).

Policy and implementations (for economic and eco system benefits)

As per the requirement of the operational Guidelines for the Implementation of the World Heritage Convention (UNESCO, World Heritage List, 880, 1997), the whole precinct was declared as protected area with 2 buffer zones (5,595 ha: include core protection zone of 297 ha, core II protection zone and construction control zone). The Summer Palace itself, which is the area nominated for inscription, forms the center of three protection zones. Outside, this there is a second protection zone, which provides the green landscape background for the Summer Palace and within which no buildings may be altered or constructed with authorization. In the outermost zone, there is control over the height and color of any new constructions. As a result of greening, within these buffer zones (increased by 46.32%) during 2005-2015, the Kunming Lake had the highest decrease in habitat threat index (HTI) by 20.95% among all water bodies in Beijing (Nie, Yang, & Huang, 2016).

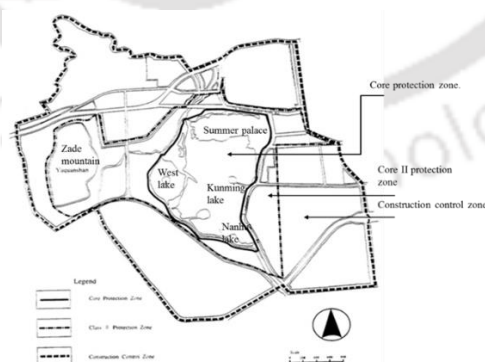


Figure 4.14: Map of Protection area and Buffer zone around the Summer Palace (ICOMS, 1998)

Construction and landscape

The Summer Palace was burned down in 1860 by the Anglo-French allied forces, but was reconstructed in 1888 by CiXi. The columns of the reconstructed Hall of Benevolence and Longevity made from the Nan Moo tree from South West China are made from single tree trunks. Emperor Qianlong then named it "Kunming", inspired by Emperor Liuche of the Han Dynasty, who once constructed an artificial lake called the "Kunming Pool" to practice battles on the water. The earth excavated from the expansion works on Kunming Lake was transferred to and piled on Jar Hill, which was renamed "Longevity Hill", (elevation-60m). Construction materials used were Stone Slates, Marble, Iron, Bricks, and Wood and decorated glazed clay roofing tiles. Protective measures have been periodically introduced, particularly for heritage monuments like installing iron sticks to fasten wooden structures (a common counter measure in the site).

The summer palace gardens are the finest example of empirical Chinese garden and play an important role in the development of their history and culture. The conservation and management of landscape is carried out using traditional techniques and appropriate materials.

Benefits / Drawback

The world heritage organization have directed the development authority to develop an appropriate conservation master plans, in close consultation with the World Heritage Centre, integrating components on risk-preparedness and tourism management in 2008. It was presented in 2009. With the presence of strict and periodic conservation plans and programs of local and central government, the protection of the summer palace is operating well. The scientific management and protection is carried out by increasingly sophisticated digital monitoring.

Water crisis and degraded water sheds in Beijing due to few short-sighted policies since 1949 have promoted the over-use of limited water resources (Qing, 2008). The water quality of Kunming Lake is highly polluted and not fit to even come in contact with human body. This is a cause of concern with such a high tourist footfall.

4.2 DPR Analysis: Dal Lake, Srinagar, India.

The DPR for Dal Lake Conservation and Management Programme was prepared (October 1999) by Alternate Hydro Energy Centre (AHEC) of the Indian Institute of Technology, Roorkee and submitted (December 2002) to MoEF. The project included two components viz. 'Lake Conservation and Management Programme' and 'Rehabilitation and Resettlement Programme'. The Conservation Management Programme included

- Sewerage Treatment
- Hydraulic Works
- Restoration and Development Works
- Solid Waste Management
- Infrastructure Development
- Catchment Management
- Provision for Land Acquisition and Public Awareness.

The Rehabilitation & Resettlement Programme included

- Resettlement of the dislocated hamlet population in new colonies
- Acquisition of watery area surrounding the hamlets.

The Sewerage Treatment and Hydraulic Works included

- Sub-optimal performance of the three STPs
- Partial working of settling basin
- Non-completion of house- to-house connectivity for carriage of sewer
- Non-construction of gates for the bays had resulted in increase in the nutrients and weeds and depletion of the fish population in the lake.
- No studies had been carried out to ascertain whether the springs existing in the lake were actually carrying water to lake or had choked.

The works undertaken under Restoration and Development Programme included

- Dredging of the blocked channels

- De-weeding
- Creation of reed belt
- Development of shoreline
- Establishment of aerators
- Carrying of fresh water from streams to the lake

The DPR had recommended dredging and deepening of 38 blocked channels in the backwaters of the lake. A team of MoEF had reported (July 2009) inadequate execution in dredging of channels of the lake and dredging of the lake without bathymetric map (Map that shows basin morphology and helps with identifying areas to be dredged). The expenditure of Rs 20.48 crores incurred on this component had so far not led to the desired outcome for both water quality and fish species. Arresting of soil erosion and the degradation process in the catchment area of 33,700 hectares with a perimeter of 93.70 km (maximum width of 16.70 km) was carried out by reducing inflowing silt load. The works undertaken under Catchment Management include

- Catchment treatment in identified zones
- Limiting the building activities in the uphill catchment area
- Restoration of degraded forests through massive plantation
- Drainage line treatment through properly designed structures enforced by vegetative measures
- Fuel wood and fodder plantation of indigenous and exotic species in state and village common lands
- Supporting private efforts of raising plantations
- Forage production through silvi- pasture
- Pasture development and on-farm fodder development
- Beneficiary participation through entry point activities
- Stabilization of quarry area

The works undertaken under Rehabilitation and Resettlement Programme aimed at rehabilitation of about 6,000 families residing aboard 58 hamlets (1999) within the lake body, subsequently increased to 11,000 families in 2005. LAWDA acquired 581 Kanals (1 Kanal = 5400 sq. ft, 8 Kanals = 1 Acre) land for relocation at Guptaganga and Chandpora at a cost of Rs. 8.32 Crore in 2003, which turned out to be a green belt in city development plan. The State

cabinet approved (October 2008) the change of land-use in 2008. In the meantime, the Jammu and Kashmir Government transferred 376 hectares (7,526 Kanals) of land to the Lakes and WDA and Srinagar Development Authority (SDA) for rehabilitate families displaced by Lake's conservation work in 2007 at Rakh-i-Arth. However LAWDA had actually taken possession of only 494 Kanals till 2011 and not much has been done to relocate the families. Evidently, it disturbed the parallel project implementation and dumping of sewage directly into the lake continued.

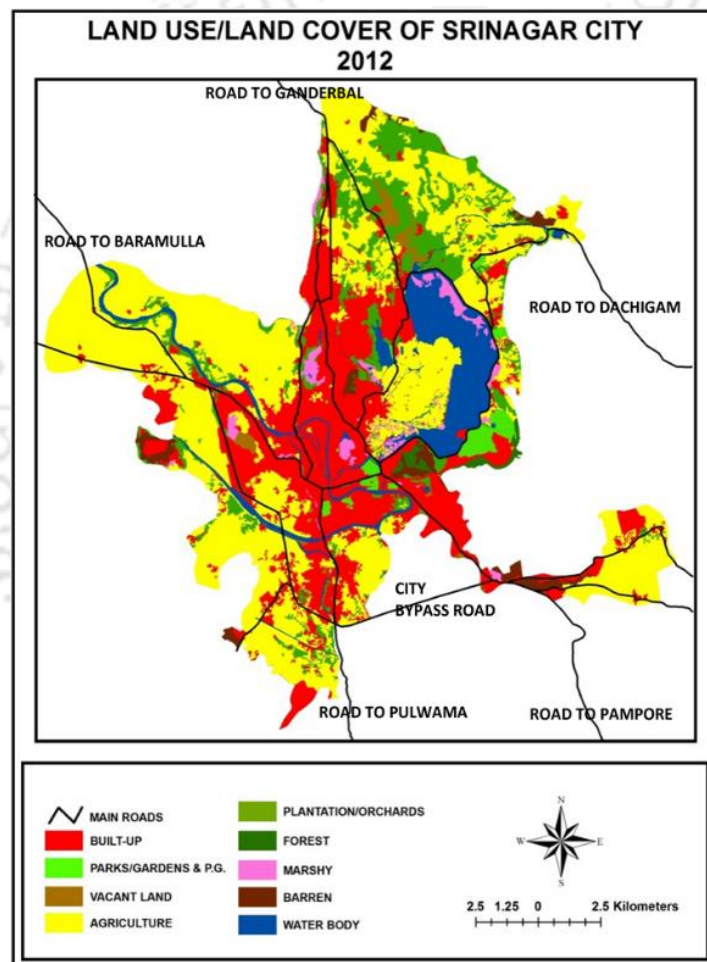


Figure 4.15: Land use Land Cover of Srinagar city 2012. (Arshad Amin, 2015)

Inferences (from DPR and Audit report by LAWDA, 2011)

Series of factors, most of them borne out of administrative mismanagement, has led to failed deadlines of the projects with a cost of more than Rs 1,000 Crore. (Qadri, 2015).

According to the audit report of the financial year 2010-2011 by the LAWDA, the DPR for conservation of the lake had not been prepared on the basis of an exhaustive investigation and survey. There was considerable underutilization of funds ranging between 32 and 60 per cent during 2006-11 due to inaction of LAWDA to execute works like house boat sanitation, infrastructure development, etc. The performance efficiency of STPs was not up to the mark (LAWDA, 2011)

With LAWDA restricting its activities only to Dal-Nigeen Lake by virtue of the State Government notification (1997), other water bodies in the State such as Wular, Mansbal, Anchar and Gilser lakes which, had suffered significant habitat and water chemistry deterioration due to unhampered human activity, had remained unattended. Though programmes for conservation and management of the Dal Lake had been in operation for some years and another for Wullar had been launched in 2011-12, yet no programme for conservation and management of other lakes had been framed/ implemented by the State Government (LAWDA, 2011).

4.3 Combined Strategies for Sustainable Urban Wetland Parks



Figure 4.16: Design with nature (McHarg, 1992), Oriented views to water

The case studies conducted were indicative of experts addressing water front design for urban wetlands with multiple and inclusive purpose. Public access to water front for both visual and physical recreation and better quality of life for communities living nearby with economic, social, and cultural benefits top the list for Planners, Designers, and Developers from all around the world (Figure 4.16). For sustainable design and better conservation techniques few contexts specific and few universal strategies were inferred from case studies. They include

- Use of Biotechnology as a better acceptance compared to chemical processes, especially for waste management and pollution control. Bio-remediation Technology as a competitive and sustainable solution for cleaning of land for construction activities, both in-situ and ex-situ.
- Different composting methods and use of biofuel like Gobar gas reduces waste disposal. This is a tested method in India.
- Phytotechnology, use of plants for detecting and reducing pollution can prove very beneficial if plant species are chosen carefully. Reed beds and Algae are good examples.
- Soil Bioengineering, in the context of upland slope protection and erosion reduction, combines mechanical, biological, and ecological concepts to arrest and prevent shallow slope failures and erosion. The innovative retaining wall construction types include: live staking, live crib wall, vegetated rock gabion, vegetated rock wall, brush mattress, wattle, brush layers and vegetated geo grid (Kumar).
- After habitat destruction, bird collision with clear and reflective sheet glass in buildings and similar structures (glass solar panels) causes more deaths compared to any other anthropogenic activity and has posed as one of the most threatened conservation issues for migratory birds (Klem, 2006). Reflective curtain walls or similar building façade design in tall structure to be avoided.
- Intervention of built environment around urban wetlands should be carefully planned considering energy and resource management, ecological design strategies and community engagement for best results.
- The developmental techniques for wetland parks include site grading, storm water management, pedestrian, vehicular and bicycle circulation including easy accessibility by differently abled.

Chapter 5

Community participation In Wetland Conseravation and Management

Community engagement has been advocated all over the world for Disaster and Risk Management, Health and Sanitation Programs, Development and Restoration projects. It has become a prerequisite for successful implementation of projects and can make a transformation. All successful projects have a few things in common; priority given to the study population, clear understanding of responsibilities and competence of the technologies used. This chapter analyses the challenges for planning failure or delay in implementations, effectiveness of participatory community system for conservation and management and highlights the integration of community participatory system and location adjustment for a sustainable development of the proposed eco-park. Few site specific cases were discussed for encouraging the population living in the fringe villages without compromising on their socio-cultural identities. This was to help articulate socio-cultural values, local knowledge and sense of ownership in planning methods and provide opportunities for tangible and coherent solutions as against conventional urban planning. A case study based model, “Sacred Groves” can be mentioned here as organic community participation. This is a community practiced method, still prevailing in nearby forests of Khasi and Garo hills of Meghalaya, which can be evolved as a conservation and sustainable method to control resource depletion and sustainable harvesting (Madhav Gadgil, 1998).

5.1 Reasons for Delay in Implementation- Stake-holders Conflicting Interest

Conflict of interest and absence of interdisciplinary activities among key government actors were identified as primary cause of delay in implementation of critical infrastructure like boundary demarcation and other developmental projects. It is evident from the protection and conservation measures undertaken during 2002-2017 (Chapter 2.4, Table 2.1) that the policy provisions government intended to adapt had multiple priorities with a common goal of C&M. They include wildlife protection and governance by the Forest Department, Planning Commission’s report to the MoEF for conservation and management to be implemented by the

state government and hydrological management under combined storm water drainage project of Guwahati city by GMDA. The wetland came under scanning by various authorities throughout the span of the study period, but was limited to policy formulation through different approaches. After a long gap of ten years since its declaration as Ramsar site in 2002, GMDA was made the single point authority for better C&M of the wetland in 2012, who then prepared the DPR to be implemented in phases along with recreational facilities and Eco-village.

Unfortunately, throughout this challenging process, the co-option of shared decision-making with the communities was not supported by any agencies. No conscious efforts were made to decentralize the environmental governance and to engage local communities. As a result, the communities in the fringe villages were misinformed about various strategies and their process of implementation, which resulted in non-cooperation among themselves and towards policy implementation. Few field exploratory observation were conducted through PRA and group discussions on resident's perceptions of ecosystem services, perceptions of quality of life, and preferences toward implementation of policies by the State Government (table 4.1). The findings indicate ignorance and non-transparency of policies. Discriminating trends in development and economic activities in fringe villages were also reported by them. Strong comments like "We will give blood, not the Beel" came from the fishing community representatives as they were misled into believing that the Government is taking away their Bio rights.

Table 5.1: Community perception towards Agencies and Conservation (Level of Evaluation: Appropriateness)

Survey question on Fact Validation	Remark
At present the conservation and management authority of Deepor Beel is GMDA. The responses were fishery, forest, municipality, Azara and Rani revenue circle.	Not appropriate
Proposed Eco-village will uplift the existing fishing villages for tourists' attraction. The villagers' perception was that Government will construct a new village. Some villagers thought that as they will be given money to construct new houses similar to the Indira Gandhi Awaas Yojana, and many will not use	Not appropriate

the money properly.	
Core area is declared as protected area and bird sanctuary. Fishing/hunting is not allowed here and in the wetland as a whole. However, unofficially, there is regular fishing activity by fishing villages for livelihood. All communities are aware of it.	Appropriate
In a draft bill, Deepor Beel was proposed as Eco sensitive zone by GMDA. There is no transparency in this state of affairs. Some villagers in the fringe area were denied approval for construction with permanent land documents (<i>myadipatta</i>). As per the communities, construction work in these areas is reeking of corruption. As many schools, hospitals were built in these areas, the fringe area is not declared as Eco sensitive zone yet. There is no existing rule to stop people to construct houses.	Not appropriate

5.2 Community Participation and Bio-rights Possibilities

Wetlands are the back bone of communities living nearby. Since time immemorial, they are dependent on these wetlands for livelihood. Blending of traditional and scientific technologies to achieve long-term conservation goals, and gender-sensitized community participation is essential for a holistic approach. As per the guidelines of National Wetland Policy, 2006 of Government of India, community participation is an important component of Conservation and Management (C&M). Participatory Rural Appraisal (PRA) should be exercised for decision-making and to develop strategies for stakeholders benefit. For C&M of wetlands located within 5 km radius of forest fringe areas, the Joint Forest Management Committees (JFMCs), also referred to as Village Protection Committees (VPCs) or Eco-Development Committees (EDCs) and are expected to play an active role (National wetland conservation policy , 2006).

The ‘Emergent Norm Theory of Crowd Dynamics’, a theory developed by Ralph Turner and Lewis Killian (1993) states that the social behavior is never entirely predictable, but with similar interests’ people come together for social change with participatory development like bio

rights. National wetland policy also advocates bio rights indicating the local community to be central in both collaborating and benefiting from natural resources.

According to Nobel Prize Winner Elinor Ostrom, common-pool resource (CPR) is a method of working together by which the resource users could establish a system that benefits everyone involved while also protecting the CPR for long-term use (Ostrom, 1990). A significant amount of academic work has explored the characteristics and challenges associated with CPRs. But this was discredited by the works done by Ms. Ostrom and showed that in her case studies sustainable CPR use is possible and has been achieved in many areas. This has enabled those groups to continue enjoying the benefits afforded to them by those CPRs while ensuring that the commons will continue to benefit future generations (Elinor Ostrom, 1994). The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) was adopted on October 29, 2010 in Nagoya, Japan. Its objective is fair and equitable sharing of benefits arising from the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity (Harry Jonas, 2010).

Bio-rights are an innovative financing mechanism for reconciling poverty alleviation and environmental conservation. By providing micro-credits for sustainable development, the approach enables local communities to refrain from unsustainable practices and be actively involved in environmental conservation and restoration. Micro-credits are converted into definitive payments upon successful delivery of conservation services at the end of a contracting period (Eijk & Kumar, 2009). South Asian Forum for Environment (SAFE) successfully installed India's first Bio-rights project at East Kolkata Wetlands, only Ramsar site of West Bengal in year 2007 and handed over the project to the community in 2009. The programme was funded by DFID (UK) through Municipal Affairs Department, Government of West Bengal. The conservation paradigm had a Bio-right component that extended group micro insurance coverage to the waste water fishers of East Kolkata Wetlands. The project has been showcased in the 4th TEEB (The Economics of Ecosystems and Biodiversity) report of UNEP as a best practice conservation effort in 2010 (South Asian Forum for Environment, 2015).

5.3 Social and Community Benefits (Human Capital Development)

The Union environment ministry has set up the National Plan for Conservation of Aquatic Ecosystems to aid the protection and restoration of wetlands with the dominant theme of

better livelihood through conservation, but not at the cost of degrading the wetlands. Watershed programmes of Natural Resources Management (NRM, XI Five Year Plan, 2007-2012), highlighted Community Forest Management (CFM) in collaboration with watershed committees and village *panchayats* to ensure maintenance of forest, watersheds and common property resources. The NRM working synthesis stated that many treated natural areas in the past are short lived and often reverted back to degraded condition due to lack of focus on productivity improvement and on livelihood component under the watershed programmes. Along with forest and water conservation, sustaining local people's interest in conserving the natural resources for their livelihood is a precondition for management of natural resources (Planning Commission, 2007). The impact of successfully completed watershed development projects by NABARD in India, include income for landless poor, availability of drinking water and fodder with socio economic development of rural communities through income generation and livelihood enhancement activities.

The State Level Nodal Agency (IWMP), Assam was constituted in 2008 and is responsible for overall Planning, management and monitoring of Integrated Watershed Management Programs (IWMP). It is constituted with Representatives from the central and state government including educational and scientific research organizations. Their Integrated Watershed Management project completed since 2009 emphasized on protective afforestation, pasture development, scientific agriculture through various soil conservation measures, harvesting of rainwater and runoff water, distribution of water to agriculture field, Horticulture, Pisciculture, Sericulture, Piggery, Poultry and Dairy Development with training and environmental motivation programmes.

5.4 Discussion and Analysis

The socio-cultural data of the fringe villages collected through the PRA method was instrumental for identifying the cultural and indigenous practices of the wetland resource utilization and bio-rights possibilities. The findings revealed very little progress in behaviour and institutional change at the local level, particularly to the wetland's degrading ecosystem and the communities from the fringe villages. Observation from site specific study, meetings and FGDs held with different communities around the wetland revealed facts supporting non-cooperation from the communities and call for a better social control. Misconception about the development

policies, and the consequences were evident. Awareness campaigns and workshops for conservation, protection and development of the communities by the NGOs and CSOs were also found to be short lived.

5.4.1 PRA Recommendations

The respondents of PRA including aged and female representatives of all villages recommended consensus building approach as an alternative to dispute resolution to develop participatory involvement towards protection, conservation and design decisions of Eco Park near the wetland. Initially, meetings were conducted engaging representatives from fringe areas separately for trust building. With guidelines from Community Action Plans of UNDP and Sustainable Development Goals of United nation-India, contextual parameters for a community action plan were sketched (Figure 5.1). This was conceptualized from the output of PRA and recommendations from all relevant stakeholders including government agencies, to help consensus building for implementing community change and institutional steering of policies.

The outcome of community plan and willingness to work together was communicated by them separately. As an initiative on consensus building to settle conflicts involving multiple communities and issues, a social plan was made by the author and two students of IIT Guwahati, to train local youths as tourist guides with the help of Rongman society, a NGO from Deochotal village, having conducted a birding workshop for local youths. This yielded a positive result from all section of the communities and it was certified by the social club of IIT Guwahati as the best proposal (March 25, 2017). A total of 15 youths were selected for the first training, was to be held in December 2018 but delayed till end of 2019. It was mutually agreed that the tribal community representatives would be guided by the social activist's group Rongman society and the fisherman communities would be led by the executive members of Pass-para committee.

Dividing the communities for assigning different roles in conservation and management was another important suggestion by the villagers from diverse communities and was backed by the FGD of organizational stakeholders. Ramsar handbook (2010 edition) on "Participatory Skills: Establishing and Strengthening Local Communities' and Indigenous People's Participation in Wetland Management" described local community control of wetland areas and delegation of management responsibility from government to local community as community participation mechanism, where involvement is in the highest order (vol-7, p-37). Danau

Sentarum wetland in Indonesia, has the local community control, with limited government influence while Nobel laureate Elinor Ostrom mentioned in her book “Governing the Commons” (1990) that meaningful and appropriate involvement and other contextual parameters like administrative and ecological situations are also equally important.



Figure 5.1: Concept Map for Preparation of a Community Action Plan (context specific)

Willingness towards Bio-rights (Figure 5.2) was evaluated through a simple process of raising hands in community meetings held in different locations. Total number of respondents was 57 (Table 5.2).

Table 5.2: Profile of the Respondents

Location	Respondents		
	Male	Female	Total
Keotpada: PRA meeting of fishing villages including Paaspara committee members (5)	16	5	n=21
Tribal villages: Meeting at Parijat Academy. Pamohi-6, Maghoapara-3, Mikirpara Chakordeo -4, Pamohi-6, village head (Sarpanch-1).	15	5	n=20
New settlers: Meeting at namghar (temple), Tetelia,	6	1	n=07
New settlers: Meeting at Boragaon	5	4	n=09

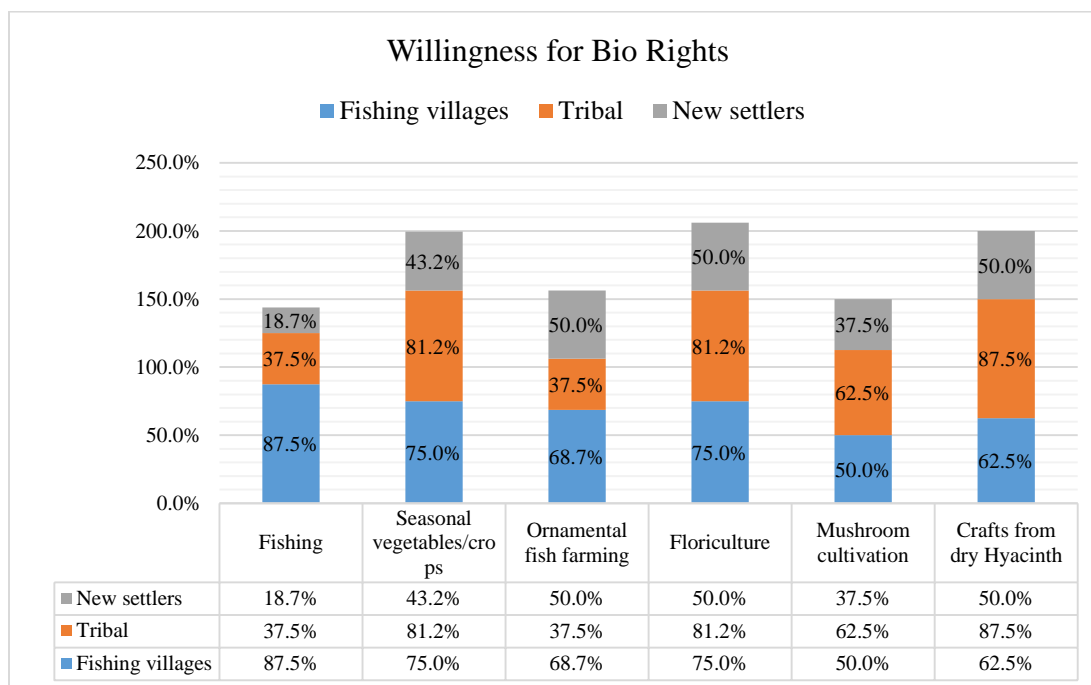


Fig: 5.2: Results of Willingness towards Bio-Rights (n=57)

The fishing communities favored all possibilities for bio rights, except mushroom cultivation. The diverse tribal communities favored agriculture, floriculture and craft making as against fishing. The new settlers had interest towards economic activities as alternate livelihood for ornamental fish farming, floriculture and crafts (50%). This establishes their partial dependency on the wetland. Non-willingness for fishing as bio rights by tribal and new settlers further justify the age old conflict between the communities.

5.4.2 FGD Inferences of Primary Stakeholders (refer Annexure 7 for FGD details)

On site FGD of primary stakeholders was held with the representative from the fishing villages and members of the “Deepor Beel Panchpara Samabai Samity” (cooperative society of 9 villages of fishing community) on March 15, 2015, Guwahati. The objective was to verify the Socio-cultural and resource mapping done through PRA, present fishing system and stakeholders’ interests. Members present were:

- 1) Mr.Golok Das, President, Keotpara village committee (Hirapara, NatunBasti and Keotpara), also advisors to the Panchpara Samabai Samity”

- 2) Mr.SaratDas, the village head, Keotpara
- 3) Mr.Baputi Das, (Member, “Deepor Beel Panchpara Samabai Samity”)
- 4) Mrs.Basanti Das (Member, village committee)
- 5) Mrs.Jyotshna Das (Member, village committee)
- 6) Mr.Sambaru Chandra Das (Senior villager, retired employee of Indian Railway)
- 7) Mr.Debendra Das (Keotpara villager and president of Scheduled caste committee of Ramsarani Mouza)

Inferences of the FGD are:

The village committee has Financial (penalty and donation), Judicial and Developmental authority and villagers abide by these rules and regulations. Revenue generation through Community fishing and “Beel-bice” (leasing), fish culture (with subsidy from the fisheries department) and micro credit system are handled by the cooperative committee. Use of non-conventional energy is nil. Women are engaged neither in economic activities, nor in Self-help Group (SHG). For conservation purpose, fencing in the Beel are constructed by the villagers to restrict picnicking and over fishing. All hamlets in the fringe areas have rights to fishing for personal use. All villagers are not in favor of declaration of these villages near the wetland as environmentally sensitive zone. They have a strong lobby of politics due to non-transparency with Government agencies. They have vehemently commented “we will give blood, not the Beel”.

Chapter 6

Design Research: Sustainable Development and Human Design

Literature review of the wetland and the fringe areas, study and analysis of community-based participatory C&M, bio rights and evaluation of case studies were instrumental for this context-specific-design-research. Detail analysis on communities, urban growth pattern, proposed DPR on C&M and the socio-cultural values were accomplished to create a baseline for the built environment to plan and design the proposed recreation & Eco-tourism.

The International Eco-tourism Society (TIES, 1990) describes ecotourism as "Responsible Travel to Natural Areas that conserves the environment and improves the well-being of local people." The concept of urban eco-tourism has been refined and agreed upon as "an ongoing opportunity to conserve biological and social diversity, create new jobs and improve the quality of life" (First Urban Ecotourism Declaration, 2004) with four principal goals:

- Restoring and conserving natural and cultural heritage, including natural landscapes and biodiversity and indigenous cultures
- Maximizing local benefits and engaging local communities as owners, investors, hosts and guides
- Educating visitors and residents on environmental matters, heritage resources, sustainability
- Reducing the ecological footprint.

Above mentioned objectives are also parts of the 'Sustainable Development Goals' (SDG), an initiative by the United Nation's 2030 Agenda. Habitat III, the new urban agenda released at the United Nation's Housing and Sustainable Development Conference in Quito (2016) that proposed to promote a global-capacity building program targeting different urban stakeholders and urban institutions, particularly involving vulnerable sections of society. This also suggests that for effective and demand-driven results, capacity building needs to be closely

linked with development objectives. Based on the ongoing rapid urban transformations in the fringe areas of the wetland, both ways capacity building involving communities and the institutions will be effectively used here.

Keeping these goals of the United Nation as guidelines, a site-specific concept map (Figure 6.1) was prepared from the outcome of Literature Review, PRAs and FGDs conducted. These factors will help to prepare suitable plans for sustainable use of resources for the built environment and landscape regeneration, a part of integrated urban planning.

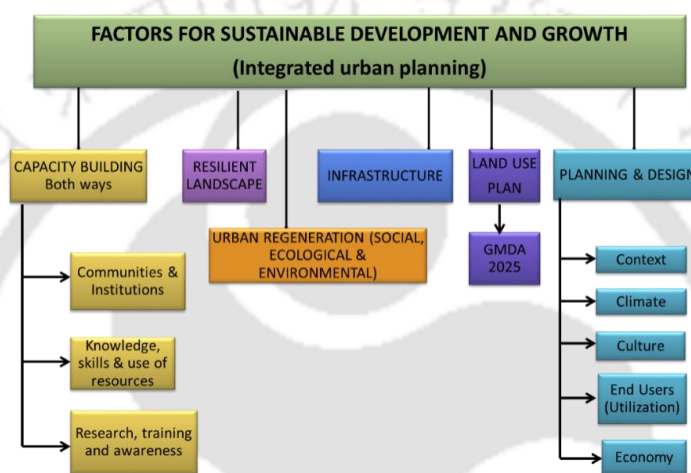


Figure 6.1: Concept map showing factors considered for context specific built environment and integrated urban planning (Simon Eisner, 1993)

6.1 Demographic analysis

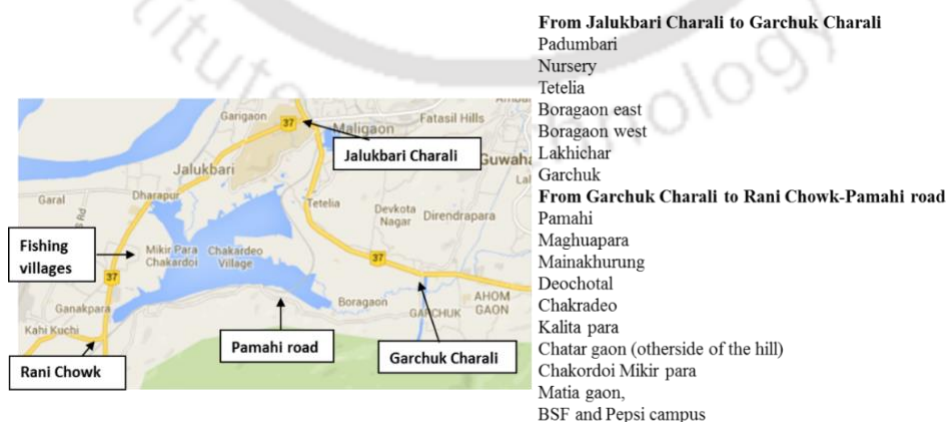


Figure 6.2: Location of villages and settlements around Deepor Beel (www.maps.google.com)

The wetland is surrounded by settlements and villages that fall under the city limit. These are mostly indigenous tribes and fishing communities including new settlements along highways (Figure 6.2). Mixed land use of residential, commercial, institutional and hospitality are seen in this urban segment. There is an Integrated Municipal Solid Waste Management Project at Boragaon, about 1.5 km away from Deepor Beel and 1 km away from NH37. Stone quarries are seen along the Rani-Garbhanga Reserve forest on the south side of the Beel. Many upcoming industries, the Mother Teresa Hospital, schools and several medicinal and aromatic plant nurseries are part of the new construction in this belt. The transport network consists of National highway 37, PWD (pitched) road connecting the southern part from Garchuk to Rani. Besides, a few other minor earthen roads and tracts also exist in the vicinity of the wetland (Figure 6.3).



Figure 6.3: Transport corridors around the wetland (photographed by author)

6.1.1 Population and area

The wetland covers 10.1 km² extended to 40 km² of swamp area when flooded (Assam State Flood Control Department records the area as 54.89 km², 2007). As per the National wetland atlas (2011), wetland area is 5.89 km² with open water area as 3.53 km² and 1.05 km² in post and pre Monsoon seasons respectively (page 231, table 10). The GIS calculation by GMDA for preparing the amended DPR (2014) and by the author (2015) found the wetland area as 10.1 km².

As per the proposed master plan 2025-Phase-1, the Pamohi village near the wetland will be included in the metro limit under special scheme along with other villages in the three new town areas. A total of 66km² will be added to the existing metropolitan area (262 km²) of Guwahati city under this scheme (Figure 6.4).

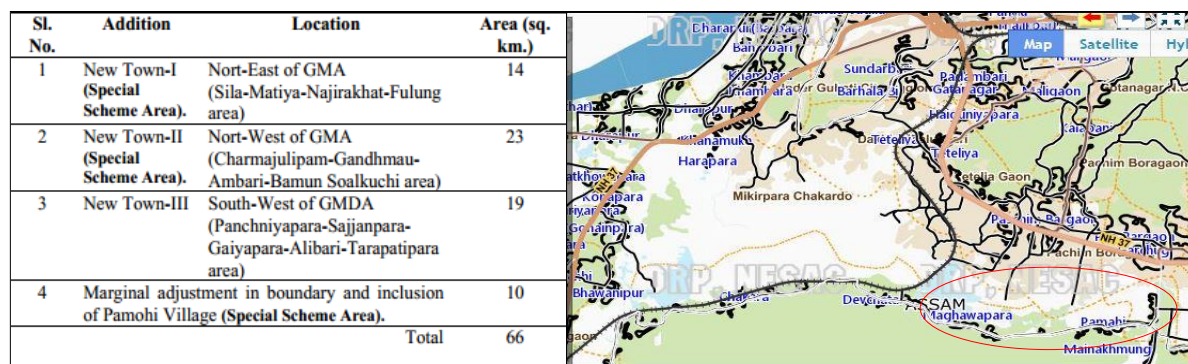


Figure 6.4: Table & Map shows the addition of the new town in the master plan 2025, GMDA, phase-1, including Pamohi village (Sl. No. 4)

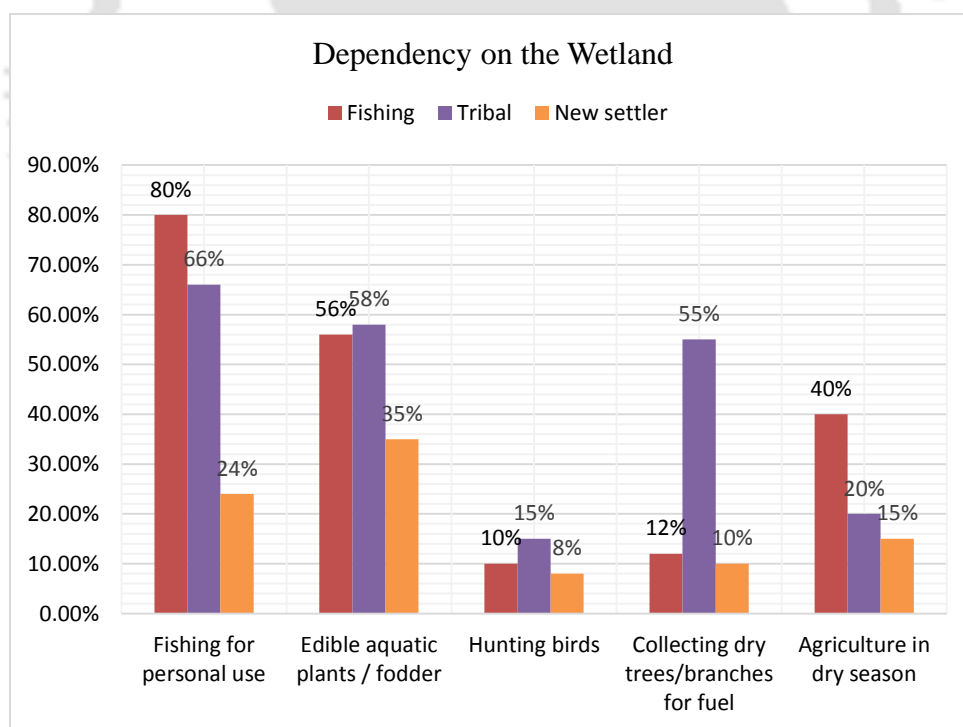


Figure 6.5: Graph showing dependency on the wetland area. (Based on PRA data)

Dependency of the community from the fringe villages on the wetland was also calculated in percentage. This was done during the PRA exercises and meetings to assess the

utilitarian importance of the wetland (Figure 6.5). The new settlers have very low dependency on the wetland.

6.1.2 Urban Growth Pattern

The population in the fringe villages towards North and the South side is in the range (numbers) of 1-4900 and consists of a moderate range of 4910-9819 towards West, South-West and North-West, based on 2011 census (Figure 6.6). The total population of 14 villages around the wetland is 4137 families, based on a study of North Dakota State University (NDSU case studies, 2007).

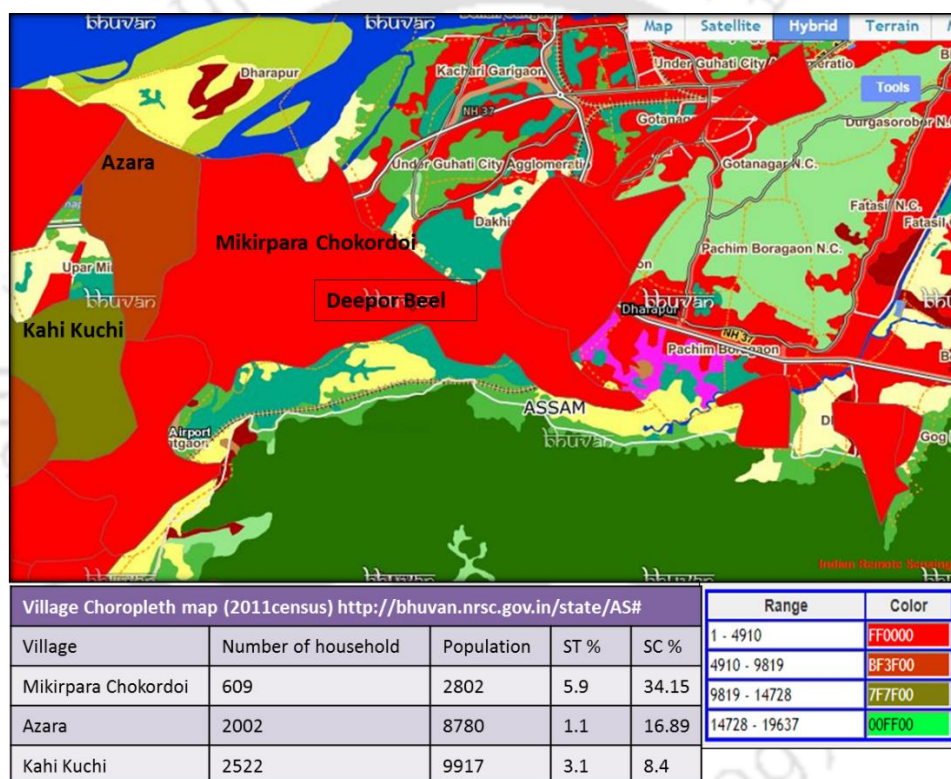
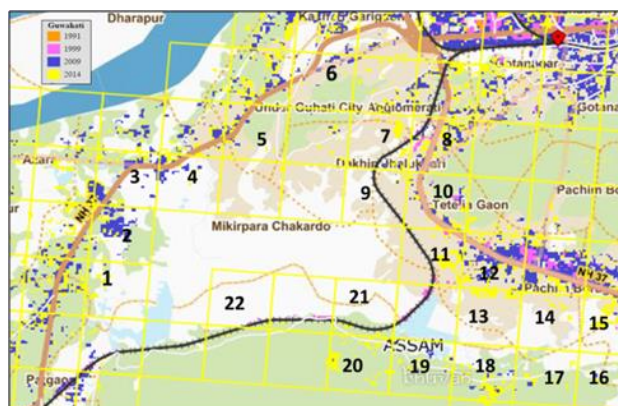


Figure 6.6: Choropleth map showing average Population (Bhuvan NRSC, 2012)

To estimate the urban growth pattern, fringe area was divided into a grid of 1km x 1km layering the map. The growth pattern in percentage was retrieved from NRSC online calculation and compared (Figure 6.7). The results clearly indicate that the new settlers' growth is the highest along the highway NH 37 on the SW and East side with an increase of 16.83% during 2009 and 2014. An increase of 2.97% was in the fishing villages in the West and a minimum increase of 0.18% on the southern villages in the same duration.



Urban growth monitoring (Percentage) 1grid=1sq.km. (city code: AS_01. Source: ISRO)																						
	Dharapur-Azara- Jalukbari					Bypass road: Jalukbari-Basishtha										Pamahi-Garbhanga						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1991																						
1999							0.45	4.50		1.71	1.53	5.31			0.27	0.09					0.27	0.45
2009	0.27	17.55	16.11	6.39	6.12	5.22	1.08	21.15	0.26	14.58	3.6	37.26	0.09	0.09	4.41	2.07	0.27	3.42	1.71	0.18	0.27	0.45
2014	4.21	23.31	24.48	11.07	12.6	8.19	7.92	36.36	2.16	21.42	13.5	51.39	7.83	2.61	21.24	5.4	4.95	14.94	6.84	12.42	4.41	0.63

Figure 6.7: Depiction and comparison of the urban growth patterns around the wetland using satellite data (Bhuvan NRSC, 2012)

6.1.3 Wetland Perspectives and Semiotic Analysis of Socio-Cultural Values

Wetlands are the backbone of communities living around them. From time immortal, water has been a vital commodity for the existence and well-being of life. Water has the power to destroy as well as to create. Carl Gustav Jung, a Swiss psychologist, influential thinker and founder of Analytical Psychology referred to water as an archetype: a symbol of life, cleansing and rebirth—a strong life force, and is often depicted as a living, reasoning force. Like many other things, signs and symbols in water imagery convey different messages in different context, cultures and to different people. The meaning of the Deepor Beel wetland is different for the casual observer and the residents actively engaged with it. Previous studies by various organizations (Planning commission 2008, North Dakota University 2007, Aaranyak 2003) have investigated this wetland, predominantly for biodiversity, ecological, scientific and aesthetic values (tangible). None have talked about the culture and heritage of the communities (intangible) living around it, and what the wetland means to them.

Wetland Management Strategies often ignore cultural values and in some cases contribute to their loss. By integrating cultural and ecological diversity in wetland management,

we can achieve a complete understanding of human ecological relations for a better management. (Nicholas, 2001). Detailed study and analysis of water imagery in the context of indigenous people living around this wetland and their cultural adaptation process will have implications in the sustainable management (cultural resource management-CRM) and conservation of culture, along with bio-diversity conservation and development of tourism. A Semiotic Analysis was done from the literature sources and meeting village representatives (uncontrolled observation), to understand the meaning of water in various socio-cultural aspects and their influences on water imagery of people in general.

Religious belief of the locals, their psychology, literature, art and architecture, are all based on the central meaning of water - without water there is no life. They believe that water is a sign for birth and death and possesses a purifying force. The Koch, Kalita, Karbi, Boro, Nepali, Rabha and Muslim (Bengali and Assamese) communities living in these villages practice many unique rituals related to water - they use sanctified water for purification after child birth and even after funerals.

Some unique water imagery in rituals, among the communities includes:

Karbitribes celebrate the '*Rongker*' festival and worship to be free from diseases and natural calamities for the entire year, they pray for a good harvest too. *Langhe Rongker* is the concluding part of *Rongker* performed near a bathing "Ghat" (place for bathing on the river-bank or pond) to prevent tiger attacks (Valentina Teronpi, Ethnozoology of the Karbis of Assam, India: Use of ichthyofauna in traditional health-care practices, 2012).

Rabha tribes celebrate a traditional prayer called '*Langa*' or '*Dinga*' puja. In this puja, all the materials used in the puja are placed on a *dinga* or boat. The *dinga* is then carried to the river bank and the rituals are performed and at last the boat emerges on the river. They have a unique dance form named '*Nakchung Reni*' to celebrate fishing in the forest rivulets or water bodies. Rabhawomen of all ages take part in this dance whole-heartedly (Raha, 1989). They also practice traditional health care with herbs and water, placing faith in the healing power of water.

The festival calendar (Table 6.1) prepared as the ice-breaking session by the villagers in PRA shows the belief systems of these fishing communities around the wetland.

Table 6.1. Festival calendar of fishermen communities prepared during PRA

January	February	April, May	June to September	November
MaghBihu	Saraswati Puja, Shin Puja	BohagBihu, HewariUtsav: Purnalengia (Pig, pigeon, cock worshiping) & Ganga Puja (starting of rainy season)	Baat Puja (Bhagawati Puja), Bhel Puja (Worshiping Banyan tree to bring happiness) & Manasha Puja (Marai Puja)	Kati Bihu

6.1.4 Socio-economic Analysis

A socio-economic survey was conducted along with PRA in a scheduled format to assess development patterns of village over the years on selected indicators, specifically in employment, education, health and crime sectors. The schedule was in the form of checklist i.e. 'yes/no' responses and filling up information/data by the group administrators (Annexure 4A). This was verified by questionnaires and interviews with village heads, local environmentalists and social activists. The profiles of the respondents and the summary of the socio-economic profile are shown in table 6.2.

Table 6.2. Summary of Socio-economic Profile (n= number of people/number of villages)

Parameters	Percentage (%)	Remarks
Employment (number of people with permanent jobs)	Male: 33 Female:11	Average of percentage in 9 villages
Employment (number of people with temporary jobs, daily wages laborer)	Male: 28 Female:6	Average of percentage in 9 villages.
Employment (number of people engaged in agriculture)	Male: 22 Female: 17	Average of percentage in 9 villages
Employment (number of people without any income)	Male: 18	Average of percentage in 9 villages. Female temporary jobs like working

	Female:6	in fields.
Education Facilities (primary and high school, number of villages)	Primary 78.5 Elementary 36 High school 21	In 14 villages Primary school -11, elementary schools – 5, high schools-3
Health Facilities (clinics/ dispensaries/ health centers, number of villages)	21	In 14 villages Public Health Center 3 and one 30 beds hospital in Azara
Crime rate (number of villages)	12	Average of percentage in 9 villages

6.2 Analysis of Detailed Project Report (DPR, Deepor Beel)

A Detailed Project Report was prepared by Architect Prem Choudhury and associates, New Delhi (2012) and vetted by the Center for the Environment, IIT Guwahati in 2013 for Guwahati Municipal Development Authority (GMDA). This was part of the project 'Restoration and Development of three water bodies in Guwahati'. Another revised Proposal for five year project for Restoration, Conservation and Development of Deepor Beel, including Eco-tourism was also submitted by the GMDA with a detailed item-wise specification and estimation. Both the proposals were studied and analyzed for the preparation of planning and designing a sustainable Eco-Park with a humane approach. The checklist for formulation of a Management Action Plan was adopted from the Conservation division-I, MOEF, Government of India, 2007 (Annexure 6).

Considering all the ecological biodiversity like aquatic vegetation, water-birds, lizards and migratory birds and habitat like mud flats, paddy fields, dry grass land, Village Grazing Reserves (VGR), marshy lands and scattered forest - the inflow-outflow pattern of rivers and wetland was divided into 4 major zones:

- Protected Core Area
- Riparian Buffer
- Conservation
- Project Activity zone (Figure 6.8).

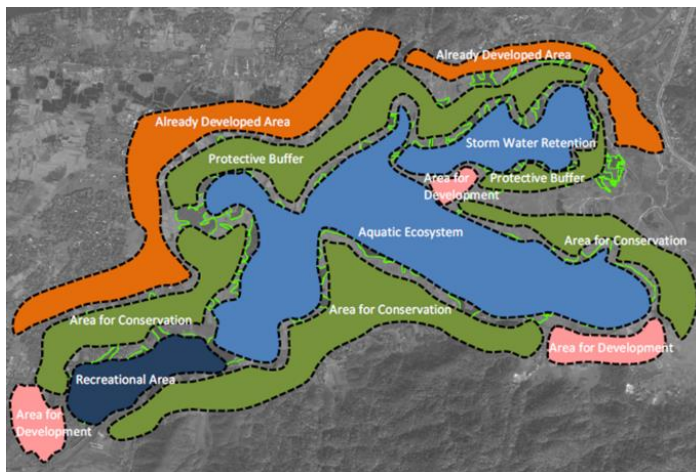


Figure 6.8: Preliminary Zoning as per the DPR (p-10)

Details of geological and climatic features with baseline data on soil type, silt extent, weeds, land use and land cover types were analyzed and considered in planning, though the range and variety of biodiversity was not specified in detail.

The DPR planning was aimed at human wellbeing, poverty alleviation, maintaining ecological character and biodiversity. It included effluent and waste management and ground water recharge along with proposals for recreation, research and development. About 35 villages around the wetland were identified to be encouraged for sustainable practices of operation and maintenance and wise use of the wetland resources. An eco-village proposal was added especially for socio-economic benefits and tourist appreciation in the fishing villages. Implementation strategies for all activities were divided in phases as shown in figure 6.9.

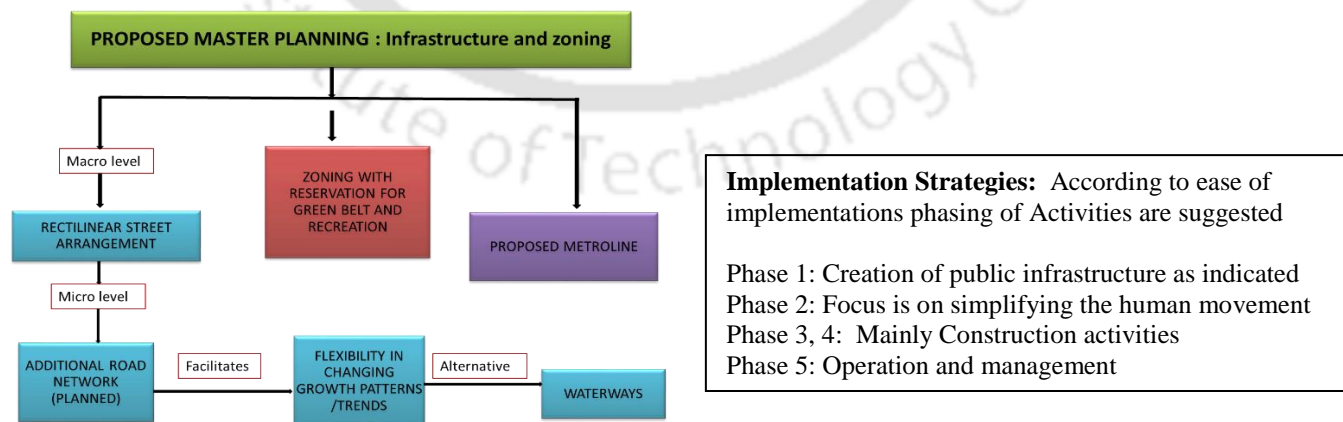


Figure 6.9: Concept map showing the analysis of the infrastructure and implementation strategies of the proposed DPR

6.3 FGD with Secondary Stake holders: Results and Analysis

A Focus Group Discussion (FGD) with secondary stake holders was held on Jan 12, 2016 (3pm to 6pm) at the seminar room of Center for the Environment, IIT Guwahati, under the able guidance of Professor Chandan Mahanta (IIT Guwahati). The topic of discussion was “Conservation and Sustainable Use of Wetlands in Urban Areas with the help of Community Participation (Bio rights possibilities) - Proposed Eco Park near Deepor Beel, Guwahati.” The goal of this FGD was to analyze all stakeholders’ attitudes and opinions about wetland conservation, with emphasis on obstructions to conservation behaviors as the cause of delayed progress. Few site-specific cases for encouraging the population living in the fringe villages without compromising on their socio-cultural identities were discussed to highlight the integration of community participatory system and location adjustments for a sustainable development of the proposed eco-park through the analysis of planning and conservation approaches. In all, ten participants from different stakeholders involved, took part in the FGD (Annexure 7). All the participants were asked about their working / research experiences in this field, their valuable suggestions / opinions to upscale the initiative taken for the conservation and the proposed Eco Park. The outcome was aimed to help articulate socio-cultural values, local knowledge and sense of ownership in planning methods and provide opportunities for tangible and coherent solutions as against conventional urban planning.

The esteemed members of the FGD (Figure 6.10) unanimously agreed that there should be a separate Water Body Development Authority under GMDA (or Government of Assam) for the implementation of this master plan. They suggested that awareness building with transparency by the government agencies will act as a strong catalyst. Though the state government was planning to form a Deepor Beel Management and Development Authority in 2010 with the provision of the Wetland Conservation and Management Rules for maintenance of healthy hydrological connectivity of wetlands, it did not materialize.

The current provisions for water body and community development in the DPR and the master plan (eco-park) should be made transparent to the communities. Their representatives should be engaged in analyzing and verifying the relevance and appropriateness of proposed interventions. This will help in gaining their confidence and strengthening their cooperation for the proposed development. There should be a board of advisors (consultants) from all

stakeholders, including prominent researchers / research organizations, banks, NGOs, specialists like socio-cultural analysts, geologists, environmentalists and community representatives with GMDA's Water Bodies' Development Authority for articulate and fast implementation of the master plan as preparation or amendment of master plan is a long term process. The delay of implementation will further interrupt the conservation of the wetland, which is already facing the anthropogenic stress and on the verge of being in the risk of removal from the Ramsar list.



Figure 6.10: FGD members at IIT Guwahati

6.3.1 FGD Recommendations and Suggested Solutions for the Future

Recommendations for Increased Community (Stakeholders) Participation:

- Unity among various tribes and fishing communities will generate opportunities to resolve conflicts and obstacle for conservation and management of the wetland. This will eventually help to address negative social and environmental impact like rapid expansion of stone quarries and destruction of forests.

- Bio rights schemes and micro-financed projects with banks (e.g. NABARD), SAFE water and other public private support will improve ownership spirits and willingness to share costs, commitments and human resources. Other than fishing, some of the schemes suggested include weaving, animal (goat, hen, pigs) rearing, growing seasonal crops with proper planning, market study and ensuring the equal distribution of project benefits.
- Several tons of plant waste is generated every year after removing the water hyacinth from the wetland for gaining additional depth to increase water retention capacity. Municipal development authorities have not identified any dumping place for this till date. Possibilities of bi-products are suggested through organizations like North-Eastern Development Finance Corporation Ltd. (NEDFiHaat) with community participation and training.
- Utilization of local knowledge based on field experience will help in social learning and capacity building for economic development activities. All economic projects should be planned as per the stakeholder priorities and needs. A relevant suggestion was that fishing communities should be given priority in fish-culture and the tribal communities on the southern border should be engaged in other micro finance options.
- In the Detailed Project Report (DPR) on Deepor Beel, a sizeable amount of finance has been approved for improvement of the fringe villages. All villagers will be given similar houses near the Beel and for improved tourism prospect a fisherman village model will be adopted. A separate eco-village will be constructed and three locations are identified for tourism hub. The Forest department will be provided with facilities for better operation and management like night-viewing boats and a forest range office will be constructed. The Village Grazing Reserve (VGR) land in the periphery of the wetland located within the zone of influence, has not been utilized for a long time, hence this land will be maintained and preserved. Dredging will be done to widen the Beel and dredgers have already been bought. The Guwahati Metropolitan Development Authority (GMDA) has prepared a master plan 2030 and both the DPR and the master plan have been approved and ready for implementation. The development of Deepor Beel (5 water bodies and 3 rivers in Guwahati city) is part of this master plan.
- Transparent policies by the government will strengthen stakeholder's participation for a sustainable Operation and Management.

Recommendations for conservation and management:

- Further selling and buying policy for land around the wetland and its flood plains should be amended by the government with the help of community intervention. A need-based survey is suggested here. All encroachment should be removed and activities like agriculture, fishing should be encouraged.
- Provision of the 'Elephant Corridor' comes under the Central Government and the railways department. As part of an eco-proposal and Wild Life Conservation Plan, an 'Elephant Corridor' should be identified and demarcated by the Forest Department with immediate effect to stop the increasing man animal conflict and destruction of crops and life. The state government can extend help with land revenue. A railway tunnel is a possible solution to create wildlife corridor on a natural slope from hill to the wetland.
- There should be no digging for siltation without proper technical intervention (3 people currently lost their lives). Expert geologist and ecologist should be engaged to keep a check on humus content and type of soil suitable for digging / dredging.
- Five Ramsar sites were proposed in February 2001 (amended in 2002) and only Deepor Beel was declared as a Ramsar site in the same year. Though the Beel area mentioned in the Ramsar list is 40² km (Ramsar, 2017), the actual wetland area at that time was 27²kms. Experts agree that for a realistic reassessment of the Beel area, the changes in land-use and land cover pattern should be done with the help of GIS and all Beel areas should be corrected in the original lists otherwise it will be calculated as a reducing area of the wetland.

Recommendations for Tourism appreciation (responsible tourism and sustainability) were as follows:

- Provision of house-boat facilities will be lucrative in the stretch from Deepor Beel to Khandajaan sluice gates, which has a splendid view.
- Ornamental fish aquariums to display the wide variety of fishes available in the wetland and other wetlands in the city.
- A flower house/museum to display rare flowers of the North-Eastern regions.
- Trekking opportunities by linking wetland with the Rani Garbhanga forest.
- Deepor Beel festival to promote cultural identity

6.4 Interviews and Recommendations

The objective of the interviews was to collect strategies backed by expertise and local knowledge that would help in meeting more structural decisions. There were few instances of repeated interviews with the same person for a better understanding of the topics discussed. Brief biographies of the interviewees can be viewed in Annexure 4 with a sample questionnaire.

Recommendations on Nature Conservation and Landscape Regeneration:

"The Man Who Planted the Tree," a fiction, also known as The Story of Elzéard Bouffier, written by the French writer Jean Giono in 1953 created great influence over its readers, so much so that many took to tree plantation seriously. This is a story of one shepherd's long and successful single-handed effort to re-forest a desolate valley in the foothills of the Alps in Provence throughout the first half of the 20th century. The tale is rather short—only about 4000 words long and was composed in French, but first published in English. Many people from all over the world followed this story with conviction, including Mr. Jadav (Moulai) Payeng, a missing tribal man from Jorhat, Assam, single-handedly planted about 1500acre of forest in sandbar of the river Brahmaputra near Kokilamukh, Jorhat, Assam in 30 years. His next dream is to create a similar forest in the sandbar of river Brahmaputra to join Kokilamukh and Majuli Island, with a stretch of green corridor.

In the context of Deepor Beel, Mr. Jadav Payeng recommended planting of elephant fodder in the forest nearby. This would curb animal infestation in the human habitat. To nurture the plants and sustain the project, a sense of ownership would be developed from the active participation of the local communities including children and women. He has also shared his success of the Corridor-Patch Matrix Model that he adopted to join the Moulai forest to the island of Majuli with a forest corridor developed solely by him.

Mr. Laxman Teron, a well-known Conservationist and Environmentalist recommended planting elephant fodder in Garbhanga forest and planting trees (Simolu, Bombaxceiba) for bird nesting (Greater adjutant Stork). He also stressed on providing 'Elephant Corridors' and defining speed limit on the roads at foothills to avoid accidents. Mr. Punya Das, President of

Deepor Beel Panchpara Cooperative Society also recommended and supported the same. He added that elephants clear the congested water body and are thus crucial for fish growth.

Recommendations on Bio-diversity Conservation and Management:

Dr. Prasanta Saikia, has a vast range of experience and several research papers on bio-diversity conservation and management—he guided us with details of the flora and fauna of Deepor Beel and all surroundings. Since his association with wetlands has been since 1989, he has analyzed rather subjectively all of the conservation and management schemes put forward by the government – commenting on their successes or failures. His recommendations include community involvement, removing all encroachments (Mother Teresa hospital was the first encroachment), planting trees as promised at the time of railway construction by the government, encouraging agriculture and fishing and discouraging any kind of construction. The inferences for wetland conservation and management from FGD, interviews and PRA are shown in the Concept Map below (Figure 6.11).

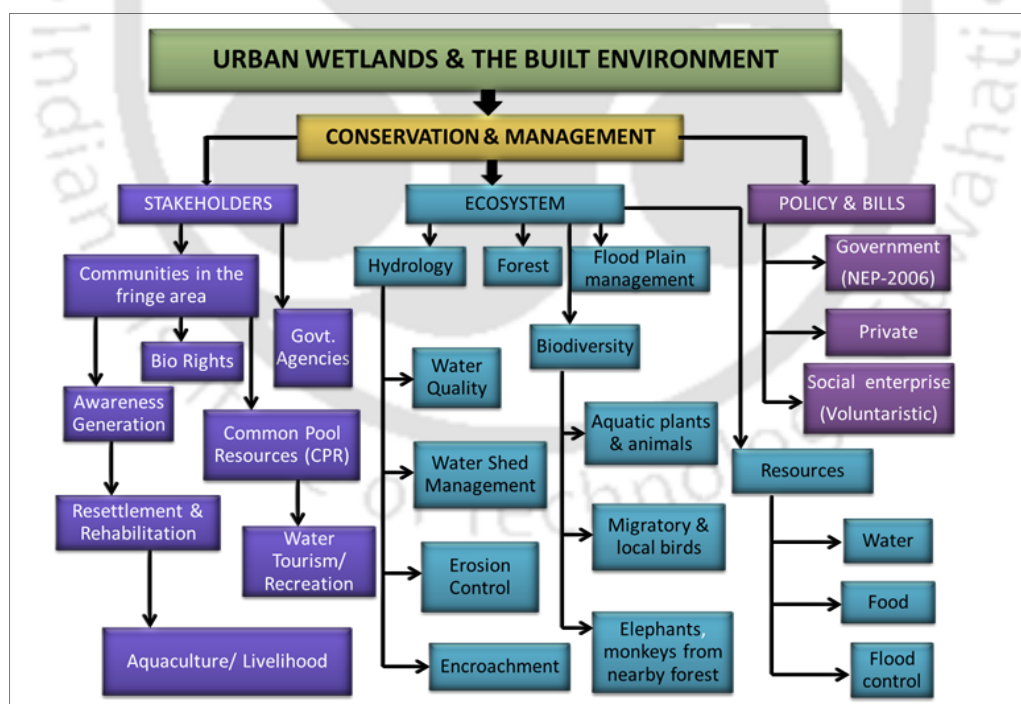


Figure 6.11: Concept map showing Deepor Beel Wetland Conservation and Management Concerns (sources: Case studies, PRA, FGD & Interviews)

Recommendations for ecotourism and consensus building:

Mr. Uttam Terron, founder of Parijat academy and pioneer of free school education to the tribal populations living in the fringe villages has shown concern about the growing visits of foreign tourists to this wetland but limited availability of tourist guides to attend them. The number of foreign tourists travelling to the wetland who came to him are about 10 per year. Similarly the number of foreign visitors coming to the Rongmon society and to environmentalist Mr. Luxman Terron are also 10 each per year (a total of 30 tourists per year on an average). These are the only three entities available who can communicate with foreign tourists around the wetland other than the forest department of the state government. They also hold workshops, training and festival celebrations to cater to the domestic travelers. Though there is no record of domestic travelers (roughly cited as average 5-10 in a week), many school children come for nature camps and stay at this school. Other than the eco-tourists, on an average very few local people visit the wetland in week days but the numbers are almost double during weekends and holidays (about 20 to 50, interview of local sources). The Eco tourists are taken for activities like guided tour around the wetland, bird watching, home stay in villages, nature workshops, research of plants/medicinal plants, boating & fishing in the wetland, forest trekking and elephant herd watching in their natural backdrop. Rongmon society has about 8 trained tourist guides who can cater to this particular spot as well. An action plan of tourist guide training was worked out to build communal harmony among the tribal and fishermen populations using feedback from FGDs and

Community consensus building in the fringe areas of Deepor Beel, Guwahati:
Tourist guide training- Empowering youth for social cause

Day and date	Morning	Afternoon	Instructor
Day 1	Tourism as a carrier and livelihood	General Behaviour & ethics	Rafikul Islam, senior tour guide.
Day 2	Biodiversity	Ecosystem	Dr. P.K.Saikia, Guwahati University
Day 3	Landscape and ecology	Medicinal plants	Laxman Terron, Environmentalist
Day 4	Conservation and management	Conservation and management	ASTEC (to be confirmed)
Day 5	Economy	Local culture	Laxman Terron
Day 6	Activity	Field work	Rongmon society
Day 7	Communication skill	Communication skill	A Plan team members

Indian Institute of Technology- Guwahati

25-03-2017



Niva Rama Mahanta (PhD scholar - center for Environment)
Sk. Nawaz Ali (PhD scholar - Department of Design)
Jitesh Singh, (PhD scholar, Department of Design)



Figure 6.12: Tourist guide training for consensus building and empowering local youth

interviews. This was the first of its kind to have an activity together among the communities otherwise don't face each other. 15 young men from the fringe villages were short listed and registered for the event that was to take place in December 2018, but postponed as fund collection was inadequate. The details of this action plan is in Figure 6.12

Recommendations on DPR and Implementation:

Mr. Ramoni Mohan Das, consultant GMDA has been actively associated with several Water Bodies' Conservation and Management Projects of Guwahati city; he has been a key member supporting the cause from the grassroots level. When he was informed about the lack of transparency among the stake holders, he agreed to discuss the DPR with the author and even held few meetings to explain the details of all government interventions. He has contributed to the FGD held (in absentia) with his valuable recommendations on community participation, reasons for delay in implementation of planning strategies and conservation and management of the wetland.

His interview summary has been put in the concept map (Figure 6.12) below:

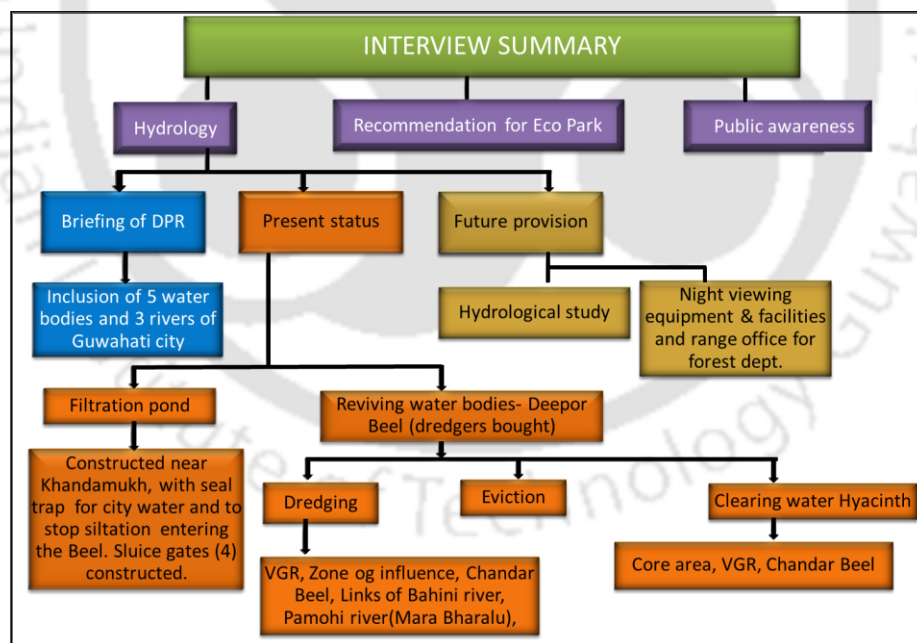


Figure 6.13: Concept Mapping of Interview with Mr. Ramoni Mohan Das, Consultant, GMDA.

Jan 2016

A concept map for growth and development was sketched with the help of all FGD members and was also discussed with the GMDA consultant (Figure 6.13)



Figure 6.14: Concept map for Comprehensive and Conscious Planning

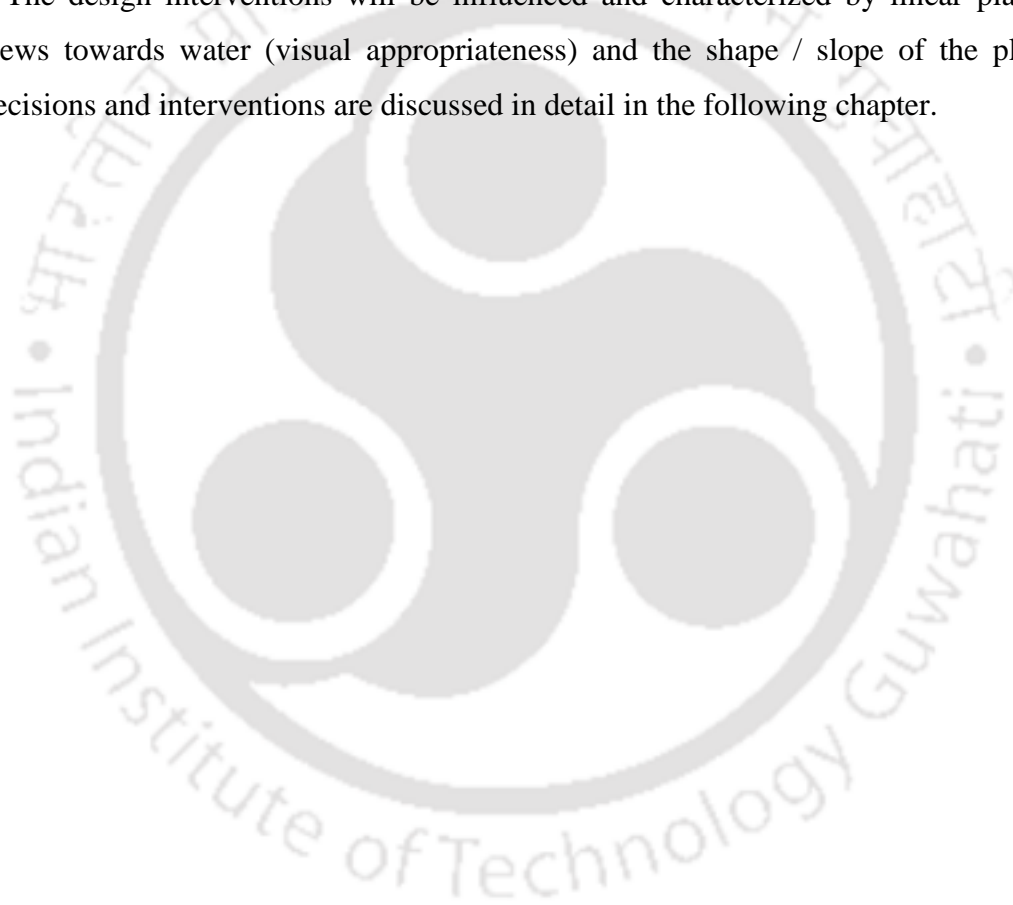
(Case studies, PRA, FGD & Interviews)

6.5 Interventions of Built Environment for Humane Design and Sustainable co-existence

As per the new rules on wetlands management and conservation (2017) by the environment ministry in India “zone of influence” means that part of the catchment area of the wetland or wetland complex, developmental activities in which induce adverse changes in ecosystem structure, and ecosystem services (2j). It is also mentioned that any construction of a permanent nature except for boat jetties should not be within fifty meters from the mean high flood level (Section 4.6-restriction of activities in wetlands). In the proposed built spaces there is no land development within the wetland and the buffer area. Also, the facilities provided in all 3 nodes does not come under the migrating birds’ flight path shown in figure 2.4, page 19.

According to Ramsar Provisions of Planning Recreational Tourism (handbook4, p-54), all activities should be planned with interpretation as a tool to enhance visitor experiences and provide them with a better appreciation to value protected areas. The three recreational and public facility nodes identified in the DPR were further scrutinized with additions and alterations from recommendations of experts and community representatives, after rechecking with

GMDA, the primary and the secondary stakeholders. To name a few, all three entry nodes will have one big multi-purpose playground for outdoor sports, which could be used as a community festival ground with food courts (not regular shops, stall types; temporary, but facility should be provided). Festival celebration facilities in the amphitheater, gazebo for public interaction and rest area, bi-cycle-jogging tracks around, artificial water bodies for tourism and aquariums will be provided for a more humane-centric design approach and utility. Initiating landscape restoration in and around the wetland will help creating a favorable micro climate. All three areas will be designed with nodes for sculptures, fountain gates etc. to showcase cultural identity. The design interventions will be influenced and characterized by linear planning to orient views towards water (visual appropriateness) and the shape / slope of the plots. The design decisions and interventions are discussed in detail in the following chapter.



Chapter 7

Design Decisions For Eco-Park

Detailed design layouts were prepared for all the three entry nodes and the southern part of the wetland to support interventions of the built environment discussed in all previous chapters. For a holistic approach towards protection, conservation and management of the wetland, the design decisions were customized through map-based analysis, DPR, findings from PRA, Interview and FGD recommendations. They were based on the roles of natural features, identified potential notified areas for conservation of the wetlands by GMDA and the socio-demographic changes in fringe communities in last two and a half decades. The Environmental Design Research Association's (EDRA) reports of 2015 and 2016 were fundamental in decision makings on societal challenges, and advances in design research. The data acquired by using ArcGIS was used for land use and transportation corridors, physical site analysis and design

7.1 Site Analysis

The site analysis was done primarily by visiting the proposed area, mapping existing physical elements and validated with layering different maps available (Figure 7.1).

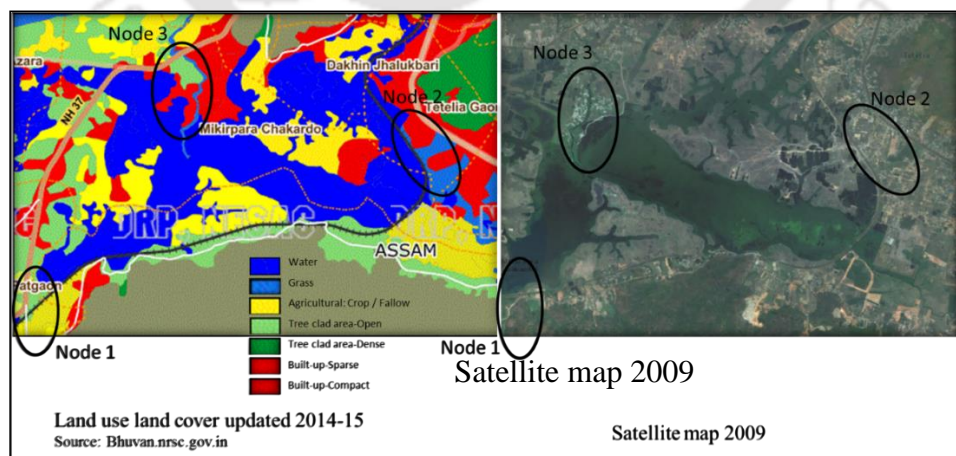


Figure 7.1: Existing land-use Validation by Visual Interpretation (Bhuvan NRSC, 2012)

Differences in land use pattern in all three proposed nodes were observed from various master plans by the State Government (Annexure 8). The extent of recreational areas proposed was validated and phase-wise implementation was suggested after comprehensive assessments done by exploratory observation and discussion with the agencies involved. Comparing the existing master plan, proposed DPR map (Figure 7.2), proposed master plan 2025 and notified and potential notified areas, the site area was analyzed for development (table 7.1).

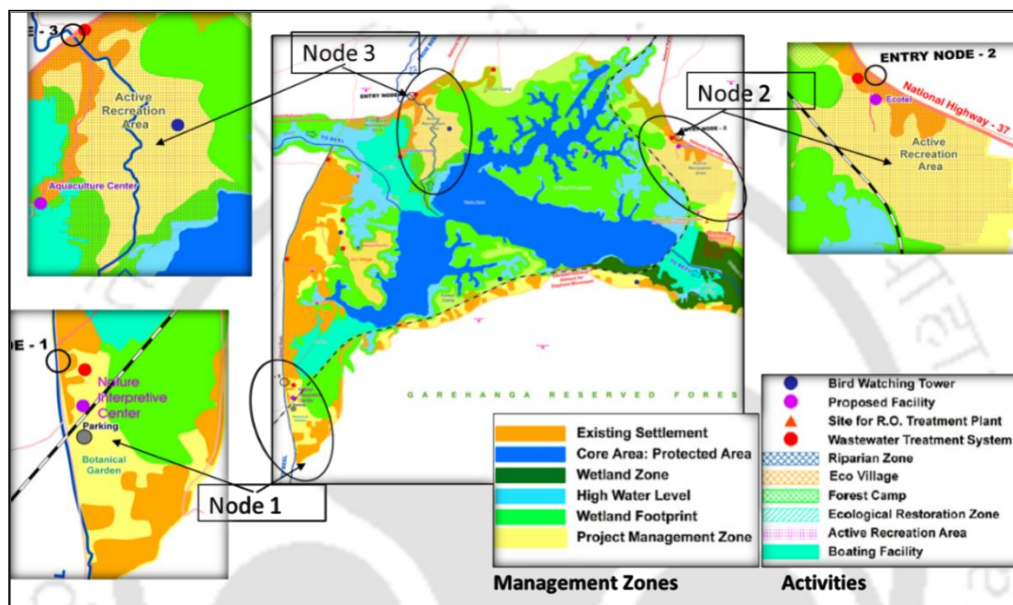


Figure 7.2: Land-use map – DPR, Deepor Beel, 2012 page-16

Table 7.1: Existing Land use Validation: Visual Interpretation

Maps	Node 1	Node 2	Node 3
DPR land use map	Botanical garden	Active recreation area	Active recreation area
City Development plan 2006	Recreational and green area	partly green and partly capital complex	Industrial zone
Existing master plan	Agricultural land	Vacant land with few houses	Agricultural land
Proposed master plan 2025 by GMDA	Recreational / green	Recreational / green	Recreational / green
Satellite map and land use land cover map 2014	Green, as per DPR	Open spaces with settlements and internal roads	Only a part is green, rest are settlements(built-up)
Potential notified area	Very few marked	Nil	Almost complete area in DPR is marked as potential area other than already notified area

In accordance with the findings from table 7.1, node one which is proposed for botanical garden and public recreational facilities is clear of any encroachment. As per the proposed DPR, Ecotel and other recreational facilities planned for nodes 2 and 3 will be developed through the PPP model. Node 2 with proposed recreation area was divided for Ecotel and resorts with cottages as approved in the DPR, along with public recreation facilities with PPP model. Node 3 is proposed with a detail layout plan for all water related recreational facilities, taking advantage of the water edges and proximity to the city limits. This can be implemented after the clarification of notified and potential notified areas. Nearly all the plots in this node are marked as notified and potential notified area (Annexure 8). In the meantime, as per the GMDA's PPP model, facilities approved by State Government for all 3 nodes will be developed phase wise in the open available land pockets, leaving the existing houses for evacuation (Das, 2016).

Existing vegetation types are different in all three proposed zones. The core area has seasonal aquatic vegetation, protective buffer zone is composed of grass land and ground covers are covered with shrubs and plants with low canopy. The project management zone has tall trees acting as buffer (Figure 7.3).

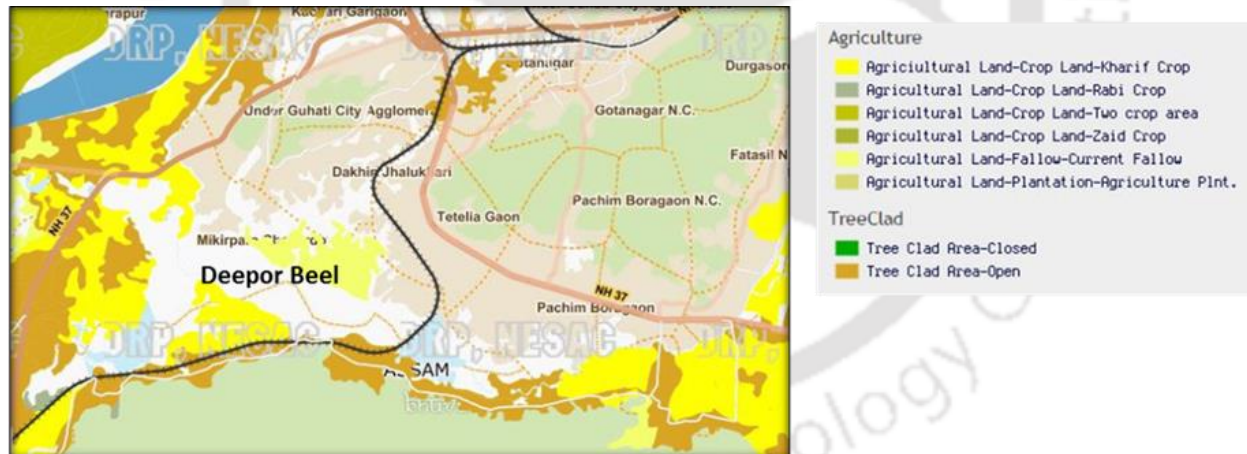


Figure 7.3: Vegetation Type (Bhuvan NRSC, 2012)

There is an immediate need for the attention for the landscape regeneration for both forest cover adjacent to the wetland and water stream in the forest. Gully control measures, with silt trap were suggested that is to be implemented by the Assam Forest Department, with proper engineering to minimize silt movement from hills to Deepor Beel. (P 8, Section 4-VII, DPR).

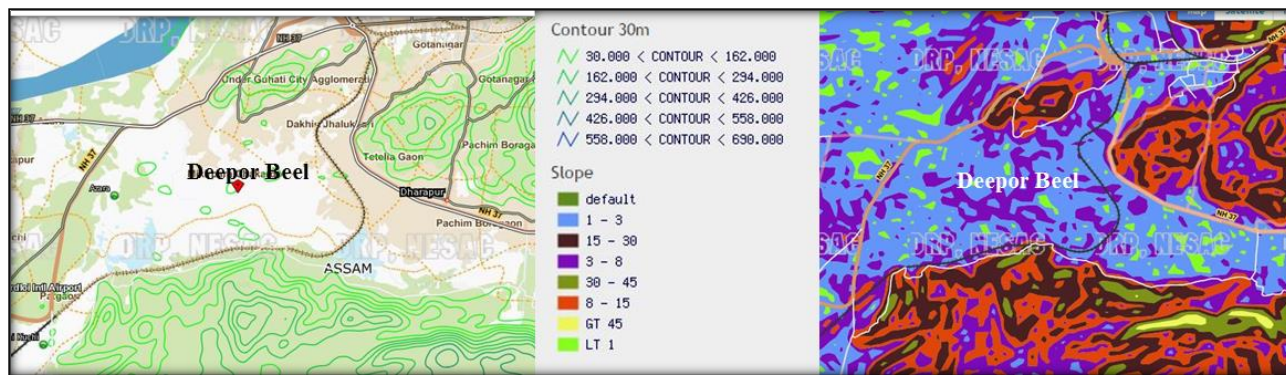


Figure 7.4: Contours and slope of surrounding hills (Bhuvan NRSC, 2012)

The contours on the south, in the hills are highly dissected for stone quarries and to be regenerated for its landscape (Figure 7.4). Contours for all three nodes indicate a slope of 5m to 7m from highway to the water body edges (Figure 7.5).

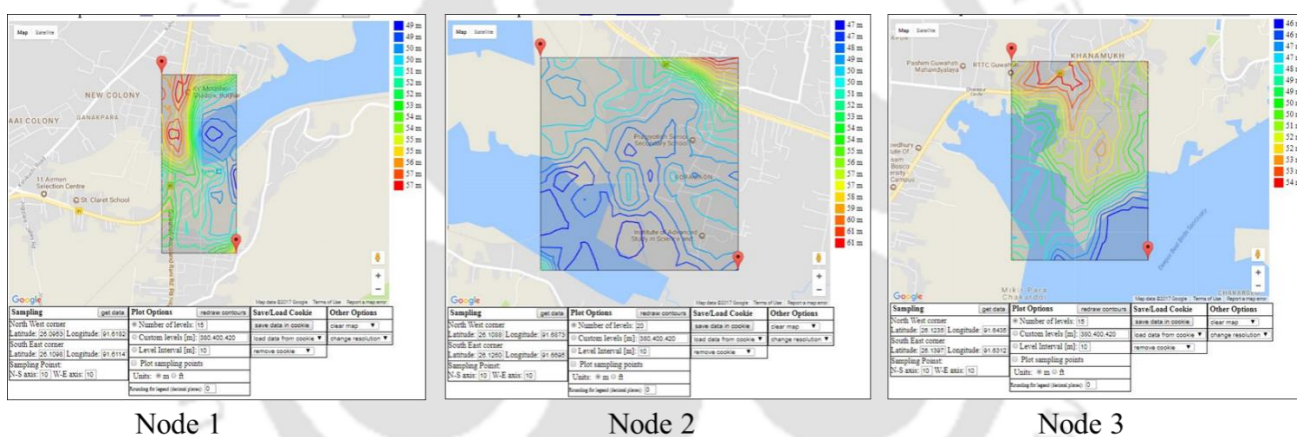


Figure 7.5: Contour levels at all three nodes (generated using Contour Map Creator software)

7.1.1 Hydrology

NRSC has generated Annual flood inundation layer and flood hazard zone (Figure 7.6) for Assam based on the flood inundation, derived from various multi-date satellite data acquired during the flood season of 2010. Entry node 1 with a proposed Botanical Garden has low to very low flood hazard. Entry nodes 2 and 3 with proposed recreational facilities lies in moderate to low flood hazard zones. The boating areas selected (B) lies in the moderate to high flood hazard zones whereas the proposed constructed wetland (4) lies in moderate to low flood hazard zones.

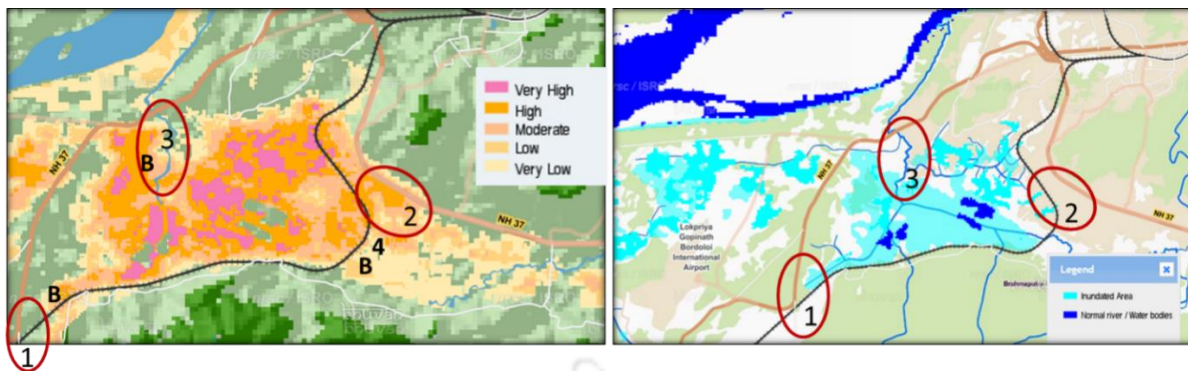


Figure 7.6: Flood Plain and Hazard Zoning (Bhuvan NRSC, 2012)

7.1.2 Soil type

The soil conditions are found as below (Figure 7.7 and Table 7.2):

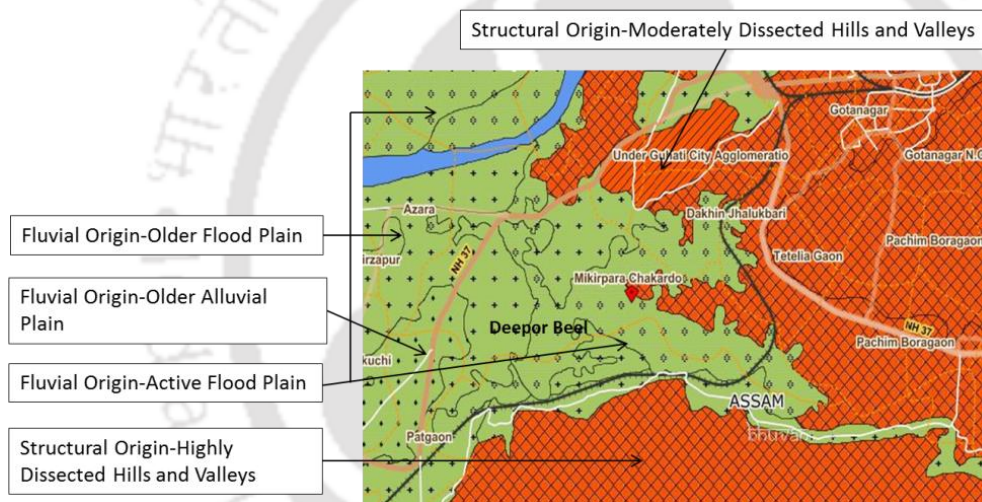


Figure 7.7: Geomorphology 2005-2006 (Bhuvan NRSC, 2012)

Table 7.2: Soil types in the proposed facilities

Proposed Site Location & Functions	Accessibility	Soil type
Entry node 1, Chaygaon Guwahati road, S-W. (91°36'43"E 26°6'4"N)		
Boating-1, Nature interpretive center, Botanical garden, Eco village(SW)	NH37 Azara	Fluvial origin-older flood plain
Pamohi road (south)		
Bird watching tower 2&3 and Elevated railway (elephant corridor)	Pamohi road	Fluvial origin-old flood plain

Boating and Canoeing 2	Pamohi road	Fluvial origin-active flood plain
Entry node 2, Tetelia, (91°40'31"E 26°7'44"N)		
Ecotel and Active recreation area-1	NH37 Tetelia	Highly dissected hills and valleys
Entry node 3, Jalukbari N-W. (91°38'11"E 26°8'19"N)		
Active recreation area 2	NH37- Jalukbari	Fluvial Origin-Older Alluvial Plain
Boating 3	NH37- Jalukbari	Fluvial origin-active flood plain
Bird watching tower 4	NH37- Jalukbari	Fluvial Origin-Older Alluvial Plain

7.1.3 Climate and environment

The climate of Guwahati is hot and humid during summer and dry in winter (Figure 7.9). Average monthly temperature is 24.2°C (fairly hot) with highest average temperature in August (28.8°C) and lowest (17.1°C) in January. Average rainfall is 1722 mm (67.8 inches), June-July being the maximum (309 – 377mm), (Figure 7.8). The city is situated near the sub-tropical moist forest biome (bioclimatic zone). Considering this, data for bioclimatic building design, and the shading devices should be designed for 60° to 84-87.3° (in Jun-Aug) sun angle in summer (Figure 7.8). Guwahati has one of the highest Black Carbon (BC) pollution levels in the world (ASTECC, 2018), due to rapid urbanization and poor environment quality control.

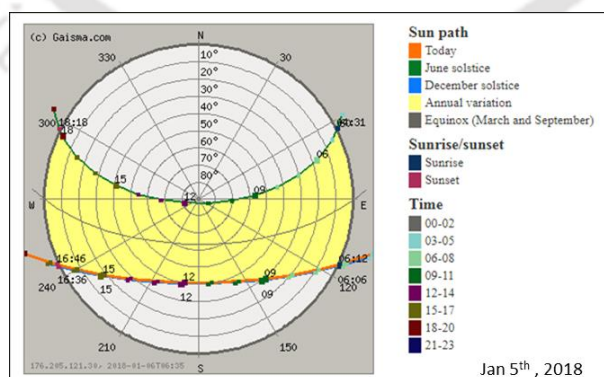
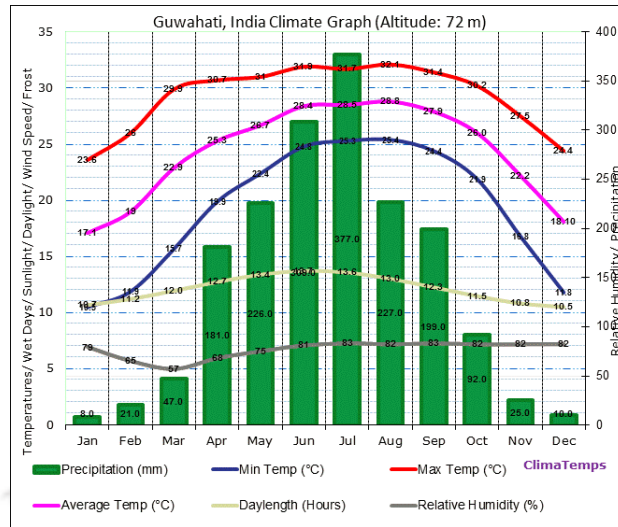


Figure 7.8: Sun path diagram Guwahati (www.gaisma.com/en/location/guwahati.html)



Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temperature °C (°F)	24 (74)	26 (79)	30 (86)	31 (87)	31 (88)	32 (89)	32 (89)	32 (90)	31 (89)	30 (86)	28 (82)	24 (76)	29 (85)
Average Temperature °C (°F)	17 (63)	19 (66)	23 (73)	25 (78)	27 (80)	28 (83)	29 (83)	29 (84)	28 (82)	26 (79)	22 (72)	18 (65)	24 (76)
Average Min Temperature °C (°F)	11 (51)	12 (53)	16 (60)	20 (68)	22 (72)	25 (77)	25 (78)	25 (78)	24 (76)	22 (71)	17 (62)	12 (53)	19 (67)
Average Precipitation mm (in)	8 (0)	21 (1)	47 (2)	181 (7)	226 (9)	309 (12)	377 (15)	227 (9)	199 (8)	92 (4)	25 (1)	10 (0)	1722 (68)
Average Daylight Hours/ Day	10h 41'	11h 13'	11h 57'	12h 44'	13h 24'	13h 43'	13h 35'	13h 01'	12h 56'	11h 29'	10h 49'	10h 31'	12h 00'
Sun altitude at solar noon on the 21st day (°)	43.9	53.2	64.1	75.7	84	87.3	84.2	76	64.6	53	43.9	40.5	64.2

Figure 7.9: Climate and Temperature, Guwahati (<http://www.guwahati.climatemps.com/>)

7.2 Design Concept and Design Proposal

The design concept is originated from general model, green model and cost model as shown in Figure 7.10. General model consists of space requirement-purpose, future expansion / growth and alternative livelihood opportunities. Cost model include available budget, initial and construction cost, Operation and Management (O&M) cost. The green model integrates the highest level of sustainability, ecosystem and biodiversity conservation. Design solution suggested was to integrate nature, human, water and the built environment with benchmark indices as below:

- Simplicity to match the urban fabric around
- Aesthetics to illustrate cultural dynamics
- Humane centric approach

- Energy and water conservation
- Scale and proportion
- Low impact on sensitive ecosystems around
- Landscape regeneration and reduced heat island effect
- Right mix of land use
- Encourage active mobility (walking, cycling)
- Tourist hotspot
- Environmental quality and Value engineering

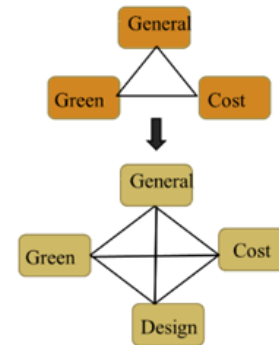


Figure 7.10: Design Concept

7.2.1 Design Proposal for Recreation by GMDA

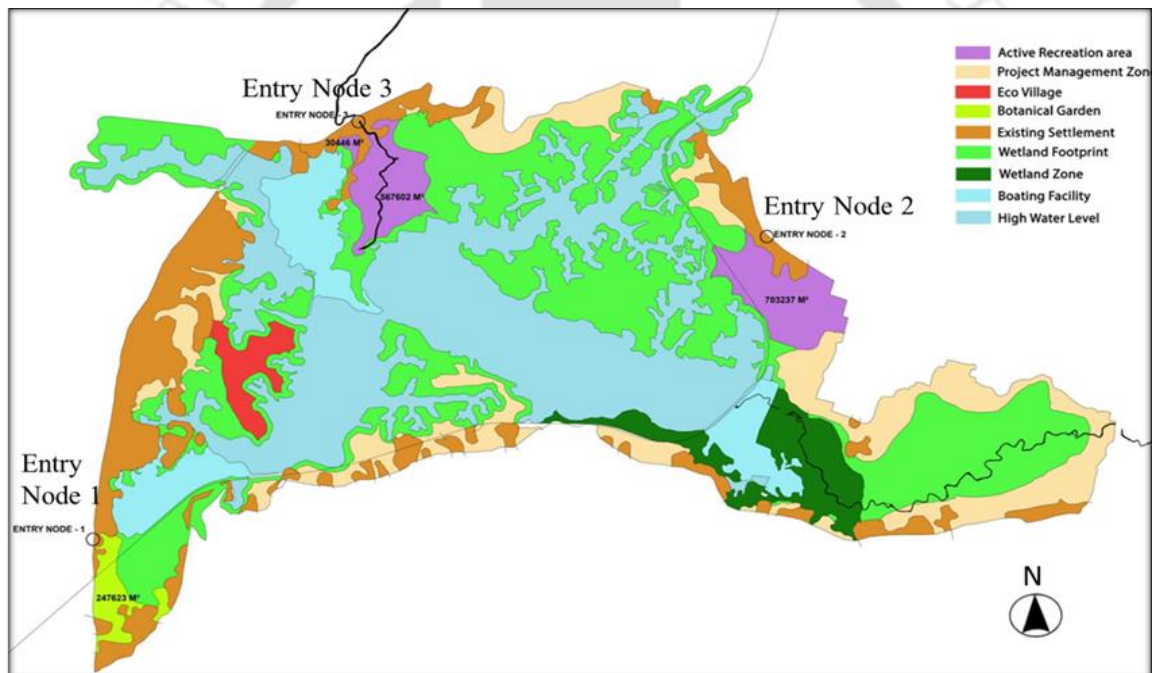


Figure 7.11: Land use plan for Recreation Facilities: Proposed by Guwahati water body Development Authority in DPR, GMDA (GMDA, 2012).

The proposed site has been divided into three zones. The core area is the protected zone (aquatic eco-system) surrounded by a protective buffer (riparian) zone and the project management zone with tall trees acting as buffers. Nature reserves are located on all four sides, whereas active recreation areas are in the North, North East and South West. Boating facilities are provided in the constructed wetland areas for city water runoff with a jetty. The institutional

area is proposed near the nature reserve in the East (Figure 7.11). A cycling track was anticipated from the Eco village in the North, stretching to the nature reserve. All these proposed facilities provide a scenic view of the blue water with a lush green backdrop of the hill in the south. Three entry nodes are marked for recreation areas by GMDA as shown in figure 7.10 with a total area of 1.61 sq.km. Facilities proposed in these nodes are listed in table 7.3.

7.2.2 Intervention of Design Decisions in the Design Proposal

The design decisions were inferred from design research and recommendations from PRA sessions and FGDs. Every activity proposed was designed with humane approach and as per their ecological importance, enhancing the economic and social standing of the community as a whole. The location and placement of economic activities with community participation are decided as per their proximity and convenience of the fringe communities. The visitors' interpretative center is proposed near the Botanical Garden proposed by GMDA. The flower cultivation areas are also marked near this with a floriculture center. These facilities will be easily accessible to both fishermen and tribal communities. The Museum, Aquarium and Aqua Culture Center and ornamental fish farming areas are placed in node 3 near all water sports facilities. Water hyacinth recycle center is proposed in node 3, being in close proximity to the city for trading, but drying yards are located in all 3 nodes for easy operation by community involvement. Node 2 was demarcated for Ecotel and resort by GMDA. Therefore a resort and two areas for Ecotel was marked in the layout plan as a proposal only. This will be at the discretion of GMDA. All three nodes are provided with amenities like parking, children's play area, jogging and cycling tracks, toilets, a multipurpose playground and amphitheater. A weekly market in each node is proposed in a traditional design, like a group of open sheds with thatched roof and a raised mud floor. The circulation corridors connecting all facilities will be one internal road and semi shaded walkways. All circulation paths will be shaded with trees planted on either side for comfort. They will be lit by solar powered street lights.

Recreation facilities include active recreation areas and water sports. Active recreation areas include multipurpose playground, jogging and cycling, nature trailing and children's playground. Water recreation facilities are divided into two groups; water sports area in shallow constructed water body near the entrance of node 3 for family and children include water sports like paddle boats, zorbing and fly board (tourist appreciation). Water sports proposed towards the

west side in the outer ring of core wetland area is for professional boating and kayaking in deep water. Two more boating areas are proposed with jetty in Pamohi road and near node 1 in south west direction. Two promenades are proposed in Pamohi road near *Deochotal* for enjoying the view. There is also provision for pool camping with stilted cottages in node 3.

An elephant corridor is proposed from the hills connecting the wetlands with a watch tower (DPR) adding a patch of hills between the nearest foothills. The patch consists of a tunnel below for the railway track and the PWD road. This will reduce accident causing elephant deaths and the man-animal-conflict. Usually the valleys are selected by the elephant herds as favorable routes for easy movement with baby elephants. They normally use two corridors: one near the watch tower and other about 3 kms west of this watch tower, in *Matia* hills. As multiple corridors are not possible due to urbanization, the route selected is one of the two favorites for the elephants, near the watch tower (Terron, 2016).

Forest tracking is another activity that is gaining popularity as niche tourism. Environmentalist LuxmanTerron along with few local youth trained by him conducts tracking for students, tourists and researchers. There are between four- five forest tracking routes near his residence in *Deochotal* area in the south of the wetland. The groups usually start in the morning and come back by noon. This activity should be continued with Government support and training.

7.2.2.1. Design decisions for ecotourism sustainability

The indicators for monitoring ecotourism sustainability can be divided into five major categories: 1) economic, 2) cultural, 3) social and 4) environmental and 5) Institutional (Aziz, Barzekar, Ajuhari, & Idris, 2015). As an example, ecotourism can provide an economic rationale if an economic value is assigned to ecological resources that are to be conserved. It can be an important part of a more comprehensive development and conservation strategy by assisting in building a constituency necessary for effective policy and action. The positive outcomes are usually the desired outcomes of ecotourism stakeholders. The success of ecotourism is usually measured by the achievement of the outcomes. The indicators for validation of this context specific study were listed in the four categories mentioned above from the book “*Sustainable tourism for development guidebook*” published by The World Tourism Organization of the United Nation (UNWTO) in 2011 to support sustainable and responsible tourism in developing

countries. They were mapped with the strategies proposed for positive impact validation (table 7.3).

Table 7.3: Ecotourism success indicators and sustainable co-existence

	Validation of criteria and indicators
Social and environmental benefits	<p>Visible Community Involvement and Commitment Ecotourism is concerned with the local community and development to be in-line with sustainable and eco-friendly practices, while maximizing visitor's experience at the ecotourism sites which in this case can be achieved by providing research and framework for raising the living standards of local people through the economic benefits of tourism; Ensure that the types of development within visitor centers and resorts are appropriate to the purposes of these areas; Establish a development program that is consistent with the cultural, social and economic philosophy of the government and the people of the host area and thereby Optimize visitor satisfaction. Feeling of ownership.</p>
	<p>Conservation of Natural Resource & Biodiversity Existing Natural resource and Wet land is Conserved by enhancing the usage of Wetland park and stop land encroachment</p>
	<p>Existence & Implementation of action plan for conservation Keeping in mind the current stage of the Project and DPR as received from Government Agencies , a detailed study was carried out and suggestion for efficient Implementation of the same has been discussed in detail</p>
Economic benefits	<p>Monetary Benefits Upon implementing the above said measures, Expected benefits in terms of using the Monetary funds and engaging the communities in the Conservation and Management (C&M) planning which will act as a strong catalyst among all stakeholders, particularly the fringe communities</p>
	<p>High Number of Tourist Visiting Travel to relatively undisturbed or uncontaminated natural areas with the specific object of studying, admiring and enjoying the scenery and its wild plants, and animals, as well as any existing cultural aspect .Proposal of Eco park, Eco-tel and other facilities along with an experience of Natural features will attract visitors of different nature including but not limited to</p>
	<p>Improvement of Standard of Living Specialized product in the natural setting where Eco practices are present with involvement of local people which is intended to increase the per Capita income of the Local Population and thereby raising their Living Standards.</p>
Socio -	<p>Attractiveness of Site The area and facilities at the selected ecotourism site incorporates sustainable design facilities, environmental zoning, nature trails management, refuse treatment practices, employing local communities and distinctive elements of natural and/or cultural heritage</p>
	<p>Community Projects Designed spaces to promote Successful local community projects that includes the</p>

	cultural values of the Local community. This helps to ensure that their local customs and traditions are observed, conserved or revived. The achievement of this is considered a success indicator for the local community participation process.
Institutional benefits	<p>Legal Institution and Framework Approved DPR by GMDA is instrumental in developing solutions for the research and sustainable development.</p> <p>Research and Design solutions of this thesis aims to support the existing legal, institutional & policy framework for the proposed ecotourism in region.</p> <p>Design has been devised to support existence of legal frameworks for participation of all stakeholders and collaboration among different related NGO's and Organizations.</p>

7.2.2.2 Carrying capacity in design decision:

Carrying capacity is applied in conservation and management of protected areas and tourism research including planning, development and destination management. Secondary sources and case studies on tourism carrying capacity indicated that there are different methods for determining it with a recent shift towards management by objective approach such as visitor impact management, limits of acceptable changes or visitor's experience instead of tourism carrying capacity (European commission, 2002). Different activities are proposed with infrastructure facilities around this wetland. In this respect carrying capacity is site specific and use specific. Ecological carrying capacity is again based on contextual objectives and forms an essential part of a site specific management plan. Generally a management plan is made by the government or the authority responsible. In this case, GMDA do not have the management plans for Deepor Beel and it is not in the planning stage too. As ecological carrying capacity is not defined and requires specialized expertise, the tourism and infrastructure carrying capacity could not be calculated. However, considerations for avoiding possible factors and indicators affecting the carrying capacity were given conforming to guidelines by Ramsar provisions (handbook 4, p-54) of planning recreational tourism (section 6.5). Since Government interventions were central to these developments, all codes from concerned regulatory and planning authorities related to the wetland and public places, GMDA's building byelaws were referred in the design research (7.3.1). The facilities provided to support recreations are as per the standards (Water, sanitation and drainage, parking, retail, internal transport corridors) to avoid any negative impact on the users and the surrounding areas.

Though the detailed carrying capacity calculations for infrastructure, ecology and tourism could not be included in the study, principles of wise use of wetlands and the indicators of carrying capacity for tourism were used as point of references in the design research conforming to Ramsar and wetland policy guidelines (Ministry of Environment, 2017). An attempt was made to calculate the Physical Carrying Capacity (PCC) of the tourists visiting the active recreation facilities in node 1, 2 & 3 using the formula given by the International Union for Conservation of Nature (IUCN). Physical carrying capacity includes the maximum number of visitors who can be physically present at a certain time and place and can be calculated using the formula

$$\text{PCC per day} = A \times V/a \times \text{RF} \text{ (Kourandeh \& Fataei, 2013)}$$

where A = area in meters squared, V/a = visitors per meter, RF = (Rotation factor) is the number of daily visits of a place which is calculated as RF= Usability time of the place/mean time of a visit, for example 9/3, assuming on and average a person spends 3 hours in the park and 6 hours in botanical garden and the park visit time is from 9 am to 6pm (9 hours). Values of the components of this equation for parks in all 3 nodes near Deepor Beel wetland are calculated in table 7.4. The PCC without RF is considered as point of reference for design of recreational areas

Table 7.4: Physical Carrying capacity (number of visitors) for parks

Activity zone	PCC=A x V/a x RF	PCC without RF	Remarks
Node 1- park	$177265 \times 1/50 \times 9/3 = 10,635.9$	3545.3	Area per person is for neighborhood park & botanical garden as district park
Node 1- botanical garden	$177265 \times 1/100 \times 9/6 = 2659$	1772.7	
Node 2-park	$173012 \times 1/50 \times 9/3 = 10,380.7$	3460.2	Resort area not included
Node 3-park	$292880 \times 1/50 \times 9/3 = 17572.8$	5857.6	Park area is after deduction of buffer from wetland edges and stream with 25m buffer on both sides
Node 3-water sports	$92815 \times 1/100 \times 9/2 = 4176.7$	928.1	
Node 3- camping	$11303 \times 1/100 \times 9/9 = 113$	113	

Note: Total area of 3 nodes=1616370 sq.m=1.61 sq.km=397.8 acre

And facilities needed. As these facilities like toilets, drinking water, signage, parking etc. are indicators of factors for calculating carrying capacity of tourism.

7.3 Area Matrix, Programming

The facilities provided in the three nodes (total area=1.61 sq.km/ 397.8 acre) are as below:

Table 7.5: Facilities Proposed in the Eco Park (All underlined activities/facilities are addition to proposed DPR)

Location	Facilities
Entry node 1: JalukbariChaygaon Guwahati road (91°36'43"E 26°6'4"N). Area=320322 sq.m	Boating 1, Nature interpretive center, Botanical garden, Boating pier, fishing village, Eco village(SW), Bird watching tower 1, <u>Flower cultivation area (open land) with an office for sale and management, Nursery to grow and trade plants and saplings, weekly market with 30 sheds</u>
Pamohi road (south)	Bird watching tower 2&3, Underground railway (elephant movement, <u>Elephant corridor connecting the hills on top to the wetland with an observatory nearby to watch elephant movement</u>), Boating and Canoeing
Entry node 2, Tetelia, (91°40'31"E 26°7'44"N). Area=703620 sq.m	Ecotel and Active recreation area 1, <u>weekly market for craft-vegetables-fish-flowers-pottery etc.</u>
Entry node 3, S-W (91°38'11"E 26°8'19"N). Area=565377 sq.m	Active recreation area, Eco- friendly resorts, Aquarium and a Museum (plants, flowers, butterfly, fishes available in whole of North East , Boating (3), Aquaculture center, Bird watching tower (4), Bicycle track, <u>Nature trailing, Ornamental fish culture</u>
Other facilities	Proposed Metro rail line touching the wetland (master plan 2025), along the bottom of Garbhanga forest leading to the airport. Reverse Osmosis (RO) treatment plant (1) in Pub Baragaon in old waste dumping ground, STP (2) at the confluence of Pamohi river and the wetland, Waste water treatment system (8), Forest camp (2),North and South of the wetland), <u>Riparian zone</u> , Project management zone and Ecological restoration zone.

7.3.1 Built Spaces

The proposal for the built up spaces include the buildings, boating jetty, railway tunnel for elephant corridor, internal roads and bridges and the promenade. The buildings were designed with traditional design identity and available local materials and techniques. The regional design elements like gabled roof with overhang and metal roofing sheets in low rise independent structures and materials like bamboo and cane were specified as per design requirements. Design factors like easy accessibility including full wheelchair access, public safety and security, use of directional and warning signage, levelled ground surfaces for public use without steep slopes or levels, shaded but visible seating in outdoor assembly areas were considered in all facility designs. The required spatial standards were mapped with building byelaws of GMDA and designed with universal design guidelines. The building typologies as per their utility are listed below:

Table 7.6: Built space requirements

Building typology	Utility	Area (sq.m)	Requirement
Interpretative center	Education & research	600	Reception, information, library, administration, meeting room, exhibition, seminar, workshop, souvenir shop, first aid room
Museum and Aquarium	Recreation, education and research	600	Aquarium, museum for butterfly and flowers, seminar, offices, meeting room
Aqua culture center	Office, education and research, training and workshop, trading	480	Office, library, workshop and training
Flower culture center	Training & workshop, trading, office, education and research	480	Office, library, workshop and training
Food courts	Commercial	Stalls-750 Dining-800	Food stall and dining area
Pool camping cottages	Recreational, hospitality	66	Single unit residence with toilet
Resort cottages	Recreational, hospitality	160	Twin cottages with family accommodation
Office blocks	Administrative	480	Office, library, meeting room

7.3.2 Eco-village

The fishermen villages in the west side of the wetland is proposed to be developed as an eco-village in its natural settings. The infrastructure facilities like internal roads, water supply and drainage and other community facilities will be upgraded to cater for eco tourists. All houses will be given identical design retrofitting and will have facilities for craft and fish trading. They will also be provided with alternative fishing zones in the west of the wetland (Figure 7.12). Tourists can experience a fishermen's village in its traditional layout and design along with experiencing fishing and various traditional crafts of pottery, metal works, cane and bamboo works, Assam silks etc.

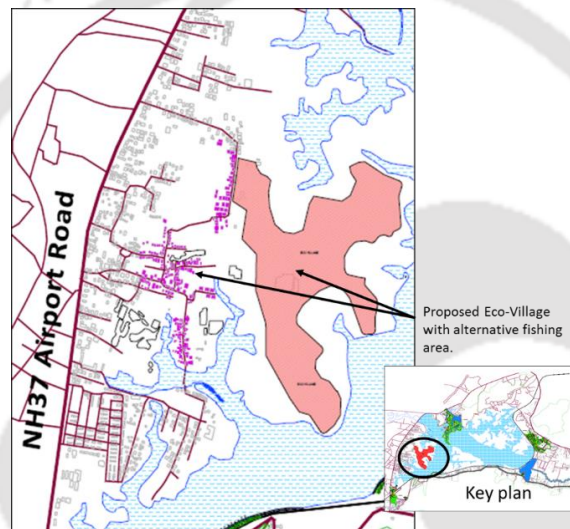


Figure 7.12: Eco-village

7.4 Design Recommendations with Ecofriendly Technology

Innovative construction technologies, materials and local knowledge recommendations were carefully implemented in the design decisions for all recreational facilities and environmental regeneration.

7.4.1 Ecological Benefits through Design

Ecological design is defined as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes" (Sim Van der Ryn, 1996). The principles of ecological design follow the balanced dynamics of nature with the surroundings (Figure 7.13). They include context specific design, very little ecological intervene, moderate

and efficient resource use, appropriate technology, green living inspiration, more fulfilling lifestyles and preserving our legacies of ancient wisdom (Ludwig, 2003). A landscape contains three major components, patch (both human settlements and wild life habitat), matrix and corridor (Figure 7.14). The patches around the wetland are the forest in the south, human settlements and wetland extent in all other directions in variable size, shape and structure. A corridor is a natural and manmade designed landscape connecting patches for dispersal and migration. The matrix, the dominant component in the landscape, is the most extensive and connected landscape element (Barnes, 2017).

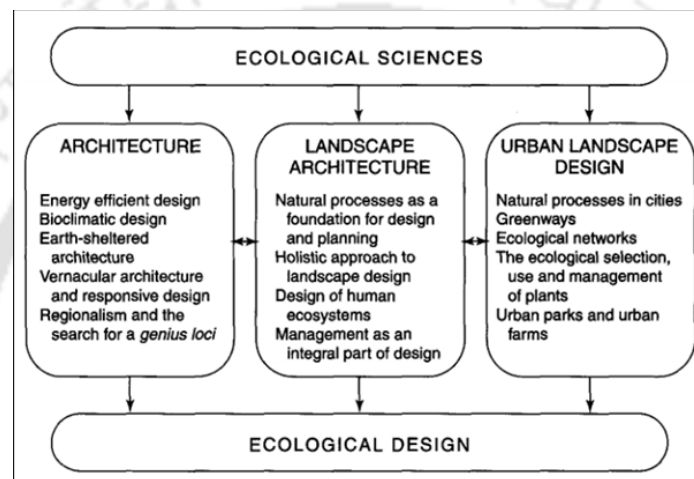
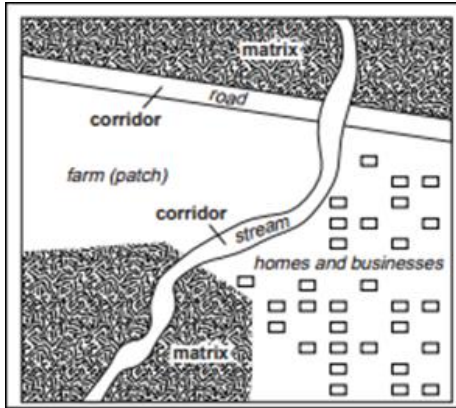


Figure 7.13: The interface of Ecology with Architecture, Landscape Architecture and Urban Landscape Design (Makhzoumi & Pungetti, 1999).

Corridors like the rivers (inlet and outlet to the wetland), railway track sides (right of way) and the roads; particularly along the foot hill of Garbhanga forest was designed to be made into an effective corridor by planting natural vegetation buffer area. The conservation buffer of 25/m along the rivers and 50m along the wetland edges with no development are provided to protect wild life habitats as barrier corridors. Patch-Corridor-Matrix model (Figure 7.14, elephant corridor, vegetation along the stream), edge, core area (bird sanctuary), buffer, and supporting design principles were used to protect nature and biodiversity at all levels of scale (Figure 7.15)



Patch-Matrix-Corridors of Deepor Beel

<u>Patch</u>	<u>Matrix</u>	<u>Corridors</u>
Agricultural	Forest	Rivers
Ponds	Wetland	Roads
Villages	Built spaces	Railway track
Grazing lands		Green

Figure 7.14: Example of Patch-Matrix-Corridor (Barnes, 2017)

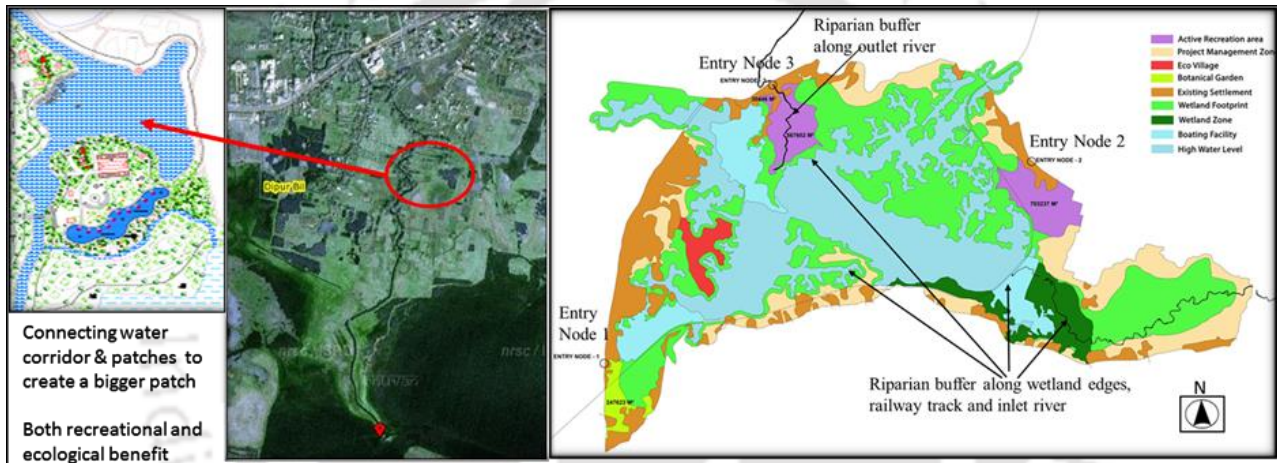


Figure 7.15: Sustainable landscape proposed – patch, corridor and riparian buffer

An Elevation planning is proposed with functions like separating different land uses, and levels with natural contours for maximum viewing angle (sections). These are attempted with both soft and hardscapes (Figure 7.16)



Figure 7.16: Elevations for maximum viewing angles

7.4.2 Landscape Elements and Edging Details

The buffer zones for conservation around the edges of the wetland were marked as per the DPR proposal. Riparian buffers with natural vegetation were added in the proposal on both sides of inlet and outlet river channels (25 meter and 50meter from wetland edges).The protective vegetation patterns in these restoration zones proposed are predominantly native ground cover. The edge or the boundary between two different landscape elements like water and land, or forest and crop land has a distinct ecology known as Ecotone (Figure 7.17).

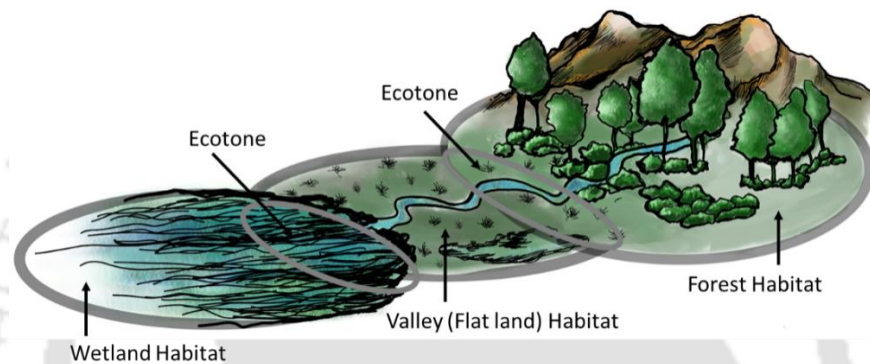


Figure 7. 17: Graphical representation of Ecotone, the edge effect near Deepor Beel (south side)

This overlapping ecosystem known as the Edge Effect has significantly more productive and diverse environments than the two individual ecologies. The transitional zone of two adjacent ecological communities creates influential and beneficial microclimates for supporting biodiversity. At some places, percolated boulder edging are proposed with minimum intervention in the natural system.

Edges: Types of edges used in design are open corridors, woody corridors and riparian edges. Open corridors include roads, pathways, service corridors and lawn strips. Hedges, tree lines, fencing with plants and dense woodland make up the woody corridors. The root system of vegetation proposed for the riparian edges provide bank stability (reduce flood and erosion), passive recreation area, maintain biodiversity and protect the environment (trap nutrients, store water, wildlife habitat). For the riparian buffer in and around the wetland, following landscape elements are proposed:

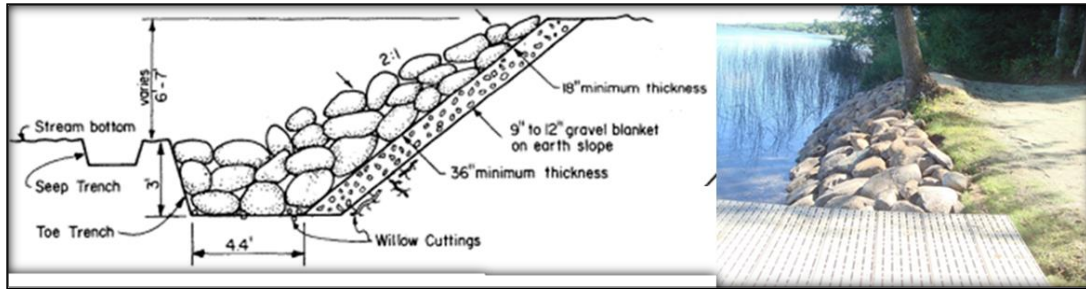


Figure 7.18: Cross section of typical percolated edge treatment

Soft scape: Native plants like hedges and tall grass are proposed for regeneration and conservation, where there will be no human intervention for better nesting places for some species of migrating birds. They include *Phragmites Karka* (Nol in Assamese), *Saccharum spontaneum* (Kahuwa in Assamese) with reeds (R.J.Deka, 2003), spider flowers (Terra farmer, white and purple). Other types proposed are nature trails, riparian vegetation, stepped stones and bioengineering.



Figure 7.19: Example of unhealthy (left) and healthy and diverse Riparian buffer (right).

(National Arbor Day Foundation, US. www.arborday.org)

Hard scape (with buffer vegetation wherever possible): Proposed hardscapes include pathways, jogging and cycling tracks, gazebos, planters, promenade, bridges and land reclamation, outdoor furniture, gabion and retaining walls and stepped sloping (Figure 7.20).

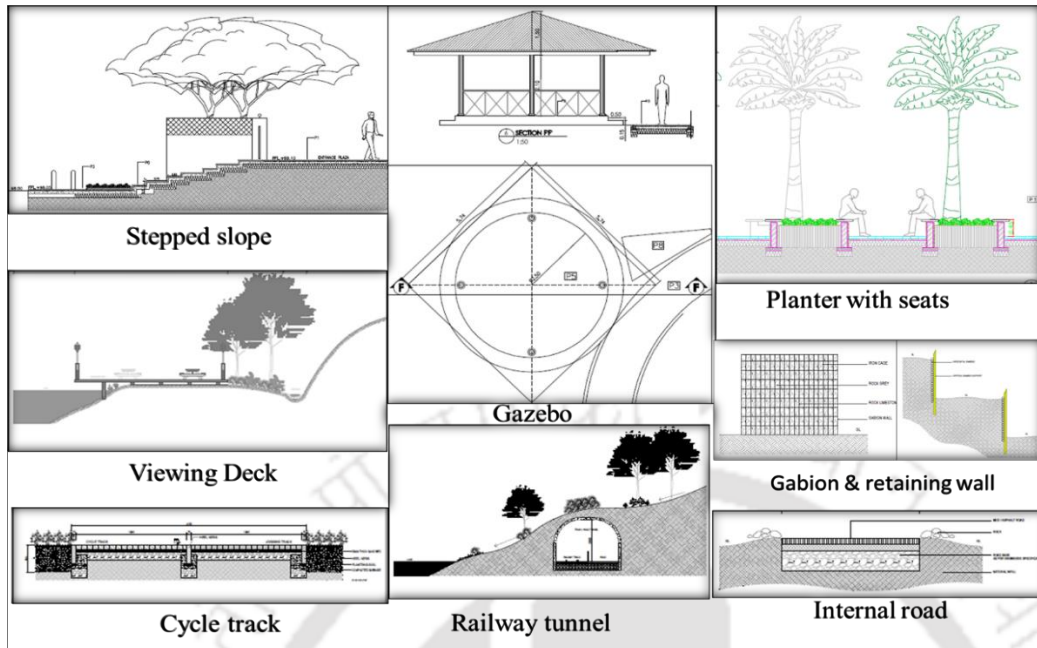


Figure 7.20: Proposed hardscape details (Drawings are attached in Annexure 10)

7.5 Cost Model

The probable cost models for the project realization was derived from the proposed DPR and all add-ons were based on research findings and FGDs. They are as follows:

- Financial expenses met by the Government are mentioned in the DPR prepared by GMDA and approved by the State Government.
- The timely initiation and implementation of the approved proposal shall avoid further trespassing and miss-use of land use. To facilitate this, the financial model needs to have multiple options for the project realization.
- Project to be developed on PPP model with a fixed tenure for Build-Operate-Transfer (BOT, E.g. 25 years)
- Involvement of corporate funding through Common Pool Resources (CPR, E.g. NABARD)
- Recurring income and revenue model through utilization of space for events, recreational facilities and public gatherings (E.g. playground, amphitheater etc. for public fare, functions)

- Revenue model generated through sponsors by sign boards, sculptures in nodes, street furniture etc.
- Development, Operation and Management (O&M) through social participation like voluntary work for Riparian Corridors, Bio swales etc. This also helps in creating sense of ownership helpful for long term usage and maintenance.
- Rental models for shops, food courts, convenient stores, weekly market, pool camping, nature trailing and trekking.
- Self Help Group (SHG) for farming of seasonal crops and flower cultivation through micro financing on Government land and/or Village Grazing Reserve (VGR) for revenue generation.
- Ticketing for facilities provided for recreation by the Government in public parks.
- Solar Innovation Park or facilities for recreation can be developed through Grid connections working on a positive energy concept.

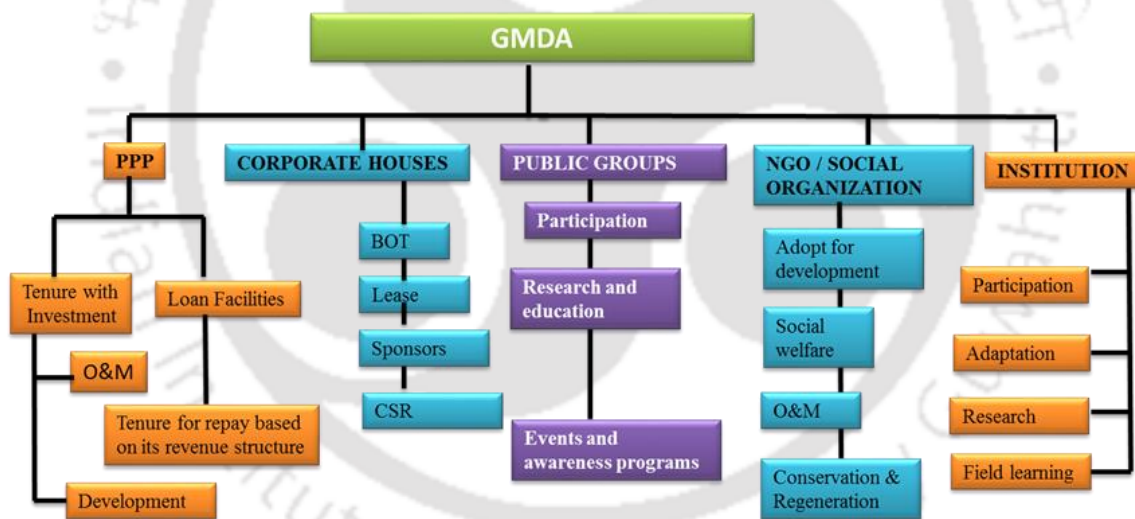


Figure 7.21: Concept map showing the model framework of stakeholders for revenue generation & working of the project

For smooth realization of the project, it will be divided into phases with categorization of expenses from low, medium and high expenses facilities (Table 7.5), further strengthening these with the model framework of stakeholders to understand the network of realization of larger goals in smaller approaches (Figure 7.21). For example, voluntary work of people can work as a starter to regenerate the landscape for the riparian buffer areas.

Table 7.7: Work Breakdown Structure for added facilities

Work Breakdown Structure for added facilities			
Expenses	Phase 1	Phase 2	Phase 3
Low	1. Permission for Elephant Corridor (tunnel) and land filling 2. Document preparation for leasing of facilities 3. Tendering	Construction of playground and Amphitheatres: clearing site, compacting and earth work	Construction of cycle tracks and Jogging track
Resources needed and source	Liaising with various agencies & carrying out all documentation and tendering process by GMDA.	Construction contract by way of Civil/Electrical/Mechanical/ Landscape for playground and Amphitheatres. Awarded by GMDA	Specialized contracting companies to deal with the activities as specified. Awarded by GMDA
Medium	1. Demarcation and survey of leasable land for Ecotel, Resort, Solar Park, and Water front development, Weekly Market & Flower cultivation 2. Internal road survey, demarcation	1. Design and detail of tunnel construction and tendering. 2. Construction of Infrastructure base work and weekly markets	Final stages of infrastructures, Buildings etc.
Resources needed and source	For surveying & demarcation. Sub contracted by GMDA Liaising work for sanctions & permissions by GMDA.	Section 1 drawing, specifications and tendering by GMDA. Section 2 by contractor awarded by GMDA.	Construction by contractors, awarded by GMDA.
High	Constructed wetland survey and demarcation	Dredging and digging Construction of Infrastructure: Internal roads with street lights, Public toilet blocks with drinking water facilities	Construction of railway tunnel and promenade: selected places around the constructed & natural wetland, inlet riverbanks
Resources needed and source	Sub contracted by GMDA	Construction by contractors, awarded by GMDA.	Construction by contractors, awarded by GMDA.
Stake holders	GMDA Permission authority Volunteer works - NGO, Institutions, Corporate Houses	Contractors, NGOs, Corporate houses, Leasee GMDA, Public participation	Contractors, NGOs, Corporate houses, Leasee GMDA, Public participation

Chapter 8

Summary and Conclusion

8.1 Summary

This research aimed at planning a holistic and sustainable approach for the conservation and management of Deepor Beel wetlands, with Eco Park as nature-based solution. It is expected to open avenues for mitigation of water-based challenges, leading to future interventions. The study explores strategies for better implementation of planning and developmental goals. It identifies potentially affected indigenous groups, seeks community participation, bio-rights and overall development. It also analyses the Mitigation-Adaptation Approach for conservation, using sustainable and resilient design decisions and promotes ecological research and education. Hydrology management and biodiversity conservation were beyond the scope of this research. However, all design decisions and interventions contribute to the protection and restoration of both.

Every activity/facility proposed here was determined in the context of its ecological importance. Preventive methods along with remedial approaches were introduced in addition to the proposal for recreational facilities by GMDA, for a humane-centric, universal and sustainable solution. This research, apart from providing an opportunity to comprehensively address all relevant issues, additionally creates a framework for the implementation of the project, which is expected to help restore the wetland, re-establish an ecological balance and promote environmental sustainability. These are summarized below:

8.1.1 Proposed Built Environment and Design Decisions

For integrating the built forms in the urban fabric, particularly in an environmentally sensitive area like Deepor Beel, both universal and local planning and design factors were considered and addressed in the proposed design.

8.1.1.1 Universal Factors

Use of handbooks and guidelines from international and national organizations for Environment Protection, Wetland Conservation and Management in planning and design are examples of universal factors considered. The check list for formulation of Management action plan by the Conservation division of Ministry of External Affairs (MOEF), Government of India was used to analyze the proposal by GMDA for Conservation and Management of this wetland. With the guidelines of Ramsar provisions of planning recreational tourism (handbook 4), activities like Flower Museum, Interpretation Center and Aquarium were planned with interpretation as a tool to enhance visitors' experiences and provide them with a better appreciation to value protected areas. Similarly, for visual appropriateness and increased utility, the proposed design interventions were influenced and characterized by linear planning to orient views towards water. Advantage of the shape / slope of the site was utilized and provided for promenades and edges with elevation planning to obtain maximum viewing angles. Two wide viewing decks are provided in single level elevation but cantilevered towards water near Mikirpara Chakordeo village in Pamohi road situated in close proximity to the wetland. At present, these spots are frequented by many visitors, but without any facilities for the public or protection for both visitors and the wetland. Stepped promenades were proposed along the edges of the water bodies and constructed wetlands at some locations in node 3 as per the functions and accessibility, for sitting and enjoying the natural vista. . Even the riparian buffer edges along the two rivers can be enjoyed for their natural beauty through the walking pathways provided beyond the sloped and vegetated buffers of 25m on either sides.

8.1.1.2 Local Factors

Detailed analysis on communities, Urban Growth Pattern, proposed DPR by GMDA on Conservation and Management and socio-cultural values were employed to create a baseline for planning and designing the built environment: the proposed recreation and eco-tourism site covers a total area of 1.61 sq.km, divided into three nodes (161 Hectare/397.8 acres). The planning concept originated from general model, green model and cost model. The green model integrated the highest level of sustainability, ecosystem and biodiversity conservation. Design research was conducted to explore strategies to speed up implementation and to find a tangible

solution for the conservation of urban wetlands like Deepor Beel. The design concept was to integrate nature, human, water and the built-environment with target indices as below.

- Simplicity to match the urban fabric around
- Aesthetics to illustrate cultural dynamics
- Humane-centric approach to design (inclusive)
- Energy and water conservation
- Scale and proportion
- Low impact on the sensitive ecosystem around
- Landscape regeneration
- Right mix of land use
- Encourage active mobility (walking, cycling)
- Tourist hotspot

The three recreational and public facility nodes identified by GMDA in the master plan were further scrutinized with additions and alterations made on the basis of recommendations given by experts and community representatives, the primary and the secondary stakeholders. To name a few, all three entry nodes are provided with one big multi-purpose playground for outdoor sports, which can be used as a community festival ground with parking, children's play area, food court and toilet facilities. Festival celebration in the amphitheaters, gazebos for public interaction and rest area, bicycle-jogging tracks around and aquariums plans are incorporated for a better humane-centric design and utility. Landscape restoration with water bodies in and around the wetland is planned to help creating a favorable micro climate. All three areas are designed with nodes for sculptures, fountain gates etc. to showcase cultural identity. With a target for an Integrated Eco-Tourism, the design domains are mainly based on low impact and cost effective design solutions (less built up volume) with active movement (cycling or walking in more than one direction), thermal comfort (shading), easy circulation and way finding, education and learning with the added attraction of experiencing vast open spaces. This is illustrated by provision of playground, nature trailing, jogging and cycling corridors in all three nodes. Thermal comfort is to be achieved through semi shaded pathways with weaved bamboo shading (Detail drawing in annexure 10)

Ecotel, resort and other recreational facilities planned for both node 2 and node 3 are designed keeping PPP model in mind as per the proposal given by GMDA. Node 2 with the proposed recreation area is divided into areas for an Ecotel and additional resorts with cottages along with public recreation facilities. Node 3 is proposed with a detailed layout plan for all water related recreational facilities, taking advantage of the water edge and proximity to city limits. This can be implemented after the clarification of notified and potential notified areas. Nearly all plots in this node are marked as notified and potential notified area (Annexure 8). In the meantime, facilities approved by state government for all 3 nodes will be developed phase wise in the open available land pockets, leaving the existing houses for evacuation (interview extract from Mr. R. M. Das, consultant, GMDA).

8.1.2 Community Perception and Participation

The conservation measures include both social and economic parameters for a better living conditions of the fringe communities along with forest and water conservation, sustaining local people and their interests in conserving the wetland resources for their livelihood is a necessary precondition for management of natural resources (wise use of wetlands resources, Ramsar handbook). The community development strategies undertaken in the Eco Park proposal envisions the social cohesion and development by integrating local communities and fisherman villages into the overall restoration and development plan and thus implement grassroots level involvement. Community fishing for personal use and livelihood, Pottery Making, Seasonal Crop Cultivation, Flower Culture, Ornamental Fish Culture, Recycling Water Hyacinth and Animal Rearing are some Bio-rights possibilities are suggested for the communities. Landscape regeneration for forest cover adjacent to the wetland and water streams in the forest needed an immediate attention. Planting of trees for bird nesting (Bombaxceiba, Ximolu in Assamese) and Elephant fodder in the forest areas was recommended by experts and suggested to be implemented through voluntary services; thereby developing a strong sense of ownership.

8.1.3 Ecological Aspects

The Landscape Design Decisions were carefully examined for modifications to minimize impact on wildlife, human wellbeing, poverty alleviation, maintaining ecological character and biodiversity. For better implementation of design strategies, the existing area under consideration consisting of forest, wetland, foothills and open /agricultural lands were grouped as

- Urban Landscape: The built environment- buildings and infrastructure, fishing and tribal villages
- Rural Cultural Landscape: Village grazing reserves, tree plantations, fisheries (ponds), crop land (seasonal)
- Natural and Semi-natural Landscape: forest, wetlands, foothills and the open lands/agricultural.

Ecological benefits for all of the above can be achieved through various built and landscape considerations, with key objectives to create a sense of community and contextual identity. The design of recreation facilities seek to provide flexibility with well-defined pedestrian links and also emphasize views of the wetlands through buffer landscape, boundary design and edge design. The types of edges used for landscape regeneration are open corridors (roads, pathways, service corridors, lawn strips), woody corridors (hedges, tree lines, fencing with plants) and riparian edges (interface between land and a river or stream) in the buffer zones. Provision for Elephant Corridor, native vegetation (grass cover) along the inlet and Outlet Rivers and wetland edges, and buffer around the existing core area (bird sanctuary) are planned using the Patch-Corridor-Matrix Model to protect nature and biodiversity at all levels of scale. For example, the native grass cover along the inlet river will also facilitate for a seamless connectivity to the water edge for the local communities to perform their religious activities and ceremonies that need physical connectivity with water. In the Riparian Buffer, the root system of vegetation provided for bank stability (reduce flood & erosion) will help maintain bio-diversity and environmental protection; trap nutrients, store water and provide for wildlife habitat. The softness and organic nature of water-to-land transitions are maintained by providing all edge and boundary details with softscapes doubling as riparian corridors and buffers in many places (Please refer to sections 7.4.1 and 7.4.2, page 108-112). Minimum buffer space kept as 25 meters on both sides of rivers and streams and 50 meters from the main Deepor Beel edges. Only circulation paths and decks are kept after this buffer. All buildings are placed at more than 100 meters away from the wetland edges maintaining a gradual transition, except all watch towers.

The proposed ecological design strategies contribute to the integrated watershed management with emphasis on protective afforestation development, harvesting of runoff water and waste water treatment. One constructed wetland is created at the junction of the inlet river and the wetland for Boating and the other two are at water park area in 'node 3' for various water

sports facilities and a pool camping area. They are formed by joining patches of water bodies for water retention. Smaller ponds are proposed as per the contours and the slope will act as Bio Swales and also add to the aesthetic value. Moreover site development activities such as drain improvement and de-siltation systems are proposed by GMDA to conserve the environment of the water-body by providing ecological design solutions for mitigation of anthropogenic degradation of the wetland's eco-system.

8.1.4 Economic Factors

The social and potential values of identified resources were considered in the planning stage for their appropriateness. Detailed study and analysis of water imagery in the context of indigenous people living around this wetland and their cultural adaptation process has shown significant implications in the process of sustainable management. Dependency of the community from the fringe villages on the wetland was calculated (Figure 6.5) in PRA method. The dependency of the fishing villages for fishing (80%) and tribal villages for fodder is highest (58%), whereas the only dependency of new settlers is for fodder collection (35%). Tribal communities and the new settlers do fishing only for personal use (66% and 24% respectively). The possible economic benefits recommended by both FGD participants and villagers were horticulture, pisciculture, floriculture, sericulture, piggery, poultry and dairy development with training and environmental motivation programs. Willingness for bio rights was also calculated in PRA for fishing, seasonal vegetables, mushroom cultivation, floriculture, ornamental fish farming and crafts from dry hyacinth. The fishing communities favored all possibilities for bio rights, except mushroom cultivation. The diverse tribal communities favored agriculture, floriculture and craft making as against fishing. The new settlers had interest towards economic activities as alternative livelihood for ornamental fish farming, floriculture and crafts (50%, Figure 4.2). These activities were proposed in the design as per their proximity. For example the floriculture was proposed with botanical garden with easy access from both fishing and tribal villages. The weekly markets provided in nodes 1 and 2 will facilitate for quick economic returns as well as maintain an age old tradition for the region as a whole. It was also obvious from the PRA meetings in all villages that unity among various tribes and fishing communities would generate opportunities to resolve conflicts and obstacle for conservation and management of the wetland. For consensus building among them, a scheme for training local volunteers as tourist

guides was suggested and successfully planned for implementation with “*Rongman Society*”, a NGO from the tribal village *Deochotal*. 15 Youths from tribal and fishing villages registered for the training to be held as the fund for the training is collected (detail in figure 6.12, page 91). Bio-rights schemes and micro financed projects with banks and PPP model were suggested to improve ownership spirits and willingness to share costs. The cost model recommended for project development was divided in phases for resource generation and timely completion, keeping the goal of SCP and DPR implementation in mind. These proposed developmental actions will also assure the improvement of quality of life of local people who are dependent on wetland as well as environmental conditions of the wetland that could be enhanced by providing them with more opportunity to be engaged in livelihood activities linked to the stewardship and management of the wetland.

8.1.5 Education and Research promotion

In line with The International Eco-tourism Society’s goals (TIES, 1990) for restoration , and conservation of eco-tourism sites along with local benefits like providing educational facilities to the locals and steps towards reduction of ecological footprints., there is provision of educational and research benefits in the natural settings, which include a Nature Interpretation Center, Aqua Culture Center, an Aquarium and a Museum for birds, flowers and butterfly species in the N-E region with interactive devices for bird monitoring in bird watching towers. Voluntary work by school and college students as suggested in the economic model for landscape regeneration and Riparian Buffer Zones will help in active learning. This will also provide a learning platform towards developing a sense of ownership for nature conservation. The forest will continue to provide for nature trailing and biological research opportunities with guidance from expert environmentalists living in the fringe villages and supported by local trained tourists guides. Recently in February 24, 2018 an eco-camp was opened by *Rongman* society in *Deochotal*. Since then, tourist groups from Netherlands (2), Australia (1), Austria (1), Delhi (1) and Bangalore (1) visited the camp and went for forest trekking. The elephant corridor proposed with a watch tower will also facilitate for wildlife observation and research. This will also help mitigating the man-animal conflict.

8.1.6 Energy Efficiency

Following the goal 11 of SDG of United Nation to make human settlements inclusive, safe, resilient and sustainable, passive design strategies for energy efficiency were implemented through building orientation, shading devices by using traditional and local materials and low-rise-structures (except bird watching and watch towers). Semi covered walkways for comfort from sun, food courts without any external walls with natural ventilation, weekly markets sheds with local thatched roof and mud floors are few example of energy efficient and sustainable design principles used. Sustainable practices like use of solar car for internal communication in all 3 nodes for visitor's comfort and reduced carbon emission, ample use of local and easily available material bamboo in retaining walls, fencing, overhead shading and recycling of water hyacinth were suggested in the proposal. To reduce the surface radiation, tree canopies are proposed along the internal tar road and all open surfaces are covered with either native ground cover or small water bodies that also helped creating micro climate.

8.1.7 Cultural and Design Identities

Building typologies are mainly characterized by traditional building design and elements with single floor structure and gabled roof. The circulation axes or the connecting lines like roads, tree-lined pathways for walking and cycling with places to unwind (seating, steps near water) will help build cohesiveness among public buildings and other point of attractions, like big open spaces for public gathering and play areas, amphitheaters, open grounds, food court, and nature trails. The traditional design of the weekly market (sheds) using thatched roof over bamboo frames with mud floors illustrates the age old tradition prevailed all over N-E region (Annexure 11, 9-Landscape Elements). Traditional designs are also suggested for landscape embellishments like sculptures, street furniture etc. to promote cultural and regional design identities. For example shaded bamboo pedestrian ways (Annexure 10, hard scape) and solar car stands/bus stops in the shape of a fishing accessory (Annexure 11, 8-Design Decisions). Festival celebration areas like playground and amphitheaters along with access to water bodies at many places are provided in all 3 nodes for a better human centric design to facilitate contextual cultural and religious practices.

8.2 Conclusion and recommendations

This study reflects the best practices for an integrated conservation and management of urban wetlands with context specific design solutions and recommendations for development. Recognizing and enhancing the concept of urban wetland park as an opportunity to conserve ecological and social diversity, it examines institutional provision for protection, conservation and management by the local government, contribution by the NGOs, capacity building for livelihood opportunities and community participation, research and development for ecological design for this valuable urban wetland during the period of 2002 and 2017 since the date of declaration as Ramsar site. The multidimensional, institutional, social and natural landscape challenges inferred were addressed as a part of socially responsive Architecture and Urban Planning. That helped in attaining sustainable and suitable design solutions for Eco Park and recreation facilities as a nature based protection and conservation strategy. For enhancing the economic and social standing of the community as a whole, now is the time for intervention by all stakeholders with interdisciplinary contributions, aiming at the Smart City Goal. However, for continuous efforts towards a holistic urban growth, inter-institutional and individual research efforts need to continue for the conservation of these Green Blue urban infrastructures.

Though this research is aimed at a holistic approach for sustainability while attaining human resource development, few intents like water quality management, environmental economy and environmental impact assessment were beyond the scope of this research. Thus, realizing the importance of urban wetlands and the significance of restoration and protection of such wetlands, following recommendations are proposed here for further implementations and research.

Suggestions for further implementations:

- Water quality monitoring and management shall be conducted on a regular basis by the operation and management authorities after construction of suggested strategies like constructed wetlands for water purification, silt traps, riparian corridors etc.
- The awareness building with transparency by the government agencies by engaging the communities in the Conservation and Management (C&M) planning will act as a strong catalyst among all stakeholders, particularly the fringe communities.

- Use of GIS for transport, managing public and wetland biodiversity, automation, smart park solution for park management and tourism appreciation will bring this wetland park a step closer to a smart Eco Park proposal.
- Economic assessment of wetland resources will help in preparing varied Economic Models for health, property and recreational values. Engagement of expert bodies (E.g. NABARD) for financial planning and feasibility studies with corporate houses will support faster generation of Common Pool Resources.
- Preparing a management plan by GMDA after carrying out detailed carrying capacity

Scope of further research:

- The scope of alternative energies in agricultural and domestic use may also be explored and evaluated.
- The magnitude and nature of community involvement for economic benefits can be worked out after careful evaluation.
- Research on environmental impact before and after interventions can help in building prototype solutions.

Project realization based upon this study is of high importance and can be achieved by breaking down the complete project work in phases for easy operation and implementation. Depending on the nature of work, the development and construction activities like procuring permissions, from the concerned authorities, land survey, clearance and compacting, site mobilization, and construction etc. were placed in a set of expenses ranging from low to high along with their importance of time frame. Phase one involves the initiation of the project with time dedicated for acquiring permissions, approvals and site mobilization. Phase two involves active work on site development with participation of the key stakeholders and NGOs to shoulder the responsibility of revival and restoration of the Eco-park. Phase three is the final stage of the project before being open for public use. The project realization enables the achievement of a sustainable growth with regeneration of the ecosystem, thereby avoiding further threats to the existing scenario. The phase wise distribution also provides time for systematic working and organizing funds and brings in opportunity for committed participation by all stakeholders.

References

- Archer, B. (1979). Design as a discipline. *Design studies*, 17-20.
- Arshad Amin, S. F. (2015). Evaluating Urban Landscape Dynamics over Srinagar City and Its Environs. *Journal of Geographic Information System*, 7(2), 211-225.
- ASTECC. (2018). *Air pollution*. Retrieved from ENVIS Centre, Assam: http://asmenvis.nic.in/Database/AirPollution_1127.aspx
- Axelrod, L. J., & Suedfeld, P. (1995). Technology, capitalism, and Christianity: Are they really the three horsemen of the eco-collapse? *Journal of Environmental Psychology*, Vol 15(3), 183-195.
- Aziz, A., Barzekar, G., Ajuhari, Z., & Idris, N. H. (2015). Criteria & Indicators for Monitoring Ecotourism Sustainability in a Protected Watershed: A Delphi Consensus. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 1-9.
- Barnes, T. G. (2017). *A Guide to Urban Habitat Conservation Planning*. Retrieved from Agriculture and natural resources, University of Kentucky: <http://www2.ca.uky.edu/agcomm/pubs/for/for74/for74.pdf>
- Barua, M. (2014). Environment conservation. (Author, Interviewer)
- Bayazit, N. (2004). Investigating design: A review of forty years of design research. *Design Issues*, Vol 20, 16-29.
- Bhuvan NRSC. (2012). *Indian Geoplatform of ISRO*. Retrieved from National remote sensing center: bhuvan.nrsc.gov.in
- Biman Bhuyan, K. B. (2013). Ethno medicinal value of various plants used in the preparation of traditional rice beer by different tribes of Assam, India. *Drug inventions today*, 1-7.
- C. Mozumder, N. T. (2014). Geospatial scenario based modelling of urban and agricultural intrusions in Ramsar wetland Deepor Beel in Northeast India using a multi-layer perceptron neural network. *International Journal of Applied Earth Observation and Geoinformation*, 92-104.
- Casagrande, D. G. (1997). *Restoration of an urban salt marsh: An interdisciplinary approach. (ED)*. New Haven, CT.: Yale School of Forestry and Environmental Studies.
- Center, China Internet Information. (2015). *Summer Palace (Yiheyuan)*. Retrieved from Beijing, A Guide to China's Capital: <http://www.china.org.cn/english/MATERIAL/30960.htm>
- Chambers, R. (1994). Participatory Rural Appraisal (PRA): Challenges,. *World Development*, Vol. 22, No. 10, 1437-1454.
- Chauhan, B. S. (2014). *6 Eco-tourism sites in PPP mode in Himachal*. Retrieved from Business Standard: <http://www.business-standard.com/article/current-affairs/6-eco-tourism-sites-in-ppp-mode-in-himachal>
- Chilika Development Authority. (2014). *Eco-restoration*. Retrieved August 22, 2014, from Chilika Development Authority: <http://www.chilika.com/eco-restoration.php>

- Commission, P. (2008). *Report on Visit to Vembanad Kol, Kerala*. Vembanad Kol, Kerala: Planning commission, Govt. of India.
- Daley, B. J. (2004). Using Concept Map in Qualitative Research. *Concept maps: Theory, Methodology, Technology, vol-1* (pp. 191-199). Pamplona, Spain: NovaText. 31192 Mutilva Baja (Navarra).
- Das, N., & Syiemlieh, H. (2009). Ecotourism in Wetland Ecology. *Anatolia*, 445-450.
- Das, R. M. (2016). DPR, Deepor Beel. (Author, Interviewer)
- David Dodman, G. M.-C. (2004). *Integrating the environment in urban planning and management*. Nairobi: UNON/Publishing Section Services.
- David Lawrenz, C. M. (2012). *Urban Wetlands*. Retrieved from Emporia State University: <http://home.kc.surewest.net/kcmalonees/wetlands/urbanwetlands.htm>
- Department of fisheries, Assam. (2014). *Department of fisheries, Government of Assam*. Retrieved from Department of fisheries, Government of Assam: <http://www.fishassam.gov.in>
- Department of Tourism, Govt. of Assam. (2017). *Tourism policy of Assam*. Retrieved from Director of Tourism: <https://directortourism.assam.gov.in/>
- Department of Tourism, Govt. of Assam. (Accessed 2019). *Arrival of tourists*. Retrieved from Assam tourism development corporation ltd.: <https://tourismcorporation.assam.gov.in/about-us/detail/arrival-of-tourists>
- Dev, A. (2014). *UP to boost eco-tourism with bird sanctuary overhaul*. Retrieved from Times of India: <https://timesofindia.indiatimes.com/home/environment/flora-fauna/UP-to-boost-eco-tourism-with-bird-sanctuary-overhaul/articleshow>
- Dey, D. (2010). *Conserving wetlands through microfinance*. Retrieved from TEEB: www.scribd.com/document/259263908/Conserving-Wetlands-Through-Microfinance-Programs-India
- Dubai Municipality. (2008). Marine Environment & Sanctuaries Unit. *Ras Al Khor wildlife Sanctuary*. Dubai, Dubai, UAE: www.environment.dm.gov.ae.
- Eco India. (2013). *Mahim Nature Park*. Retrieved from Eco Park: <http://www.ecoindia.com/parks/mahim>
- Economy watch. (2010). *Eco Tourism Industry*. Retrieved August 23, 2014, from [economywatch.com](http://www.economywatch.com): <http://www.economywatch.com/world-industries/tourism/eco>
- Eijk, P. V., & Kumar, R. (2009). *Bio-rights in theory and practice*. Netherlands: Wetland International.
- EKWMA. (2014). *Conservation and management plan of East Kolkata Wetlands*. Kolkata: EKWMA.
- Elinor Ostrom, R. G. (1994). *Rules, Games, and Common-Pool Resources*. MI, United States: The University of Michigan Press.
- Environment Agency-Abu Dhabi . (2011). *International Waterbird Census 2011, Status of wetlands and water birds in UAE*. Abu Dhabi.
- EUCC news. (2013). *Increasing pressure on Llobregat Delta, what will be the next?* Retrieved from EUCC Mediterranean Centre: www.euccnews.wordpress.com

European commission. (2002). *Defining, measuring and evaluating tourism carrying capacity in European tourism destinations*. European commission.

European commission. (2005). *Community participation*. ECHO, EU evaluation.

Express new service- Bhubaneswar. (2014). *Laying roads: State asked to use cold mix tech*. Retrieved from The new Indian Express: www.newsindianexpress.com

Fraser, M. (2013). *Design research - an overview*. Surrey, UK: Ashgate publishing limited.

Ghosh, S. (2010). *India and eco-tourism*. Retrieved August 23, 2014, from e-pao.net: http://e-pao.net/epPageExtractor.asp?src=travel.India_and_eco_tourism.html

Giovanni De Feo, A. N.-G. (2013). Historical and Technical Notes on Aqueducts from Prehistoric to Medieval Times. *Water*, 1996-2025.

GMDA. (2009). *Master plan for Guwahati Metropolitan Area – 2025, part 1*. Guwahati: GMDA.

GMDA. (2012). *Master plan*. Retrieved from Guwahati Metropolitan Development Authority: www.gmda.co.in

Gogoi, A. (2007). *Pillars of Nation Building, Jaymati and Lachit Barphukan*. Guwahati: Asom Lekhika Sangstha.

Gregor Torkar, B. Z. (2011). Qualitative interviews in human dimensions studies. *Varstvo Narave, vol 25*, 39-52.

Guangqing Chi, D. W. (2013). In-migration to remote rural regions: The relative impacts of natural amenities and land developability. *Landscape and urban planning, volume 117*, 22-31.

H. Wang, Q. S. (2014). GIS-based framework for supporting land use planning in urban renewal: case study in Hong Kong. *Journal of urban planning and development*.

Haase, D. (2015). Reflections about blue ecosystem services in cities. *Sustainability of Water Quality and Ecology*, 77-83.

Harry Jonas, K. B. (2010). Community Protocols and Access and Benefit Sharing. *Asian Biotechnology and Development Review*, 49-76.

Hiscock, S. (2007). Broaden your horizons. *In Britain*.

IANS. (2012). *Mushroom path for Eco Tourism*. Retrieved from en-maktoob yahoo news: <https://en-maktoob.news.yahoo.com/mushroom-path-eco-conservation-075927872.html>

Iberia nature. (2014). *The Delta del Llobregat*. Retrieved from Natural history of Spain: www.iberianature.com/material/delta_llobregat.html

ICOMS. (1998, October). *The Summer Palace, an imperial garden in Beijing*. Retrieved from International Council on Monuments and Sites: <https://whc.unesco.org/document/154509>

IITG. (2013). *Assamese community and language*. Retrieved from Resource center for Indian Language Technology solutions, Phase II: www.iitg.ac.in/rcilts

- J.K.Garg. (2015). Wetland assessment, monitoring and management in India using geospatial techniques. *Journal of Environmental Management*, 112-123.
- Jyotishma Das, S. P. (2011). Species diversity of water birds in Deepor Beel, Assam. *Journal of Research in Biology*, 363-369.
- K.Medhi, D. (2003). Potters and pottery of the Assam region. *Earthenware in South East Asia*. Singapore: Singapore university press.
- Kai Xu, C. K. (2010). Changes of urban wetlands in Wuhan,China, from1987to 2005. *Progress in Physical Geography*, 207-220.
- Kakati, B. (1941). *Assamese : Its Formation and Development in 1935*. Guwahati: Government of Assam.
- Katcher, A. H., & Beck, A. M. (1987). Health and caring for living things. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*,, 175-183.
- Klem, D. J. (2006). Glass: a deadly conservation issue for birds. *birds observer*, 73-81.
- Kourandeh, H. H., & Fataei, E. (2013). Estimation of Tourism Carrying Capacity of Fandoqloo Forest in Ardebil Province, Iran. *Bulletin of Environment, Pharmacology and Life Sciences*, 64-70.
- Krishna G. Bhattacharyya, N. K. (2009). Impact of urbanization on the quaity of water in a natural reservoir: a case study with Deepor Beel in Guwahati city, India. *Water and Environmen* , 83-96.
- Kumar, K. (n.d.). *Landslide Problems and Preventive Techniques in North East*. Gangtok: CSIR, GTE division.
- LAWDA. (2011). *Audit report for the year ended 31 March 2011*. Srinagar: LAWDA.
- Leo Zwarts, R. G. (2009). *Living on the edge: Wetlands and birds in a changing Sahel*. Zeist: KNNV Publishing.
- Liiu, E. b. (2014). *Chinese Research Perspectives on the Environment, Volume 3*. Netherlands: Social Sciences Academic Press and Koninklijke Brill NV.
- Linda N Groat, D. W. (2013). *Architectural design research*. New Jersey, Canada: John Wiley and Sons.
- Loktak Development Authority. (2014). *Loktak Wetland Comlex*. Retrieved from Loktak Development Authority: <http://www.loktaklake.org/loktaklake.html>
- Ludwig, A. (2003). *Principles of Ecological Design - Integrating Technology, Economics, and Ecology*. Oasis Design.
- M.N.Nagabhushana. (2013). *Bituminous Emulsion Based Cold Mix Technology*. New Delhi: CRRI.
- Madhav Gadgil, N. S. (1998). People, Refugia and Resilience. In C. F. Fikret Berkes, *Linking Social and Ecological Systems: Management Practices and Social Mechanism for Building Resilience* (pp. 30-42). City Pressambridge Univer.
- Mahanta, N., Samuel, A., & Rajput), B. (2018). Community Participation and Bio-rights Possibilities in the Conservation of Urban Wetlands: a Study of Deepor Beel (lake), Guwahati, India. *ICDCL*. Noida, India: Amity University, Noida.

- Makhzoumi, J., & Pungetti, G. (1999). *Ecological Landscape Design and Planning*. London: E & FN Spon.
- Mary Thornbush, O. G. (2013). Sustainable cities targeted by combined mitigation–adaptation efforts for future-proofing. *Sustainable Cities and Society*, 1-9.
- Mazlina Mansor, I. S. (2008). Sense of Well-Being from Experiencing Green Infrastructure Network in small towns. *International Conference on Environmental Research and Technology 04/2008*; . Penang, Malaysia.: ICERT.
- McHarg, I. L. (1992). *Design with nature*. Washington DC: John Wiley & Sons.
- Ministry of Environment. (2017, September 27). *Wetlands (Conservation and Management) Rules, 2017*. Retrieved from India Environmental Portal:
<http://www.indiaenvironmentportal.org.in/content/447822/wetlands-conservation-and-management-rules-2017/>
- Ministry of Urban Development, Govt. of India. (2015). *Promoting innovative smart solutions under smart cities mission, Amrut and Swachh Bharat mission*. Retrieved from Smart cities: http://smartcities.gov.in/upload/smart_solution
- Ministry of Urban Development, Govt. of India. (2016). *Promoting innovative smart solutions under smart cities mission, Amrut and Swachh Bharat mission*. Retrieved from Smart cities: http://smartcities.gov.in/upload/smart_solution
- Nassauer, J. I. (2004). Monitoring the Success of Metropolitan Wetlands Restoration: Cultural Sustainability and Ecological Function. *Wetlands*, Vol. 24, No. 4, 756-765.
- Nath, D. (1989). *History of Koch Kingdom 1515-1615*. Delhi: Mittal Publication.
- National wetland conservation policy . (2006). *Conservation of Wetlands in India: A Profile*. New Delhi: MoEF, GOI.
- Nayan Sharma, G. J. (2012). Assessing wetland landscape dynamics in the Deepor Beel of Brahmaputra basin using geospatial tools. *Asian Journal of Geoinformatics, Thailand, Vol.12, No.1, Thailand*.
- NDSU case studies. (2007). *Preparation of a Management Plan for Deepor Beel Wetland in India*. North Dakota: NDSU.
- NESAC. (2012). *Urban growth pattern*. Retrieved from Urban and Infrastructure portal: www.nesac.gov.in
- NEYP. (2015). *State Govt ignoring Centre's directives*. Retrieved from NEYP news: <http://neypnews.com>
- Nicholas, G. P. (2001). Wet sites, wetland sites and cultural resource management strategies. In E. Barbara A. Purdy, *Enduring records: the environmental and cultural heritage of wetlands* (pp. 262-270). Oxford: Oxbow books, Oxford.
- Nie, C., Yang, J., & Huang, C. (2016). Assessing the Habitat Quality of Aquatic Environments in Urban Beijing. *International Conference on Geographies of Health and Living in Cities: Making Cities Healthy for All, Healthy Cities 2016* (pp. 162-168). Elsevier B.V.

- Niva Mahanta, B. R. (2018). Community participation.
- Novak, J. D., & Ithaca, N. Y. (1977). *A theory of education*. Cornell University Press.
- NWCP. (2014). *National Wetland Conservation Programme*. Retrieved August 22, 2014, from Ministry of Environment and Forest, Govt. of India: <http://envfor.nic.in/division/national-wetland-conservation-programme-nwcp>
- NWCP. (2016). *National wetlands conservation programme*. Retrieved from Ministry of Environment, Forest and Climate Change: <http://envfor.nic.in/division/national-wetland-conservation-programme-nwcp>
- Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. UK: Cambridge University Press.
- P.K.Saikia. (2005). *Qualitative and Quantitative study of Lower and Higher Organisms and their Functional role in the Deepor Beel Ecosystem*. Umium, Meghalaya, Shillong: North Eastern Space Applications Centre, Department of Space, Government of India.
- P.K.Saikia, M. (2011). *Biodiversity in Deepor Beel, Ramsar site of Assam, India*. Deutschland, Berlin: LAP Lambert Academic Publishing.
- Parineeta Dandekar, H. (2011). Welcome, but a lost opportunity: This cannot help protect the wetlands, sir. *South Asia's Network on Dams, Rivers and People*, pp. 1-12.
- Patowary, A. (2013). *GMDA submits storm water drainage project*. Retrieved from Assam Tribune: <http://www.assamtribune.com/scripts/mdetails.asp?id=sep2613/city05>
- Patowary, A. (2014). *Govt dumps Rule of city water bodies Act*. Retrieved from Assam Tribune: <http://www.assamtribune.com/scripts/detailsnew.asp?id=jul0214/city05>
- Peter G. Saenger, D. K. (2009). Architectural and landscape risk factors associated with bird-glass collisions in an urban environment. *The Wilson journal of Ornithology*, 126-134.
- Phukan, S. K. (2003). *Hydronymy of Assam*. Guwahati: Supriti Phukan.
- Planning Commission. (2007). *Report of the Working Group on Natural Resources Management ,Eleventh Five Year Plan*. New Delhi: Planning Commission, GOI.
- Planning Commission, G. I. (2008). *Report on visit to Deepor Beel in Assam*. New Delhi: Planning Commission, Govt. of India.
- Qadri, A. (2015). *The world famous Dal Lake dying a slow death*. Retrieved from The Tribune: <http://www.tribuneindia.com/news/jammu-kashmir>
- Qing, D. (2008). *Beijing's Water Crisis, 1949-2008 Olympics*. Beijing: Probe International Beijing Group.
- R.J.Deka, N. K. (2003). Zoos' print journal. *Zoos' print journal* 18(3), 1043-1045.
- Rafael Marce', J. H.-R. (2012). The Llobregat River Basin: A Paradigm of Impaired Rivers Under Climate Change Threats. In S. G. Sabater, *The Handbook of Environmental Chemistry* (pp. 27-51). Springer.
- Raha, M. K. (1989). *Matriliney to patriliney: A study of the Rabha society*. Delhi: Gian Pub. House.

- Ramsar. (2002). *Deepor Beel*. Retrieved from Ramsar Site Information Service: <https://rsis.ramsar.org/ris/1207>
- Ramsar. (2004). *Wetland tourism: a great experience*. Gland, Switzerland: The Ramsar Convention on Wetlands.
- Ramsar. (2017). *Deepor beel*. Retrieved from Ramsar site information services: rsis.ramsar.org/ris/1207
- Ramsar convention. (2017). *Ramsar site information service*. Retrieved from Ramsar: <https://rsis.ramsar.org/ris-search>
- Reporter, S. (2012). *Green Roads Mission launched in State*. Retrieved from The Assam Tribune, Guwahati: www.assamtribune.com
- S. Pérez, A. G.-S. (2012). Wastewater Reuse in the Llobregat: The Experience at the Prat de Llobregat Treatment Plant. In A. G. Sergi Sabater, *The Llobregat. The Story of a Polluted Mediterranean River*. Berlin: Springer.
- S.N. Prasad, T. R. (2002). Conservation of wetlands of India – a review. *Tropical Ecology*, pp. 173-186.
- Saikia P.K, S. M. (2011). *Biodiversity in Deepor Beel-Ramsar site of Assam, India. Faunal diversity*. Deutschland, Germany: LAP Lambert Academic Publishing.
- Saikia, K. B. (2013). Threat to the Migratory Avian Fauna of Deepor Beel: A Ramsar site in Assam . *The Ecoscan* ,7 (1&2), 31-36.
- Secretariat of the Convention on Biological Diversity. (2004). *Guidelines on Biodiversity and Tourism Development*. Montreal, Canada: Secretariat of the Convention on Biological Diversity.
- Secretariat of the Ramsar Convention on Wetlands (Ramsar, I. 1. (2012). *Destination wetlands: supporting sustainable tourism*. Ramsar Convention on Wetlands, Gland, Switzerland, & World Tourism Organization (UNWTO),.
- Seema Mehra Parihar, S. S. (2012). Characterizing wetland dynamics: A post-classification change detection analysis of the East Kolkata Wetlands using open source satellite data. *Geocarto International* 28(3), pp. 273-287.
- Shannon, K. (2011). Approaching Urban Development. In M. N. Carmen Mendoza Arroyo, *reflectiosn- on development and cooperation* (pp. 35-42). Barcelona: Map Impresores Grafman S.L.
- Sharma B.K, S. S. (2012). Deepor Beel- a Ramsar site of India: an interesting hotspot with its rich Rotifera biodiversity. *Acta Zoologica academica scientiarum Hungaricae, Budapest*, 105-120.
- Sharma Nayan, O. B. (2006). Remote Sensing Based Study on Channel Changes and Wetland Ecosystem Dynamics of Brahmaputra River in India. *International Conference on Riverine Hydrology* (pp. 84-85). Scotland: conference proc.
- Sharma, A. (2013). *Assam's Sole Ramsar Site Gasps for Breath*. Retrieved from The pioneer: <http://www.dailypioneer.com/>

- Sharma, M. (2012). *Ramsar-convention-and-dispiriting-state-indian-wetlands*. Retrieved from Halabol voices: <http://voices.halabol.com>
- Sharma, M. (2015). Using focus groups lin community based rehabilitation . *Asia Pacific Disability Rehabilitation Journal*, 41-50.
- Sim Van der Ryn, S. C. (1996). *Ecological Design*. Island press.
- Simanta Kalita, D. B. (2012). *Supporting Urban Sustainability Location: Guwahati, India Focus Ecosystem: Deepor Beel Ecosytsem Ecosystem type: Wetland*. Retrieved from Slide player: <http://slideplayer.com/slide/4199584/>
- Simon Eisner, A. G. (1993). *The Urban Pattern*. New York: John Wiley & Sons.Inc.
- Singh, K. P. (2014). *Pallikaranai to Turn Wildlife Park*. Retrieved August 24, 2014, from The wild life of India: <http://www.thewildlifeofindia.com/blog/pallikaranai-to-turn-wildlife-park.html>
- Smile Foundation. (2012). *Parijat Academy*. Retrieved from smilefoundationindia: www.smilefoundationindia.org
- South Asian Forum for Environment. (2015). *Biorights*. Retrieved from South Asian Forum for Environment: <http://www.safeinch.org/cmspage.php?id1=4&id2=66>
- Special correspondent The Hindu. (2012). *Eco-restoration project on in Pallikaranai marshland*. Retrieved from thehindu.com: <http://www.thehindu.com/todays-paper/tp-national/tp-tamilnadu/ecorestoration-project-on-in-pallikaranai-marshland/article3671963.ece>
- Staff-Reporter. (2014). *GMDA report on Deepor Beel*. Retrieved from The Assam Tribune: www.assamtribune.com
- Talukdar, K. (2013, October). *Fish deaths at Deepor Beel*. Retrieved from The Telegraph: https://www.telegraphindia.com/1131018/jsp/northeast/story_17465252.jsp
- Talukdar, K. (2013). *Speeding train mows down elephant calf*. Retrieved from The Telegraph: https://www.telegraphindia.com/1131221/jsp/northeast/story_17704435.jsp
- Talukder, S. (2014). *NGT notice to Assam on garbage dumping on wetlands*. Retrieved from The Hindu: <http://www.thehindu.com>
- Terron, L. (2016). Environmentalist. (Author, Interviewer)
- Thomson, R. C. (1948). *Assam Valley–Beliefs and Customs of Assamese*. London: Luzac and company ltd.
- TNN. (2012). *Kamrup district administration bans filling of wetlands*. Retrieved from The Times of India city : <https://timesofindia.indiatimes.com/city/guwahati/Kamrup-district-administration-bans-filling-of-wetlands/articleshow>
- Tracy Boyer, S. P. (2004). Valuing urban wetlands: A review of non-market valuation studies. *Wetlands*, vol.24, 744-755.
- UNESCO. (1997). *World Heritage List, 880*. UNESCO.

UNESCO. (2013). *Summer Palace, an Imperial Garden in Beijing*. Retrieved June 10, 2015, from UNESCO, World heritage culture: <http://whc.unesco.org/en/list/880>

UNESCO. (2014). *Keoladeo National Park*. Retrieved from UNESCO-World Heritage Convention: <http://whc.unesco.org/en/list/340>

V.K.Bansal. (2011). Application of geographic information systems in construction safety planning. *International journal for project management*, 66-77.

V.V.Sugunan, B. (2000). *Ecology and fisheries of beels in Assam*. Barrackpore, West Bengal: Central Inland Capture Fisheries Research Institute .

Valentina Teronpi, H. T. (2012). Ethnozoology of the Karbis of Assam,India: Use of ichthyofauna in traditional. *Ancient science of life*, 99-103.

Valentina Teronpi, H. T. (2012). Ethnozoology of the Karbis of Assam,India: Use of ichthyofauna in traditional health-care practices. *Science of life*. Retrieved October 19, 2013, from www.ancientscienceoflife.org.

W. Otie Kilmer, R. K. (1992). *Designing Interiors*. Wadsworth Publishing.

Wendy R. McClure (Editor), T. J. (2007). *The Built Environment: A Collaborative Inquiry Into Design and Planning, 2nd Edition*. New Jersey, United States: Wiley.

Wikipedia. (2012). *Garchuk Lachit Garh*. Retrieved from Wikipedia: https://en.wikipedia.org/wiki/Garchuk_Lachit_Garh

Wordpress. (2013, December 19). *The battle of Saraighat*. Retrieved from Rubu Writes: <https://rubuwrites.wordpress.com/2013/12/19/the-battle-of-saraighat/>

ANNEXURE 1: LIST OF PROJECTS AS PER SMART CITY PROPOSAL: GUWAHATI

Sl No.	Projects in SCP	Cost (Rs. in Crore)
	Area Based Development (ABD)	
	Borosola Beel(Lake) project	
1	Construction of Treatment Plant	80.00
2	Cleaning & Re-section of Beel (Lake)	
3	Development of parks	
	Mora bharalu River project	
4	Treatment Plant at every one Kilometer	421.00
5	Cleaning & Re-section of Drain	
6	Construction of Embankment & Compaction	
	ABD	
7	Solar	
8	Walkway & Cycling Track,	
9	Shops etc.	
10	Restaurants over Bridges etc.	
	Bharalu River project	
11	Treatment Plant at every one Kilometer	296.00
12	Cleaning & Re-section of Drain	
13	Construction of Embankment & Compaction	
14	Solar	
15	Walkway & Cycling Track,	
16	Shops etc.	
17	Restaurants over Bridges etc.	
	Brahmaputra Riverfront Project	
18	Embankment (Filling and cutting of earth)	532.00
19	Construction of Concrete sloping wall with rock filling	
20	Construction of Infrastructure work	
	Deepar Beel Project	
21	Base Work - Development for half area	250.00
22	Construction of Infrastructure - solar,walkways, shops etc.	
23	Adjustment (Totaling Mistake in Proposal)	(40.00)
	Pan City	
	ICT Project on Public Transport System	
24	Development of ICT application	150.00
25	Development of Hydraulic Information System	
26	Installation of GPS, Wifi network, Computer and other electrical equipment	
	Bus Stop Wholly developed by Private organizer (100%) on BOT Model	
27	Construction of Bus Bay & Bus Stop with all facilities on all two lane roads	432.00
28	Marking of Bus bay on three lane road	
	Improvement of Road/Foot Path/Traffic Junction on PPP mode Cost	
29	Construction of Footpath	40.00
30	Construction of Road crossing	

ANNEXURE: 2 WETLANDS REGULATIONS AUTHORITY IN INDIA

Including the Ramsar Convention on Wetlands 1971, Acts/Bills for the Conservation of Water Bodies in India are as follows:

1. The Indian Wildlife (Protection) Act, 1972
2. The Indian Fisheries Act, 1897
3. The Indian Forest Act, 1927
4. The Territorial Waters, Continental Shelf,
5. Exclusive Economic Zone
6. The Water (Prevention and Control Of Pollution) Act, 1977
7. Water (Prevention and Control of Pollution) Act, 1974
8. The Maritime Zones of India (Regulation Of Fishing By Foreign Vessels)
9. Forest Conservation Act, 1980
10. The Environment (Protection) Act, 1986; The wetlands rules (conservation and management)
11. Coastal Zone Regulation (Crz) Notification
12. Wildlife (Protection) Amendment Act, 1999
13. National Conservation Strategies On Environment & Development
14. The Biological Diversity Act, 2002
15. Convention on Wetlands (Ramsar, Iran, 1971)
16. Convention on Biological Diversity, June 1992
17. Bonn Convention on the Conservation Of
18. Migratory Species of Wild Animals
19. International Convention for the Protection of Birds
20. National Water Policy, 2002
21. National Policy for Hydro Power Development
22. Convention on Conservation of Migratory Species of Wildlife Animals (CMS)

(Source: Churning Still Water, Report by-Center for Science and Environment, 2012).

ANNEXURE 3: COMPARATIVE STUDY OF RAMSAR WETLANDS IN INDIA

S. No.	Location (area in Hectare) and Managing Authority	Present status (Development/Conservation Plan/ Degradation)	Eco tourism / Nature park
1.	<p>Loktak Lake Located in Moirang, 50 km from Imphal city in Manipur (28700). Managed by: Loktak Development Authority (LDA) under the Government of Manipur</p>	<p>Also called the only Floating lake in the world due to the floating phumdis (round floating mats of heterogeneous mass of soil, vegetation and organic matter, locally known as phumdis). It was included on the Montreux Record in 1993 (signifying habitat degradation), as a result of ecological problems such as deforestation in the catchment area, infestation of water hyacinth and pollution. The construction a hydroelectric power plant has caused the local extinction of several native fish species (Sharma M. , 2012). Short term action plan (STAP) for conservation and management of Loktak Lake integrating Manipur river basin was initiated in March 2009 by the Govt. Other threatening issues are; soil erosion leading to wetland sedimentation and reduced water holding capacity due to shifting cultivation and encroachment in the catchment area and decline in fish resources thereby affecting the livelihoods of the fisher communities (loktaklake.org, 2014).</p>	<p>The Keibul Lamjao National Park, the only floating national park in the world is in the southwest part of the lake (4000 Hectare) famous for Brow-antlered Deer (<i>Rucervus eldii</i>) or Sangai also called the Dancing Deer.</p>
2.	<p>Keoladeo Ghana National Park, Rajasthan (2,873). Situated in the</p>	<p>A rare World Heritage site, under the UNESCO Convention concerning the ‘Protection of the World Cultural and Natural Heritage’. It is a complex of ten artificial, seasonal lagoons, situated in a densely populated region. It was placed on the Montreux</p>	<p>Bharatpur bird sanctuary. KNP is listed as Eco park by</p>

	<p>confluence of river Gambhir and Banganga. Managed by: the Rajasthan Forest Department with the support of local communities and national and international conservation organizations.</p>	<p>Record in 1990 due to water shortage and unbalanced grazing regime around it. As a result of the Panchana dam constructed at 95 km upstream of Keoladeo National Park (KNP) there is almost no water supplies to the park and the rivers are disappearing in the absence of fresh water flow (Parineeta Dandekar, 2011).</p> <p>Due to its strategic location in the middle of the Central Asian migratory flyway and presence of water, this is an important site for migratory birds. A recently started conservation programme for the 27 satellite wetlands surrounding this park has further enhanced the protection of the migratory waterfowl arriving in the Central Asian flyway to winter in Western India. This is the only park in India that is completely enclosed by a 2 m high boundary wall that minimizes the possibilities of any encroachment and biotic disturbances, but there is no possibility of a buffer zone. The major threats to the property are the water supply (both quantity and quality); invasive vegetation (Prosopis, Eichhornia, Paspalum); and inappropriate use of the property by neighboring villages (UNESCO A. , 2014).</p>	<p>ecotourisminindia.com</p>
3.	<p>Wular lake, located in Bandipora district, 40 km northwest of Srinagar city, Jammu and</p>	<p>One of the largest fresh water lake in India. The Jhelum River flows into the lake and flows out. It meets Krishanganga river downstream from the lake. Significant absorption basin for annual floodwater of the Kashmir valley. Wintering site for a number of migratory waterfowl species, important habitat for fish and contributes about 60 percent of the fish yield of the Kashmir Valley. More than 8,000 fishermen</p>	<p>A popular tourist destination for trekking, bird watching, boating, fishing, water skiing and a host of</p>

	<p>Kashmir (26000). Managed by: Department of Wildlife Protection. Govt. of Jammu & Kashmir.</p>	<p>earn their livelihood from Wular Lake. http://www.discoveredindia.com/jammu-and-kashmir/attractions/rivers-and-lakes/wular-lake.htm Current threats include water pollution from animal and agricultural waste from the catchment areas, weed infestation, hunting birds, rampant siltation from rivers flowing from the nearby hills, human encroachments and hydrological alteration due to the construction of the Krishanganga hydropower project. The South Asian Voluntary Association of Environmentalists (SAVE) is a joint initiative of individuals with the aim to protect the ecology and to conserve the nature at Wular Lake and a partner organization for management.</p>	<p>outdoor water sports and activities.</p>
4.	<p>Chilika lake (116,500), located 50 km south west of the Puri city in Orissa along the eastern coast of India. Managed by: Chilika development authority under the department of forest and environment, government of Orissa.</p>	<p>Largest saline water lagoon in India. Fed fresh water by two major deltaic branches Bhargavi and Daya of the Mahanadi river system and sea water inflow during high tide. First Ramsar site reported in India. It is the largest wintering migratory bird spot in India. The highly productive ecosystem of the lagoon with its rich fishery resources sustain livelihood of more than 0.15 million fisher folk around the lagoon. The Chilika ecosystem had encountered threats like siltation, shrinking of watershed area, choking of the inlet channel, shifting of the mouth connecting to the sea and loss of biodiversity leading to loss of productivity of livelihood of depending communities (chilika.com, 2014). It was included in the Monteux Record in 16/06/93 due to changes in ecological character and degradation of the lagoon ecosystem,</p>	<p>Nalabana bird sanctuary, an island in the Chilika Lake (Nalabana means forest of reeds, has an area of 1553 hectare). Listed an Eco park by ecotourisminindia.com</p>

		but was removed (11/11/02) and reported as best managed wetland with maximum funding.	
5.	Vembanad-kol wetland, Kerala The Vembanad Lake is bordered by Alappuzha (Alleppey), Kottayam and Ernakulam districts of Kerala (20,000)	The lake has got a freshwater dominant southern zone and a salt water dominant northern zone, both separated by a Barrage/Bund (lock) at Thanneermukkom. The Vembanad Lake is important from the point of view of its flora and fauna, supporting a population of over 20,000 water-fowls in the winter months. It is renowned for its live clam resources and sub-fossil. The soft, organically rich sedimentary substratum of the inshore region is an ideal habitat for shrimps. Vembanad serves as a habitat for a variety of fin and shellfish, and a nursery of several species of aquatic life. For centuries, the backwaters have provided a safe and efficient means of transportation for goods and people moving between the interior and the port towns along the coast. The major commercial and economical activities in the lake include agriculture, fisheries, lime shell mining, backwater tourism, etc. (Commission, 2008). Major threats are eutrophication, infestation by water hyacinth, reclamation & habitat loss due to construction, pollution and over fishing.	The Vembanad bird sanctuary is located at Kumarakom and Pathiramanal. An extensive garden with a good collection of a rare and endangered species of trees and plants numbering about 190 species, a butterfly garden and a fish sanctuary is a tourist hotspot in the 'Coconut lagoon' resort in Kumarakom .

The inferences from the above study show that the major threats to these Ramsar wetlands with rich biodiversity, especially with avian habitat (both native and migratory) are more or less typical. They are hydrological abstraction due to construction of dams, pollution, eutrophication, siltation and infestation; reclamation & habitat loss due to construction and agriculture; pollution from sewage, pesticides, industrial effluents & unscientific tourism activities and over exploitation of resources

ANNEXURE 4: BRIEF BIOGRAPHY OF THE INTERVIEWEE

Sl No	Name, Designation	Expertise	Date	Place	Interview type
1	Dr. Prasanta Kumar Saikia, Head of Biology, Guwahati University	Biostatistics, Ecology, Zoology	11 th Nov, 2013, 12 th July 2019	Guwahati	In depth
2	Mr. Sarat Das, Head of village Keotpara (Gaobura) and Mr. Golok Das, Advisor to the president of Paspapa committee.	Administration	24 th July, 2014 & 12 th Feb, 2016	Keotpara village, Guwahati	In depth, semi structured
3	Padmashree Mr. Jadab Payeng (Moulai), Nature conservator	Landscape regeneration, wild life protection	14 th Oct, 2014	Jorhat	In depth
4	Mr. Uttam Terron. Head and director of Parijat Academy.	Education, social worker	16 th Oct, 2014 & 12 th Feb, 2016,	Guwahati	In depth, semi structured
5	Mir Naseem Ahmad. Vice Chairman (retired) of J & K Lakes and Water Development Authority	Town planning, wetland management.	17 th Nov & 20 th Nov, 2015	Dubai	In depth and semi structured
6	Mr. Punya Das. President Deepor Beel Paanchpada cooperative society (of fishermen)	Administration	13 th Mar, 2015	Keotpara village, Guwahati	Semi structured
7	Mr. Laxman Terron. Environmentalist	Environment	15 th Mar 2015, 13 th Feb, 2016	Guwahati	In depth, semi structured
8	Mr. Ramani Mohan Das. Consultant, GMDA	Construction and planning	13 th Jan, 2016, 3 rd July, 2017	Guwahati	In depth, semi structured
9	Ms. Purnima Barman. Biologist, ASTEC. Whitley Award (Green Oscar) winner, 2017.	Wildlife Conservation	27 th May, 2017	Telephonic interview	Semi structured

1. Dr. Prasanta kumar Saikia:

Professor P.K Saikia is the head of department of Zoology, Guwahati University. His specialization is Animal Ecology, Wildlife Biology, Ornithology and Biodiversity Conservation. He holds special training on wildlife biology & biodiversity conservation management & handling of bio-statistical software from universities in the USA, UK and India. Backed by his 35 years of research experience on wildlife, he has been an integral part of Deepor Beel biodiversity conservation and management and organized numerous community based conservation work in Assam since 1989. He was also part of many funded research projects by world's renowned organizations.

2. Mr. Sarat Das and Mr. Golok Das:

Mr. Sarat Das, head of fishermen's village Keotpara (Gaobura) and Mr. Golok Das, an active member and advisor to the president of Paspara committee are both resident of Keotpara village and have been actively involved in the operation and management of the wetland. Especially in village administrative affairs and community fishing.

3. Padmashree Mr. Jadab Payeng (Moulai):

Popularly known as the "Forest man of India", nature conservator Jadab Muolai Payeng was interviewed on October 14th, 2014 at his Jorhat residence. Objective was to know about his achievement in making a jungle single handedly. It was one of the best context specific approaches for landscape regeneration & conservation.

Mr. Jadav (Muolai) payeng, a Missing tribal man from Jorhat, Assam, single-handedly planted about 1500acre of forest in sandbar of the river Brahmaputra near Kokilamukh, Jorhat, Assam in 30 years. This forest is named after him as Moulai wood (Moulai Kathani). Jawaharlal Nehru University awarded him the title of —Forest Man of India. The reserve is now home for many endangered animals like the one-horned rhino and Royal Bengal tiger. His next dream is to create a similar forest in the sandbar of river Brahmaputra to join Kokilamukh and Majuli Island with a stretch of green corridor. He has been visiting many countries to deliver lectures on Forest regeneration and Nature conservation and has many accolades to his credit. In 2015, he was honored with Padma Shri.

4. Uttam Teron:

An avid social worker from a very young age, Uttam Teron established a school for underprivileged in Pamohi (2003) with only 4 children and now has a strength of 512 (2018) children including 63 students staying in a hostel from deep inside Garbhanga forest, where there are no schools. The school has children from eleven tribal villages nearby studying from Nursery to class Tenth. He has also contributed towards conservation of the wetland and economic benefits of the underprivileged fringe communities; Mushroom cultivation, weaving, animal rearing etc.

5. Mr. Naseem Ahmed:

Mr. Naseem Ahmed was vice chairman (retired) of J & K Lakes and Water Development Authority (LAWDA) and was also the chief town planner, Srinagar, Kashmir before that. He was interviewed on 17-01-2015 and 20-01-201 in Dubai to understand the conservation and management strategies of Dal lake. Water treatment and waste water disposal, implementation as per the DPR and results and other future plans and execution were discussed over two semi structured interviews.

From 1990, Naseem served as chief town planner Kashmir for 19 years. He served the Srinagar Development Authority for three times before taking over as Vice Chairman of LAWDA in 2007. Naseem did his Master's in Urban and Regional Planning from the prestigious Delhi School of Planning and Architecture. He also did his Post-Graduation in Urban Planning and Practices from the University of London. He has also worked in London for five years.

6. Mr. Punya Das:

Purna Ram Das is the president of the Deepor Beel Paanchpada cooperative society.

7. Laxman Teron:

Mr. Laxman Teron is a wildlife activist, environmentalist and ornithologist residing in Chakardeo, one of the fringe village of the wetland. Working at the grass root level since many years, he also worked with many research organizations for conservation of the wetland and the forest nearby. He has helped many researchers with his local knowledge of native trees and medicinal plants. He has been associated with many NGOs and other voluntary organizations for nature protection and conservation. He was one of the pioneer to establish the medicinal and aromatic plant garden of city plantation range at Chakardo near Deepor Beel. He has been felicitated as the Deepor Beel Star on the occasion of Deepor Beel Festival in 2014.

8. Mr. Ramani Mohan Das:

The Guwahati Water Bodies (Preservation and Conservation) Act notified three wetlands – Deepor, Silsako and Borsola-Sorusola for restoration and conservation. This work was trusted to Guwahati Metropolitan Development Authority (GMDA). Mr. Das, Consultant, GMDA, has been working actively for implementation of the DPR Deepor Beel and was instrumental preparing and approval of the proposal.

9. Purnima Burman: winner of Green Oscar 2017

Biologist, conservationist and activist Purnima Devi Barman has been involved in the conservation of the Greater Adjutant Storks -- called Hargila is Assamese and its habitat for eight years now and the people of Assam fondly call her 'Hargila Baideu' meaning stork sister. She has won the prestigious Whitley Awards 2017, also known as the 'Green Oscars'. Barman has mobilised followers into the 'Hargilla Army' an all-female team of conservationists dedicated to protecting the greater adjutant who through this programme are offered sustainable livelihood, training and education opportunities in many villages of Kamrup district, Assam.

A sample questionnaire of interview is listed here

Interview with the Vice Chairman (retired) of J & K Lakes and Water Development Authority and Chief Town Planner, Mr. Naseem Ahmed, (Jan 20th , 2015, Dubai).

Topic: Dal Lake restoration and implementation of DPR.

Details of the interview:

1. Water treatment and waste water disposal:
What has been done as per the DPR?
Any other implementation, Results and Future plans

2. Dredging and De-weeding of the Lake
3. Any voluntary community participation or induced participation, awareness program. Awareness programs are held regularly through volunteers and NGO's.
4. Resettlement & Rehabilitation of nearby people. Identified and shifted already? What plans?
5. Any planning failure due to non-cooperation from the fringe communities? Vigilance?
6. Livelihood opportunity / self-revenue generation
7. Implementation of Catchment management plan
8. Restoration of degraded forests through plantation, contour hedgerows and in situ moisture conservation. Methods followed?
9. It was proposed to develop a 50 metre wide green strips with a pedestrian mall on either side of the Telbal Nallah under thick plantation, so that the whole stretch assumes a pleasant shape of a continuous green over a length of 7 km from Dachigam nallah upto settling Basin. Is it done?
10. Fuel, wood and fodder plantation of indigenous exotic species.
11. What methods are implemented for sewage from the house boats and floating villages as against conventional methods? Adaptability?
12. Solid waste disposal methods
13. What works are being done for the source of water inflow to the Dal Lake - the Telbal Nala
14. The proposed Wetland Reserve (about 47.50 hectare of low lying water logged area on the left bank of Telbal Nallah) was proposed to be planted with species which are known to take up nutrients from the water below and to help reduction of the nutrients coming into the lake from diffused sources like Paddy fields and other agricultural areas . What is the progress?
15. In order to trap the drainage from the iarea of Nishat Harwan road along the foothills of Zabarwan mountain upto the Ishbar village going directly into the Dal Lake and also stream line the water flowing from springs in this area, a channel 38.1 m (125'-0") wide at its bed was proposed to be constructed along NFR from Nishat road intersection upto Telbal nallah termination for a length of 3.8 kilometers. What has been done?
16. In addition to above mentioned measures, the report also mentions about development of eco-tourism, craft bazaar, mini zoo, amusement park, cable car, tourist villages as long term perspective plans. Any development?
17. Suggestions for the study location- Deepor Beel, Guwahati: follow the lessons learnt. Community participation will be case specific- especially development of existing co-operative fishing with scientific measures like net size, better supply inputs like growth hormones, action plans for promoting alternative horticulture and tourism development through credit support.

ANNEXURE 5-A: VILLAGE COMMUNITY SCHEDULE

District:

Development block:

Gram panchayat:

Name of the village:

Name of the Respondents:

Name	Position	Name	Position
1.		5.	
2.		6.	
3.		7.	
4.		8.	

1. What is the distance to the facilities mentioned below from your village? Give Particulars.

Facilities	Distance from the village In km	If available in the village, Mention numbers	Facilities	Distance from the village In km	If available in the village, Mention numbers
Bus stop			Private Veterinary clinic/ Hospital		
Public Telephone			Artificial Fertilization Center		
Primary School			Nationalized Bank		
Upper Primary School			Regional Grameen Bank		
Secondary School			Bhumi Vikash Bank (land development)		
Higher Secondary School			Cooperative Bank		
College			Post Office		
Industrial Training Center			Cooperative Society		
Aanganwadi / Baalwadi Center			Seed Bank		
Informal Education Center			Fertilizer and Pesticide Shop		
Health Sub-Center			Regional Food Godown		
Primary Health Center			Subsidized shop (cheap price)		

Community Health Center			Weekly Market		
Mother-child Welfare Sub Center			Daily Market		
Private Doctor / Clinic			Police chowki / station		
Non Registered Doctor			Development Block		
Pharmacy			Tehsil Headquarter		
Veterinary Hospital			District Headquarter		

2. How many Hamlets (settlements / communities) of the Village are connected to a road?

Name of the Hamlet	Road situation					Availability of Electricity on the roads	Road communication availability throughout the year / months
	Main Road	Pitched Road	Gravel Road	Mud Road (katcha)	No Road		
						Yes / No	
						Yes / No	
						Yes / No	
						Yes / No	
						Yes / No	

2.1 If communication is not available throughout the year, give reasons

- A.
- B.
- C.

3. Source of water in the village: (can have multiple answers)

For Drinking purpose: 1) _____ 2) _____ 3) _____

For other uses: 1) _____ 2) _____ 3) _____

3.1 The quality of the drinking water you use is, 1) Good 2) Bad

3.1.1 If bad, why? Give reason / reasons

- A.

B.

C.

3.2 During which months of the year people of the village have drinking water problem?

1) _____ 2) _____ 3) _____ 4) _____

3.3 According to you how many families in the village have access to pure drinking water and toilets?

A) Pure Drinking Water _____ B) Toilet _____

4. How many families in the village have electricity connection?

House hold purpose		Agricultural purpose		Business purpose	

4.1 In an average, how many hours per day there is electricity supply in the village?

5. What types of crops are grown in the agricultural lands of the village limit?

	Crop 1		Crop 2		Crop 3		Crop 4	
	Name	Area	Name	Area	Name	Area	Name	Area
Ravi								
Khareef								
Jayad								

6. What are the sources of irrigation available for agriculture in the village? How much area is irrigated from these sources?

Source	Total numbers/length	Total Irrigated area	Source	Total numbers/length	Total Irrigated area
Canal			Govt. tube well		
River			Private tube well		
Pond			Check Dam		
Other Natural source			Stream		

7. Provide details of the crops grown by the villagers.

Name of the crop	Area	Funds required	Production	Name of the crop	Area	Funds required	Production
1.				6.			
2.				7.			
3.				8.			
4.				9.			
5.				10.			

8. What are the difficulties / complications faced by the Farmers in the village?

A)

B)

9. Present status of Land use in the village. Give details.

Land area (in Acre)						
Gross area	Population	Area under water	Agricultural	Pasture	Barren	Others

10. For overall development of the village, what are the works done so far by these organizations? Please explain.

Name of the Organization	Works done
Village Panchayat	
Area Panchayat	
District Panchayat	
MLA fund	
MP fund	
NGO	
TSDC services	

11. Under NREGA (National rural employment guarantee act) scheme how many people have been registered from the village?

Description		SC	ST	BC	Minority	Other	Total
Total number of workers	Gents						
	Ladies						

12. How many Self Support Groups has been formed in the village under various schemes?

Name of the Self Support Group	Business / Profession	Name of the Scheme

13. Details of Birth and Death in the village during last three years

Years	Birth		Death	
	Gents	Ladies	Gents	Ladies
2012-2013				
2013-2014				
2014-2015				

14. For public distribution process under the Supply Department, How many people have various Ration cards as mentioned below?

Name of the card	SC	ST	BC	Minority	Others	Total
APL						
BPL						
Antyodaya						
No cards						
Others						

15. In last three years, how many families in the village have been benefitted / aided by various Government operated schemes?

Name of the Scheme	Number of families	Number of members

16. It has been observed that in every community, people have some good and some bad habits, which they cannot leave, even if they want to. Mention such habits of the people from this village.

Good habits	Bad habits
1	1
2	2
3	3

17. A community may be very peaceful, but some of them may have committed some crime, sometime. After all everybody makes mistake in life. Give details of the number and types of crimes in your village during the last five years.

Types of Incidents	Number of incidents		Present status in compared to the last 10 years		
	Total numbers	Enrolled / Reported	Increased	Same	Decreased
Burglary					
Murder					
Rape					
Physical Assault					
Eve teasing					
Attempt to murder					
Attempt to rape					
Land dispute					
Women abuse					
Dowry					
Robbery/Loot					
Kidnapping					
Ransom					

Ethnic Conflict					
Dalit abuse					
Family Violence					
Narcotic related					

17.1 Reasons for increase or decrease of crime during the last ten years.

Increased	Decreased

18. Natural assets like River, Canal, Pond, Sand, Jungle, Pasture, Hills are generally available in villages. Better use of such resources can make life prosperous. Give details of such assets in your village.

Resources	Approximate numbers/quantity, area(write units)	Use / benefits at present	Potential use	Hurdles / barrier in potential use

18.1 Can any of these resources be helpful for economic benefits, if used wisely?

Yes No

18.2 If yes, describe such resources.

Resource	What type of help is required at present	How many people will benefit (possible numbers)

19. There are some important necessities which can make life better in any society. For example: irrigation for farmers, education for children, and employment for youth and work for the artisan. What are the needs of your village?

Target group	Very important	Secondary
Children		
Old people		
Ladies		
Farmer		
Poor		
Youth		
Disabled / Invalid / Retarded		
Cattleman		
Skilled Artisan		
Migrated people		
Others (mention group)		

19.1 In absence of the important necessities mentioned above, generally what are the types of difficulties faced by the people of your village?

20. If Government or any outsider want to help the villagers, what types of cooperation will help you progress? We are asking you about few areas. Please tell us what types of help you need. (Kindly ask about the help without any hesitation and understand well.)

Development area	For Man	For Woman
Employment		
Multiple / Good Education		
Development of Skill		
Health services		
Entertainment		
Local Panchayat		
Encouragement for Education		
Others (mention)		

Note: Please notify in order of preference

21. Is there any demand or need which you think is of utmost importance for the villagers?

Yes No

21.1 If yes, please describe

Demand / Needs	Nature of help required
1.	
2.	
3.	
4.	

Observation-

Name:

Date:

Note: The format was translated and adapted from the PRA schedule provided by Professor K.N. Bhatt, Allahabad Central University.

ANNEXURE 5-B: STEPS FOR CONDUCTING PARTICIPATORY RURAL APPRAISAL (PRA).

Description	Major Objectives	Respondents in the Group	Methods
Step 1: Social Mapping	<ul style="list-style-type: none"> To demarcate the human settlements within the physical boundary of village by social, economic, religious and geographical features; To assess the availability of basic infrastructural facilities in the village; To measure the demographic characteristics of the dwellers in terms of education, occupation, income and land ownership; and To determine the housing and living conditions of villagers. 	Mukhiya (village head), Members of paspara Cooperative committee for fishing, Woman members of Panchayat, Well aware persons, prominent persons, retired teachers, village level workers and student facilitators.	Transect walk. Villagers divided into 12 groups with student facilitators (4+4), including a woman member. In the beginning a festival calendar was created with the help of the crowd gathered and the students. At the end all groups met at the community center and collated the information gathered.
Step2: Resource Mapping	<ul style="list-style-type: none"> To identify existing physical and natural resources available in the village; To assess such useless or abandoned resources which may be useful for village; and To investigate the local products by season. 	Persons involved in social mapping, progressive farmers, workers involved in cottage industry etc. (in this case Pig rearing was included)	
Step 3: Wealth Ranking	<ul style="list-style-type: none"> To rank the households by different economic categories; To analyze the magnitude of poverty in the village; To find out the reasons and problems of different economic classes; and To measure the scope for poverty reduction among villagers. 	Few (3-4 persons) neutral or unbiased persons who have adequate knowledge about the economic condition of households in the village	
Step 4: Seasonal Analysis, Festivals	<ul style="list-style-type: none"> To analyze the farm-based activities and work load of the villagers; To measure the employment opportunity of villagers by month; 	Persons having adequate knowledge regarding farm activities (fishing), migrant people, women, agricultural	

	<ul style="list-style-type: none"> • To find out the magnitude of out migration in the village; and • To assess the needs and consumption activities of villagers on selected indicators. 	and non-agricultural labourers etc.	
Step 5: Trends Analysis	<ul style="list-style-type: none"> • To work out the problems and development pattern of the village over the years on selected indicators, specifically in employment, education and health sectors; • To identify the transformation of different types of problems in specific time intervals; and • To measure the current practical problems of villagers specifically in employment, education and health sectors. 	Sensitive aged male and female having knowledge of the village in past, Mukhiya/Sarpanch, youths	A Focus group discussion was held while the 12 groups were taking the transect walk. The members were Mukhiya (village head), 2 members of Paspara Cooperative committee for fishing villages, 2 woman members of the Gao Panchayat, 2 elderly retired Government employees from the village.
Step 6: Chapati Diagram	<ul style="list-style-type: none"> ○ To visualize the local power structure of the village; ○ To identify the households who have adequate influence in development and decision making process; ○ To assess the relationship among different local power structure; and ○ To work out reasons for influence of such types of household. 	Few (3-4 persons) neutral or unbiased persons who have adequate knowledge about dominate people of village, socially and economically poor people.	
Step 7: Diagram for Availability of Basic Service Facilities	<ul style="list-style-type: none"> ○ To assess the availability of basic facilities in the village by distance; ○ To measure the most important needs of basic facility in the village; ○ To analyze the quality and availability of services. 	Mukhiya/Sarpanch, Well aware persons, prominent persons, retired teacher, village level workers etc.	Same as steps 1-3, was authenticated in the group discussion.
Step 8: Metrics Ranking	<ul style="list-style-type: none"> ○ To measure the availability and use of fertilizers; ○ To measure the number of patients by types of disease and caste; ○ To assess the types of health services availed by households; 	The metrics ranking exercise was organized among different types of people who have good knowledge about the area. It was	

	<ul style="list-style-type: none"> ○ To work out the indebted households in the village by caste and class; ○ To assess the availability of livestock among households by caste and use; ○ To identify the options for livelihood for economically weak sections. 	considered with representation of caste, class, and gender of participants.	
Step 9: Informal Discussion and Identification of Problems, Recommendation for Micro credits and Bio-rights.	<ul style="list-style-type: none"> ○ To validate and cross-check primary information and take consent of different types of homogenous community/social groups; ○ To identify the major and minor problems prioritized by sectors; ○ To share the collected information among different types of people. ○ Recommendation 	12 small groups of local villagers and 3 student facilitators. The group was based on gender, caste, class, occupation, age etc.	Focus Group discussion. Data validation was done the next day after preparing the report, through telephonic conversation.
Step10: General Meeting, assessment of the facts, assigning responsibility among villagers	<ul style="list-style-type: none"> ○ To authenticate, recheck and share the primary information collected from the stakeholders. 	With the help of Mukhiya (village head), Members of Paspapa Cooperative committee for fishing villages, Woman members of Panchayat.	

Note: The format was adapted from the PRA manual provided by Professor K.N. Bhatt, Allahabad Central University.

ANNEXURE: 6

Check list for formulation of Management action plan, DPR of Deepor Beel		
Source: (Conservation division-I, MOEF, Government of India, 2007), Ramsar fact sheet		
Description	Proposed DPR	Remarks
Location	South of Guwahati city, Assam	Guwahati, Assam
Area and Altitude	About 14.2 sq km (8802 Bigha=1426.68 Hectare), out of which 4.1sq.km is Bird sanctuary. Altitude:165'-186' above MSL	40 sq.km (Ramsar Fact sheet). Wetland inventory MoEF- 4000 Hectare
Latitude and Longitude	Longitude: 91°36' E to 91°42' E Latitude: 26°05' N to 26°09'	91°35'- 91°43' E 26°05' - 26°11'N (Ramsar Fact sheet)
Depth	1m -4m (dry season to maximum flooding)	
Ecological Features	Wetland, aquatic vegetation, water birds, lizards and migratory birds. Winter habitat like mud flats, paddy fields, dry grass land, village grazing reserve (VGR), marshy lands, scattered forest	
Inflow-Outflow Pattern	Fed by the Basistha-Bharalu- Bahini river (East), outlet at Khonajan to the Brahmaputra river (West, 5 km stretch,).	
Zonation	Divided into 4 zones (proposed): protected core area, riparian buffer, conservation and project activity zone (surrounding the wetland core area, p-10).	
Geological and Climatic Features	Tropical monsoon climate, very humid. Soil type is mainly Fluvial origin with flood plain and Alluvial Plain. Some parts consist of highly dissected hills and valleys. High moisture contents in the soil support rich vegetation. Monsoon from May to September and a pre-monsoon period in March-May with occasional storms. Winter is dry and cool. Temperatures range from 10.6° to 36°C.	
Baseline data		
Soil texture	Highlands on the North and South has highly dissected rocky soil and the valley has fluvial soil consisting of clay, silt, sand and pebbles.	Ramsar Fact sheet

Extent of silt	Inlet drainage network, 250m from the mouth will be redeveloped as riparian zone and detention pond with holding capacity of 350 KL and 3-4m deep is proposed on North East side for sedimentation and accumulation of silt (p-19).	
Quantum of Biomass	Renewable energy based	
Soil Moisture Content	Not specified	High
Quality of water	Influent water quality improvement action carried out, (p-18, 19)	
Extent of obnoxious weeds	Not specified, but mentioned about harmful effect of phosphorous from sediments that accelerates weed growth (p-21)	
Groundwater level	Lining the drain channel with stone and open joints to assure percolation of water and improving ground water level (p-18)	
Range and variety of biodiversity-flora, fauna, birds and fish.	Variety of fishes in the beel (p-28), no details mentioned	
Land use Pattern		
Vegetation	Aquatic plants in the core area, grass covers lined with shrubs and plants with low canopy in the buffer zone and tall trees near the settlement area and project management zone.	
Human Settlements	Very dense along the highways towards the north, East and West. Tribal communities in the South. Proposed manmade areas will be used for recreation facilities with hard edge construction for boating facilities. Construction is restricted to defining edges (p-13) in the project management zones.	Proposed eco village for all fishing villages to uplift the existing settlements.
Agriculture	Though there are few agricultural lands remaining towards the South and the South East, only some part of it is cultivated with seasonal crops.	
Effluents		

Sewage	High concentration of sewage effluent into the lake from settlements(south eastern, p-19)	A constructed wetland for waste water treatment is proposed (p-19).
Pesticides	Nil, no agricultural effluent	
Chemicals Entering into wetland	Proposed effluent detention pond for siltation and waste water treatment.	
Flora		
Macrophytes	Not specified	Ramsar Fact sheet: Oscillatoria and Microcystis species are dominant
Plankton	Not specified	Ramsar Fact sheet: A total of 18 genera of phytoplankton and 21 genera of Zooplanktons. The population density of phytoplankton reaches fairly high levels during winter season and re-treating monsoon but remain low during summer season.
Benthos	Not specified	Wetland inventory, MoEF: Presence of huge variety of aquatic life-littoral benthic species
Fauna		
Birds	Not specified	Ramsar site supports 18 globally threaten and 35 endangered vertebrate species under Indian Wildlife Protection Act, 1972. (Saikia P. K., 2005)
Fishes	Not specified	Ramsar Fact sheet: 19 families-50 species
Reptiles	Not specified	20 amphibian, 12 lizards, 18 snakes and 6 turtle and tortoise species. (Saikia P. K., 2005)
Mammals	Not specified	Asiatic Elephants (Elephas maximus) found in the adjoining Rani-Garbhangga reserve forest visit the

		wetland for bathing and fodder. (Saikia P. K., 2005)
Others		
Population/families directly dependent on wetland resources	About 35 villages around the wetland will be targeted to encourage for sustainable practices (p-30)	500 fishermen's families (survey)
Socio-economic survey of wetlands through questionnaires	Not done for the DPR	Done in PRA method for 7 villages
Cultural and indigenous practices Of wetland resource utilization.	Fishing, use of aquatic vegetation	
Jurisdiction of various concerned Departments dealing with wetland reservation	GMDA, Forest, Wild life, Railways	
Existing conservation measures taken	Declared Bird sanctuary in 1989. Ramsar site in 2002. GMDA now responsible for conservation and management.	
Interface with researchers to incorporate relevant research findings in MAPs	Zoology Department-Guwahati University, Aranyak, other NGOs, ASTEC, NESEC.	
Involvement of people up to Panchayat level in decision making	No involvement in planning or decision making	
Wise use practices of wetland research, if any in existence	Human wellbeing, poverty alleviation, maintaining ecological character and biodiversity.	11 strategies to achieve this with 28 Key Result Areas mentioned for assessment in Ramsar handbook of wise use of wetland
Monitoring mechanism at local and state level	Water quality monitoring In all lakes of Guwahati city (p-51)	

ANNEXURE 7: DETAILS OF FGD MEMBERS

Participant Demographics / engagement (research and conservation) with the wetland in number of years:

Sr. No.	Name and Address of Participant	Engagement in this field in Years
1	Dr. Chandan Mahanta. FGD Chair. Professor, Department of Civil Engineering, Dean of students' affair, IIT Guwahati.	Above 20 years
2	Dr. Parimal Chandra Bhattacharjee. (Retired) Professor and Head, department of Zoology Guwahati University. Vice-President- Primate Research Centre; Member: IUCN-SSG Primate, International Ornithological Congress(IOC); Executive council – ASTEC, Research Advisory Council, Department of Forest; Expert committee of the MEE of the PAs-GOI-MoEF; Executive Trustee-WTI; Ex-Member of TRAC (Training Research and Academic Council) WII, TPCG (Technical and Policy core group)-National Biodiversity Strategy and Action Plan (NBSAP) and Coordinator –NE states; Executive body SACON, State Coordinator of Inland wetland Survey–UNDP-SACON.	Above 20 years
3	Dr. Prasanta Kumar Saikia. Professor in Zoology, Animal Ecology and Wildlife Biology, Coordinator, Post Graduate Diploma in Wildlife Management, Department of Zoology, Guwahati University.	Above 20 years
4	Dr. Arup Kumar Misra. Director, Assam Science Technology and Environment Council (ASTEC), Guwahati.	Above 15 years
5	Jaydeep Baruah. Scientific officer and Head of Environmental department, ASTEC.	Above 10 years
6	Pankaj Deka. Senior Scientific officer, ASTEC.	Above 15 years
7	Uttam Teron. Parijat Academy	Above 10 years

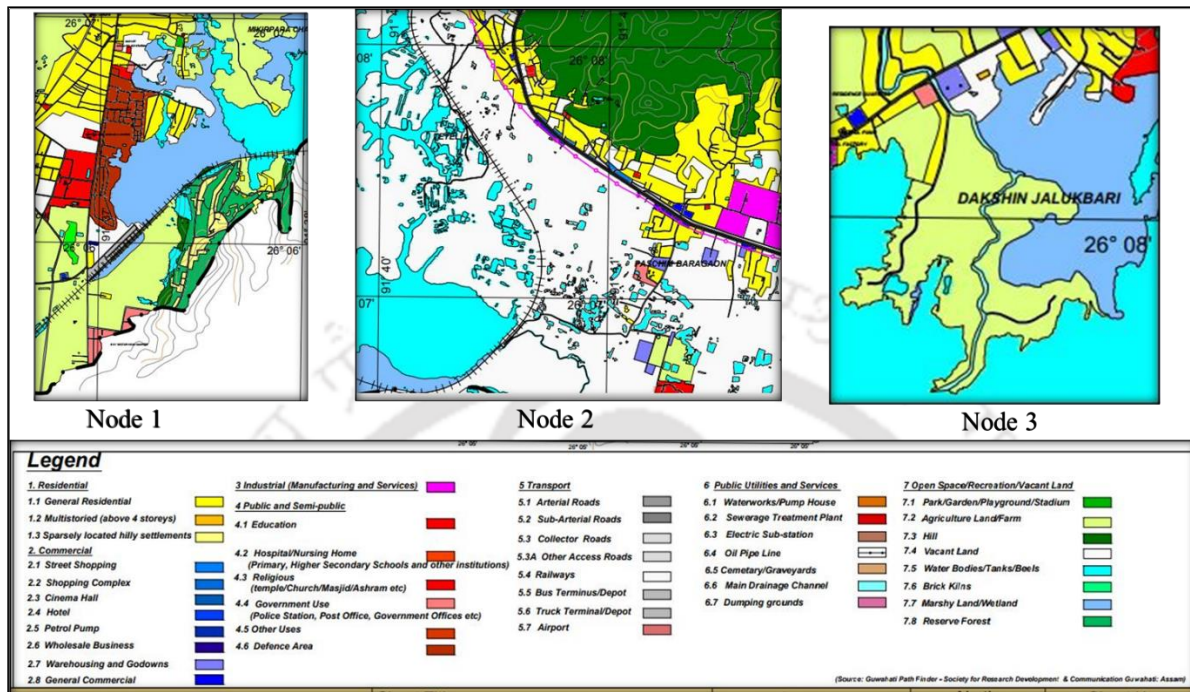
8	Nawaz Ali. Acting Principal, Guwahati College of Architecture.	Above 5 years
9	Masfiq Alam Hazarica. Aaranyak	Above 5 years
10	Arup Das. Aaranyak	Above 5 years
11	Ramani Mohan Das (In absentia, in depth interview). Consultant, Guwahati Metropolitan Development Authority (GMDA).	Above 15 years
12	Nilutpal Das (In absentia). Safe Water.	Above 5 years
13	Niva Rana Mahanta, Professor and FGD coordinator, Amity University-Dubai	Above 3 years
14	Manmoromi Mahanta, Moderator	TV presenter

Agenda:

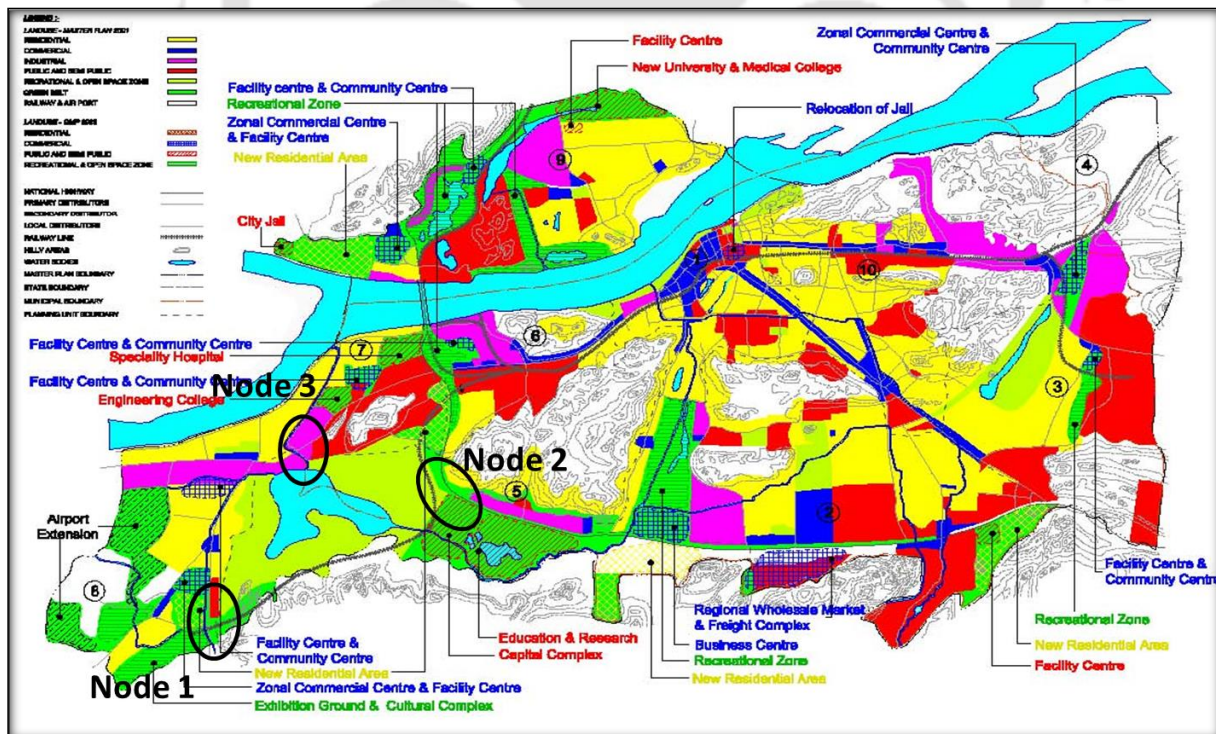
1. Introduction: Participants
2. Aim and Objectives
3. Introduction: underlying issues
4. Video Montage - 15 minutes (East Kolkata wetland, Rupa lake, Nepal)
5. Discussion with a tea break
6. Vote of thanks and mementos handover

ANNEXURE 8: MASTER PLANS

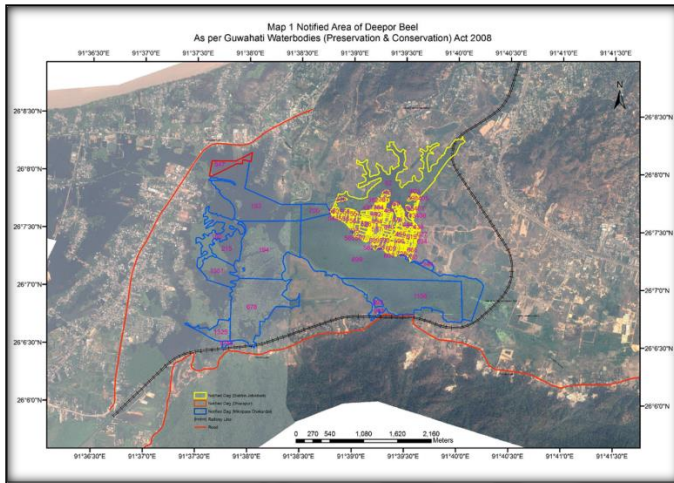
8.1 Existing Master plan, Deepor Beel, Source GMDA website



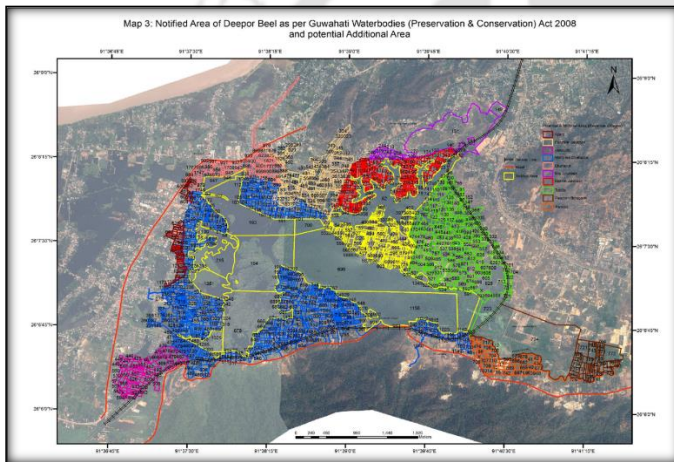
8.2 City development plan (CDP), 2006



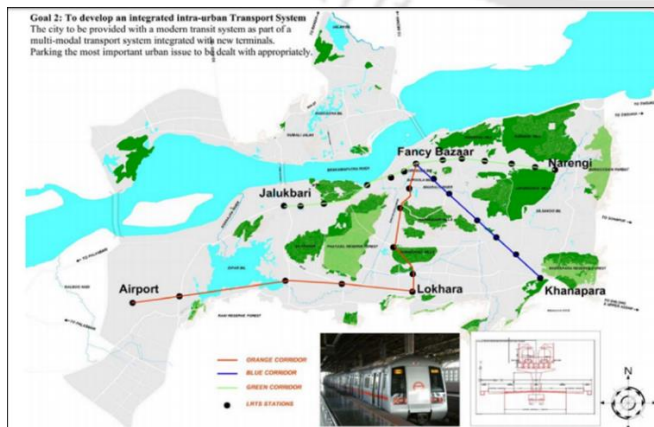
8.3 Notified area (Draft Deepor Beel, GMDA)



8.4 Potential notified area (Draft Deepor Beel, GMDA)



8.4 Map showing proposed metro-rail line (source: Proposed GMDA Master plan 2025)



ANNEXURE 9: LAND DETAILS OF DEEPOR BEEL

Revenue Circle: Azara and Guwahati. (Source: Five year project for restoration, conservation and development of Deepor Beel, GMDA)

A. Land area of Water-body as per Act. 2008	
Village/ Daag numbers	Land area (local unit)
Dharapur	51 B. 2 K. 3 L
Mikirpara Chakardoi	4032 B. 4 K. 19 L
Dakshin Jalukbari	1038 B. 0 K. 5 L
Total A	5122 B. 2 K. 7 L
B. VGR Land	
947	51 B. 2 K. 3 L
193	402 B. 0 K. 12 L
700	65 B. 4 K. 0 L
Total B	519 B. 1K. 15L
C. Chadar Beel	
100	70 B
Total C	70 B
D. Bird Sanctuary	
194	719 B. 3 K. 0 L
678	492 B. 1 K. 2 L
699	1200 B. 1 K. 11 L
1156	678 B. 4 K. 4 L
Total D	3090 B. 4 K. 17 L
Grand total	8802 B. 4K = 1426.678 Hectare = 14.27 sq.km. approx

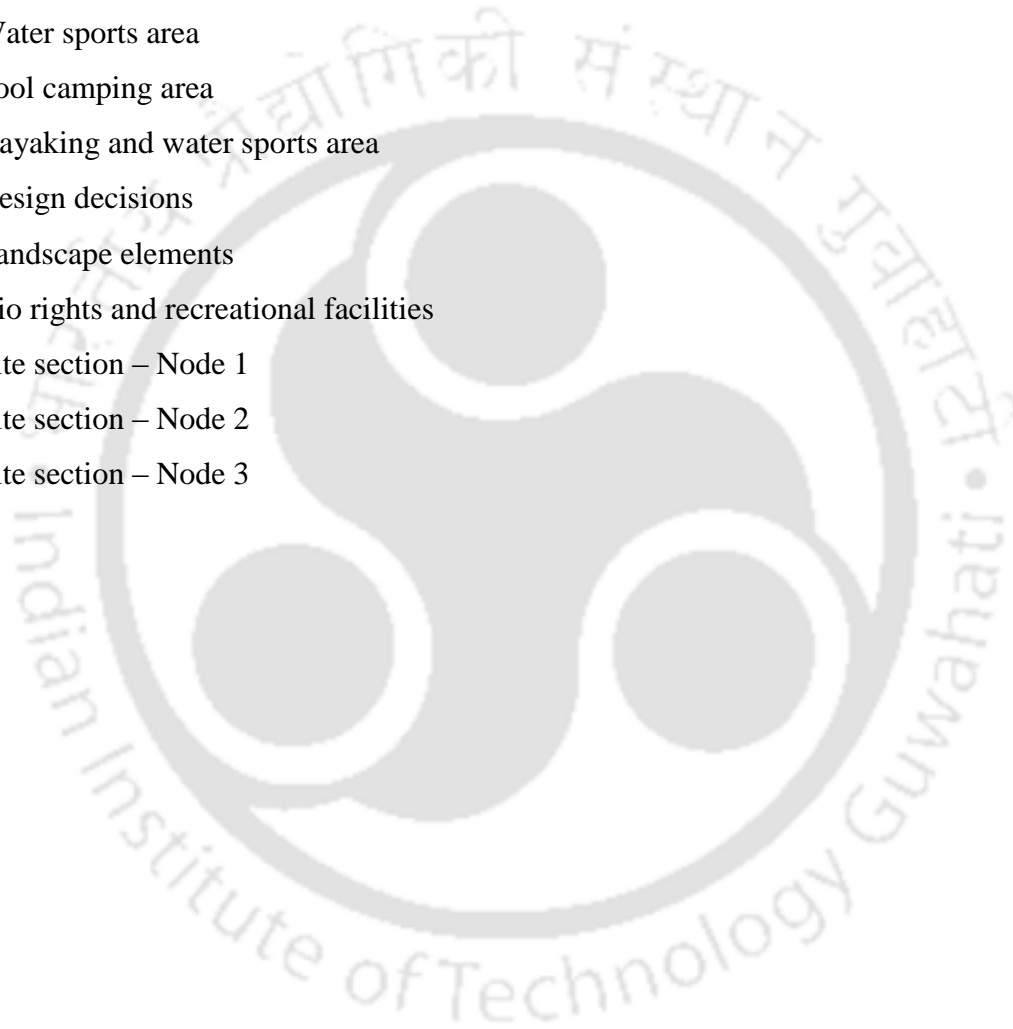
ANNEXURE 10: LIST OF PROPOSED HARDSCAPE DRAWINGS

1. Retaining walls
2. Bamboo walls
3. Jogging and cycling track, Internal road section-flat
4. Internal road section-High
5. Deck section
6. Storm water swale
7. Stepped deck section
8. Elephant Corridor over railway and road
9. Gazebo detail
10. Bench detail
11. Cycle stand detail
12. Planter box detail
13. Conceptual sketches for embellishments



ANNEXURE 11: LIST OF PROPOSED LAYOUT DRAWING

1. Site plan
2. Layout plan - Node 1
3. Layout plan - Node 2
4. Layout plan - Node 3
5. Water sports area
6. Pool camping area
7. Kayaking and water sports area
8. Design decisions
9. Landscape elements
10. Bio rights and recreational facilities
11. Site section – Node 1
12. Site section – Node 2
13. Site section – Node 3



ANNEXURE 12: LIST OF BUILDING PLANS

1. Interpretative center
2. Aqua culture center / Flower culture center / Administration block
3. Aquarium and Museum
4. Food court
5. Toilet block
6. Pool camping cottage
7. Resort cottage
8. Reception kiosk

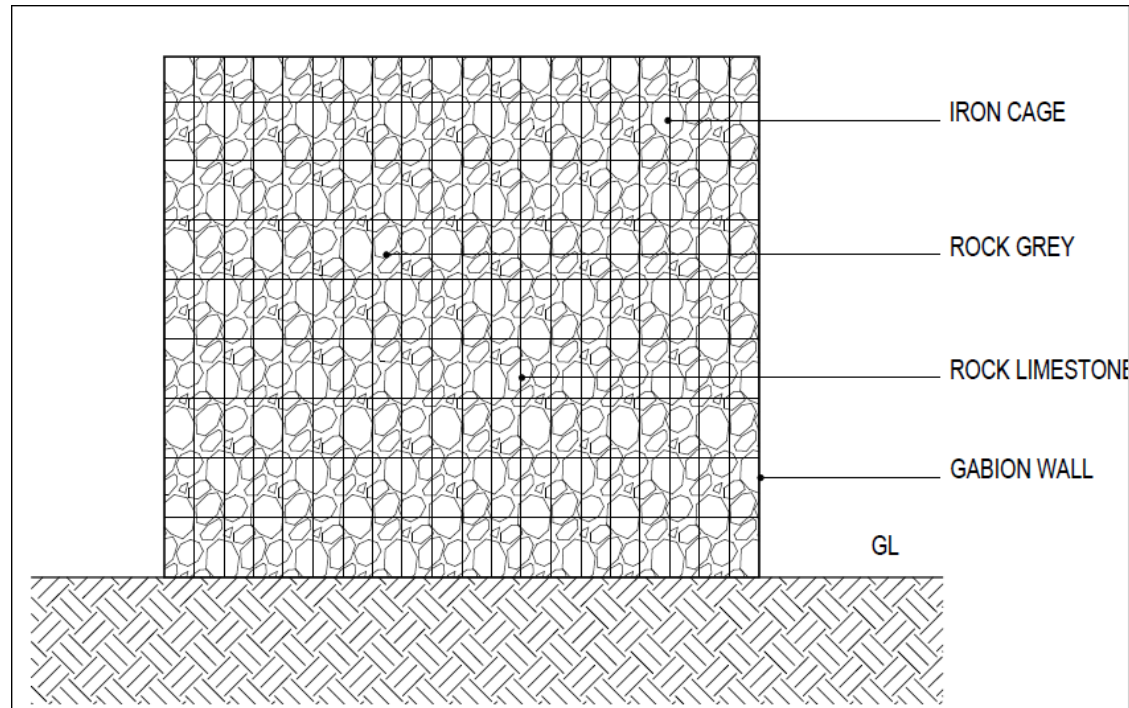


ANNEXURE 13: LIST OF PUBLICATIONS

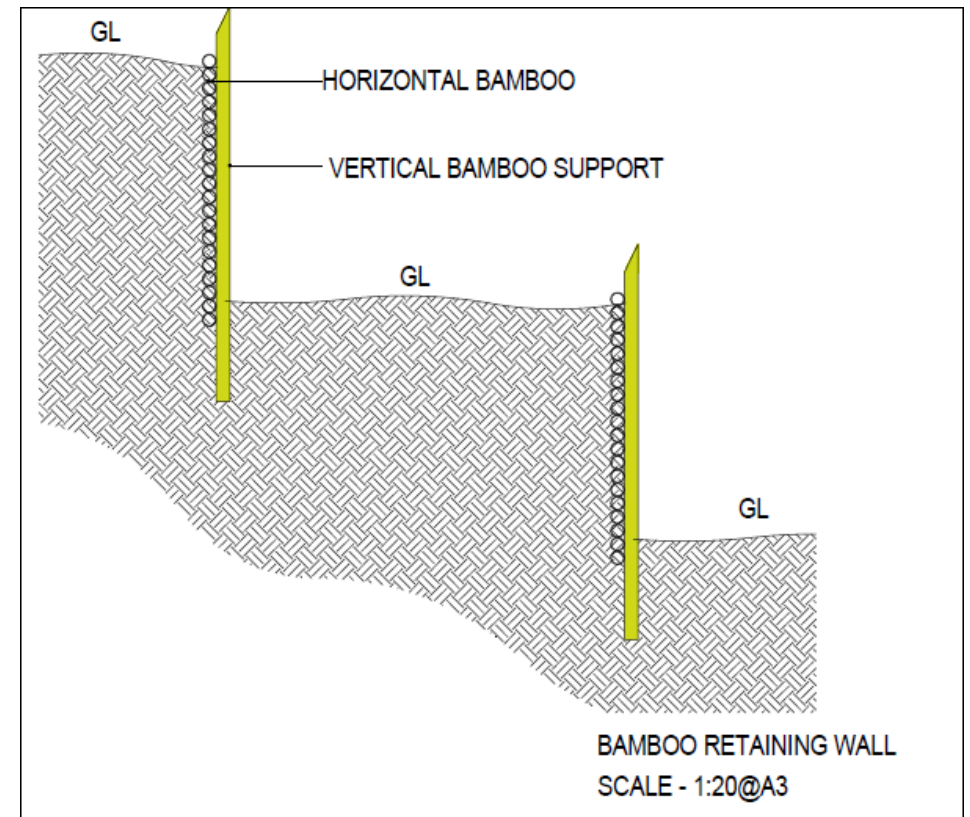
1. Jointly presented "Community participation and bio rights possibilities in the conservation of urban wetlands: a study of Deepor Beel (lake), Guwahati, India" with Mr. Abraham Samuel and Banafsha Rajput in ICEIL 2018, Noida on 21-12-2018.
2. Jointly published research paper "Thermal Comfort in Built Environment through Shading: The Case of Guwahati City" in AJET Volume 1, No. 2, November 2016, Amity University Dubai. ISSN: 2518-6493
3. Presented Conference paper "Adaption of Vernacular Architecture as a Sustainable Identity for the Contemporary Built Environment" at the South Asian Vernacular Architecture, SPA Bhopal, India 11-13 Dec 2015.
4. Presented jointly authored paper at the Manipal international symposium, "Integration of Green Palette in Desert Cities: Mitigating Challenges under the Stewardship of Dubai Municipality2015". Abstract published conference proceedings.
5. Presented conference paper titled "From Persian gardens to parks of the 21st century; a cross cultural study on constructed landscape of Dubai and India" at the Manipal Colloquium April, 2014, in Manipal University India. Abstract published in the proceedings.
6. "Resilient & sustainable water front design decisions for Urban Wetlands" Niva Rana Mahanta and Dr. Chandan Mahanta.Submitted this paper (extended abstract) to 20th National Symposium of Sustainability, IIT Gandhinagar, India on 25-10-18 and presented by Dr. Chandan Mahanta as key note speech on 7-11-18.
7. 'Landscape Interventions for Resilience and Sustainability in Urban Wetland Parks: a review' Accepted in ASET 19. Coauthored with Banafsha. Accepted, presented on 26-3-19 (Scopus Indexed)
8. 'Adventurous Architecture and Green Technologies' Accepted in ASET 19. Coauthored with Ajmeena (student), Accepted, presented on 26-3-19(Scopus Indexed)
9. Co-authored and presented the paper "Water imagery, belief systems and adaptation in place making: study of 'Deepor Beel' wetlands, India" with Mr. Abraham Samuel in CPFTMC at Amity University Dubai on 19th June 2019.

Number of conference/ Seminar attended (During the last 3 academic years in related field of research)

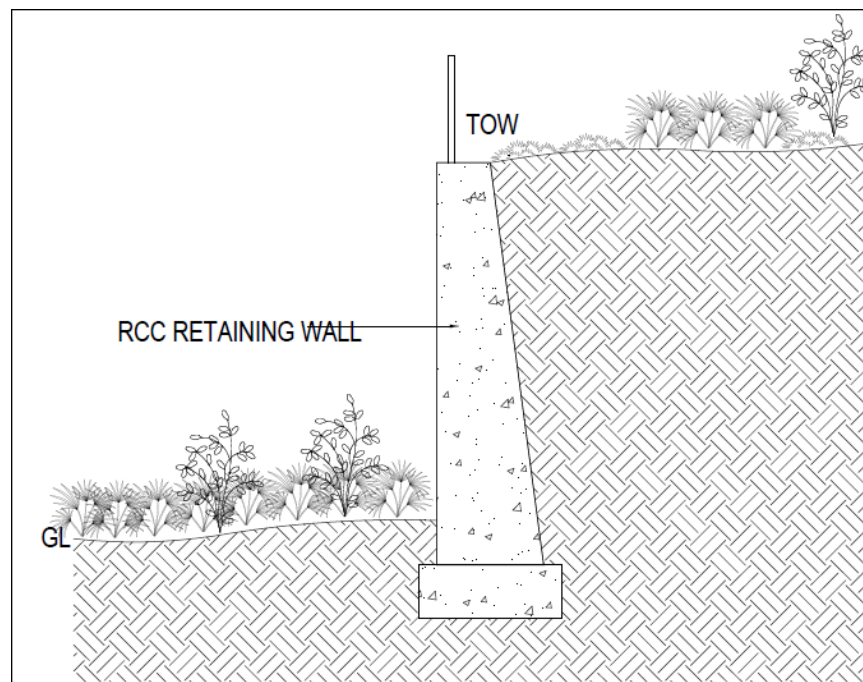
1. Was invited as key note speaker and panel discussion at the 4th International Conference on Sustainable Architecture & Urbanism (March 7th & 8th 2018) at the Holiday Inn, Knowledge Village organized by Islamic Azad University in Collaboration with Masdar, (3:30 to 7:30 pm). Jointly presented on the topic "Design decisions: Urban wetland, resilience & sustainable water front design" with Abraham Samuel.
2. Conducted and attended World Architectural Summit at Amity University Dubai. February 2017
3. Key note speaker at The Second International Congress on Sustainable Architecture and Urbanism. Arranged by the Islamic Azad University-Dubai Academic City, Dubai, United Arab Emirates on 11th March 2016. Topic was "Urban Wetlands and the built environment".
4. Attended the World Architecture Festival (WAF), Meydan, Dubai. 10th & 11th February, 2016.
5. Mentored and accompanied Architecture students for South Asian Students Design Competition, held at School of Planning and Architecture, Bhopal, India on 10th and 11th December, 2015. Students were honored as the 1st special mention category.
6. Attended 2nd Annual Arab Future Cities Summit- 2nd & 3rd November, 2015, Dubai. "Smart Solutions for Sustainable Cities"



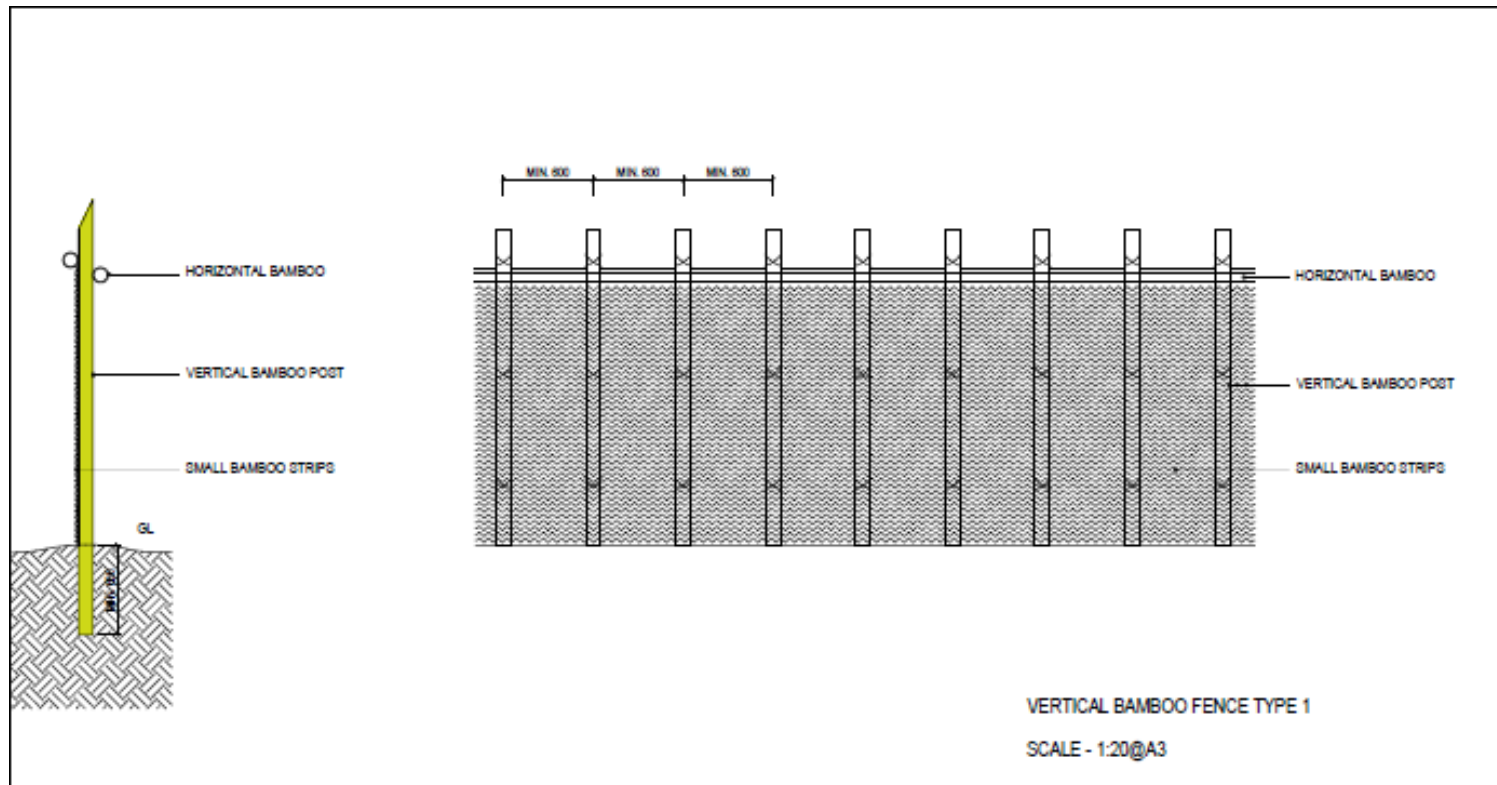
Gabion Wall



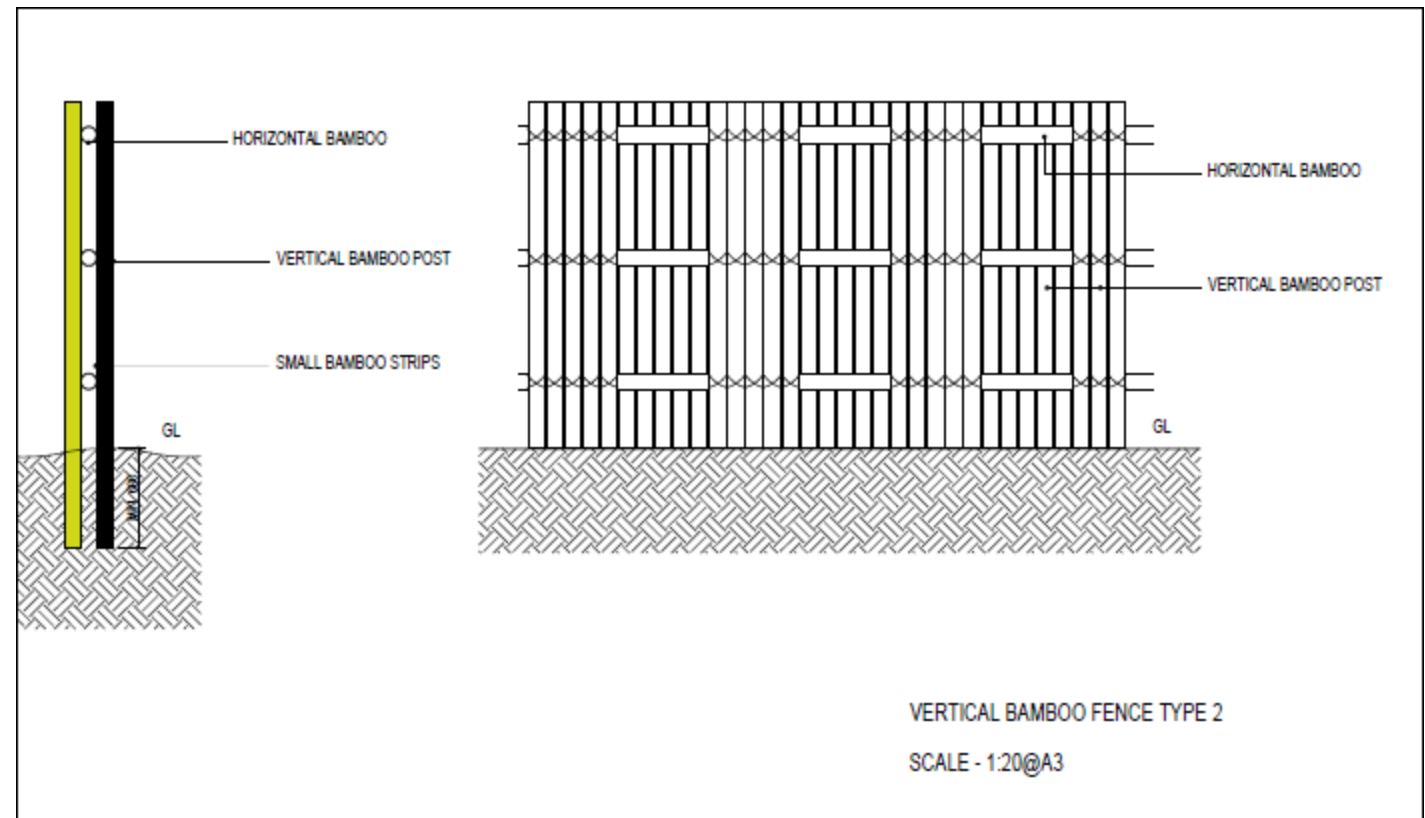
Bamboo Retaining Wall

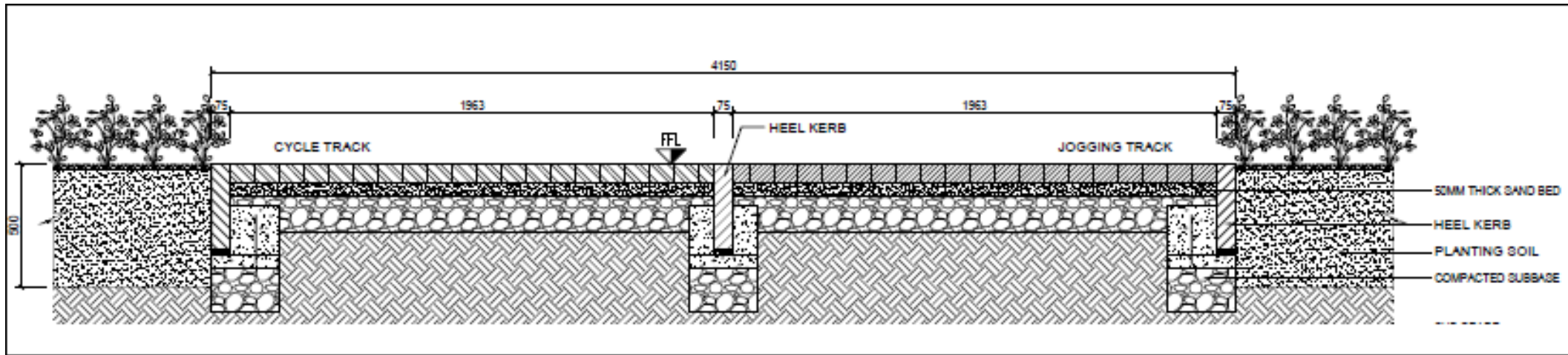


R.C.C. Retaining Wall

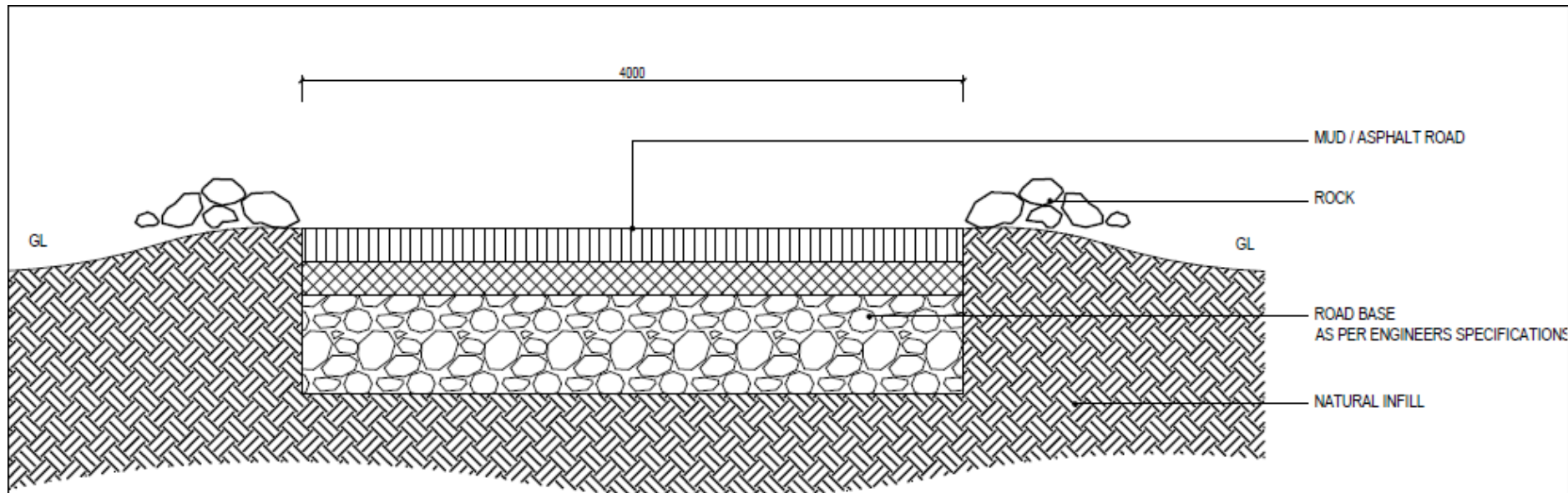


Bamboo Fencing

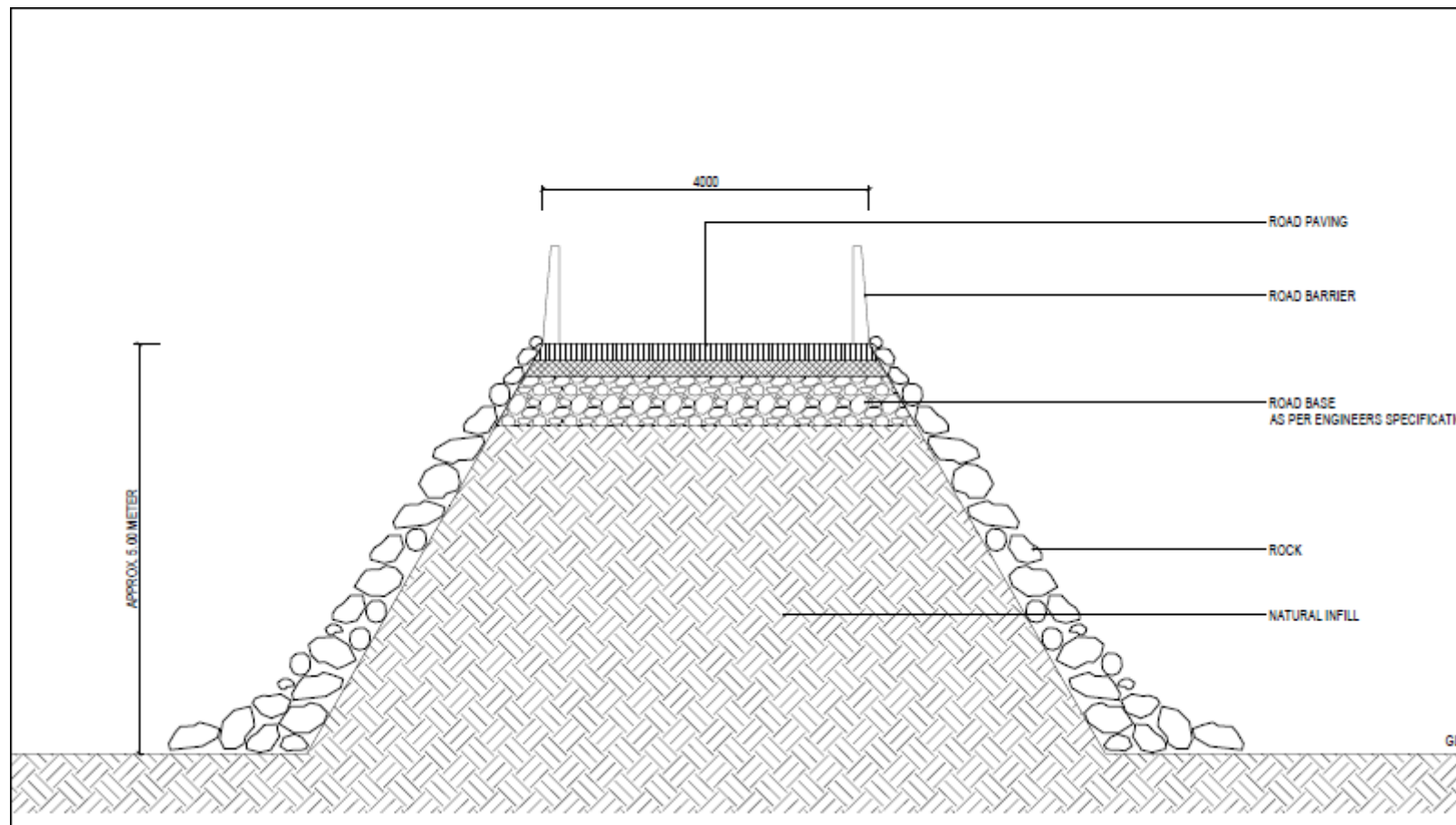




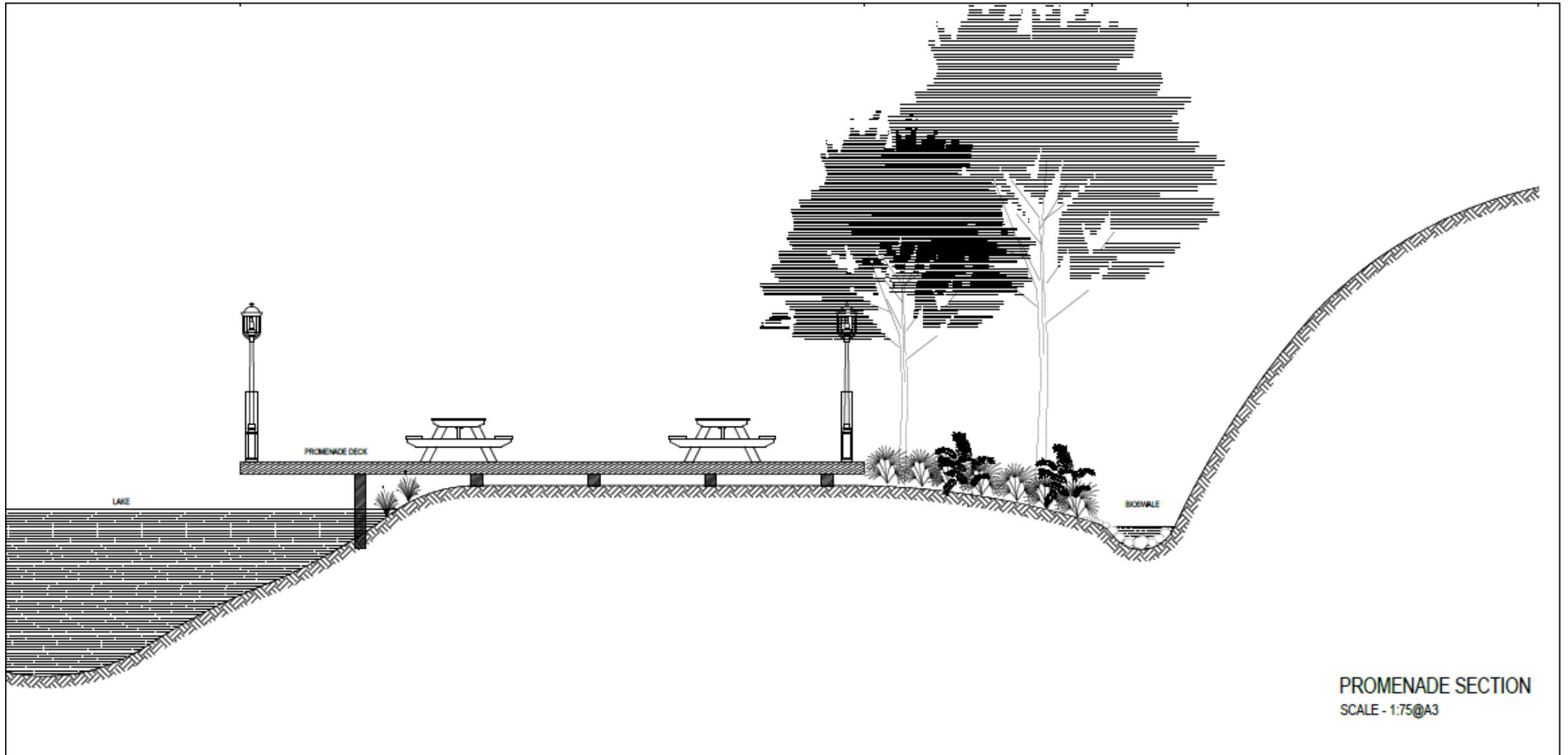
Jogging and cycling track



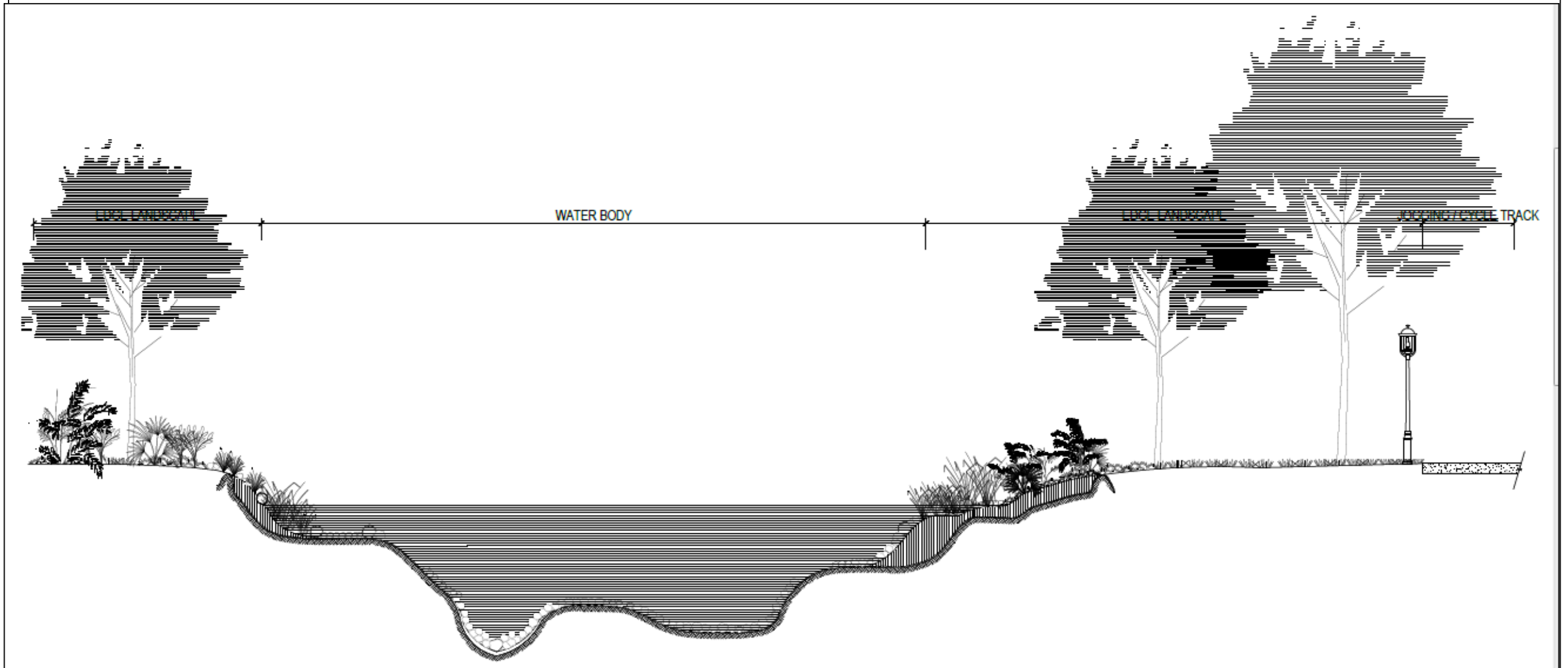
Typical Internal Road section




Internal Road Section - High

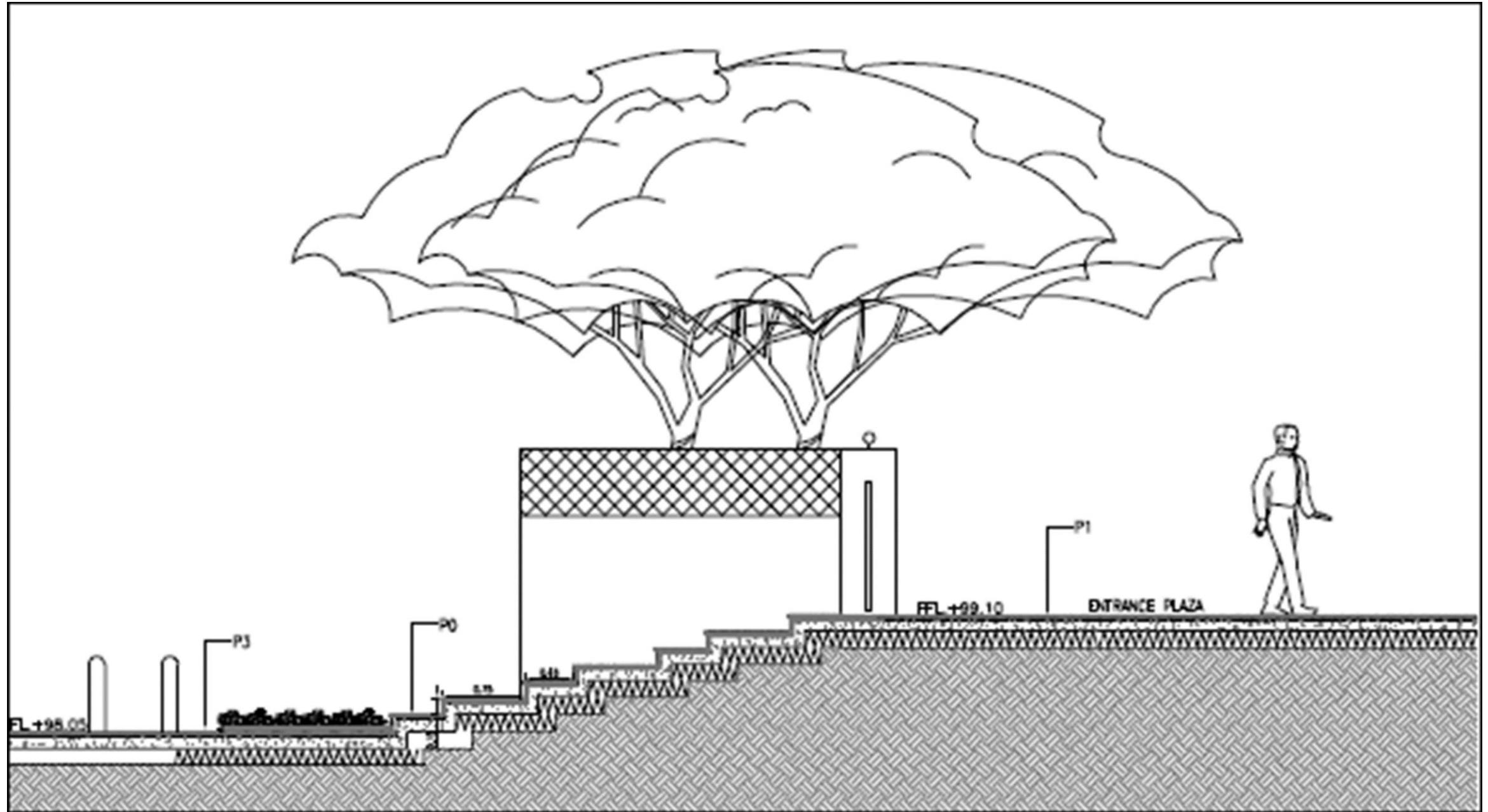


Deck area section

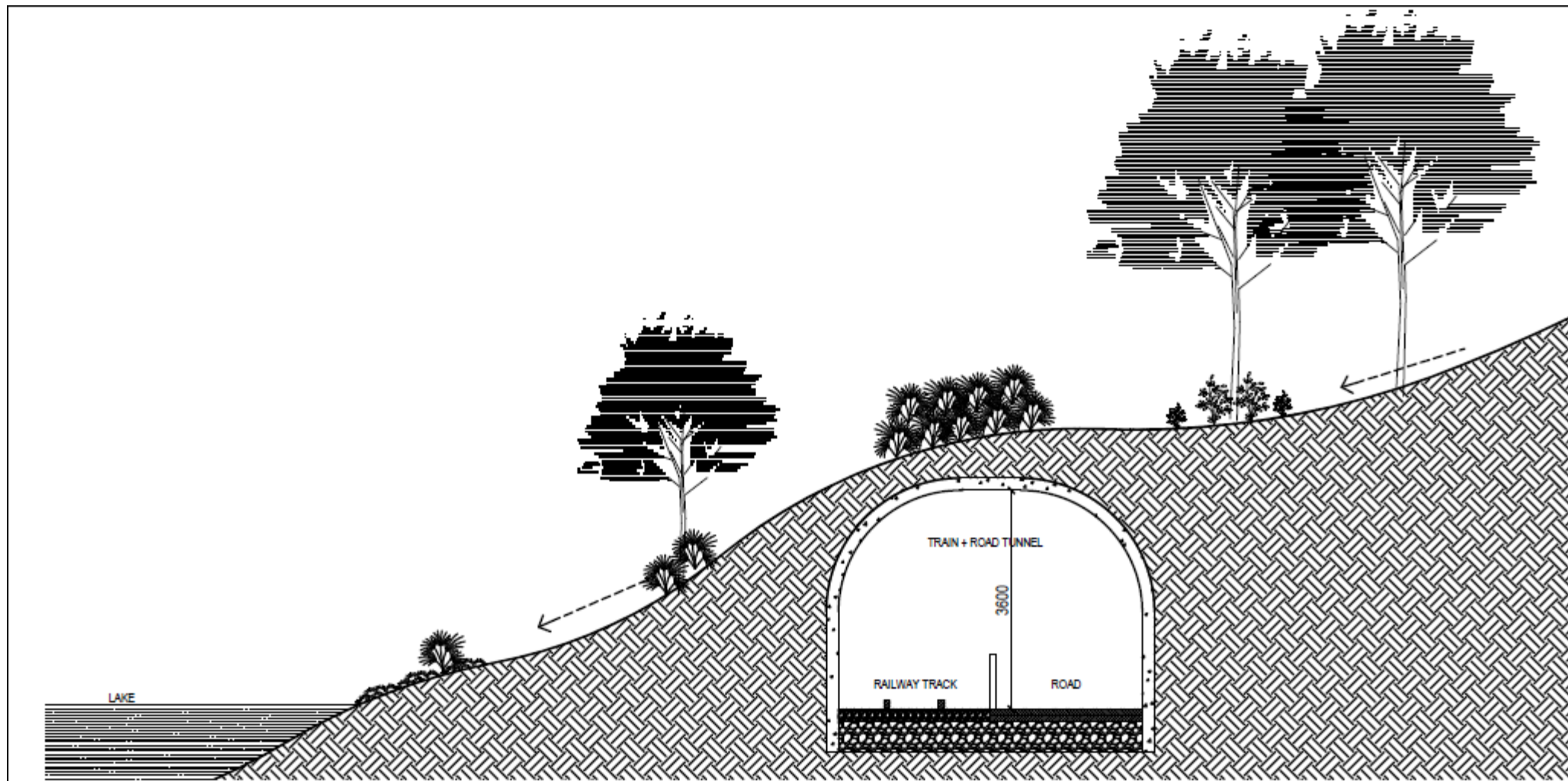


Storm water swale

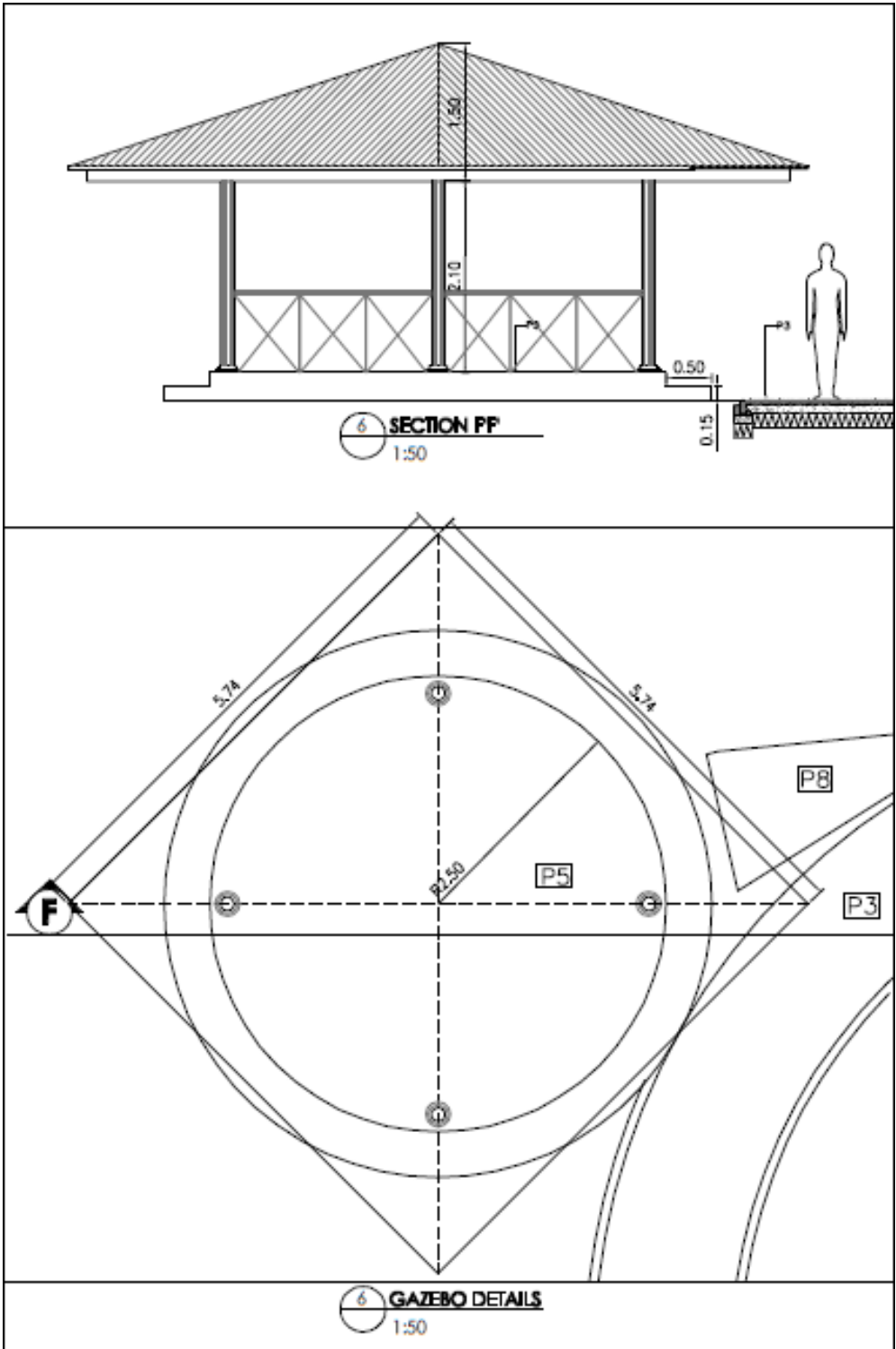
Name: NM 1H2239_N R Mahanta	Date: 25-04-2017	Project Name: Deepor Beel Eco Park	Landscape Elements- Hardscape details	 IIT Guwahati
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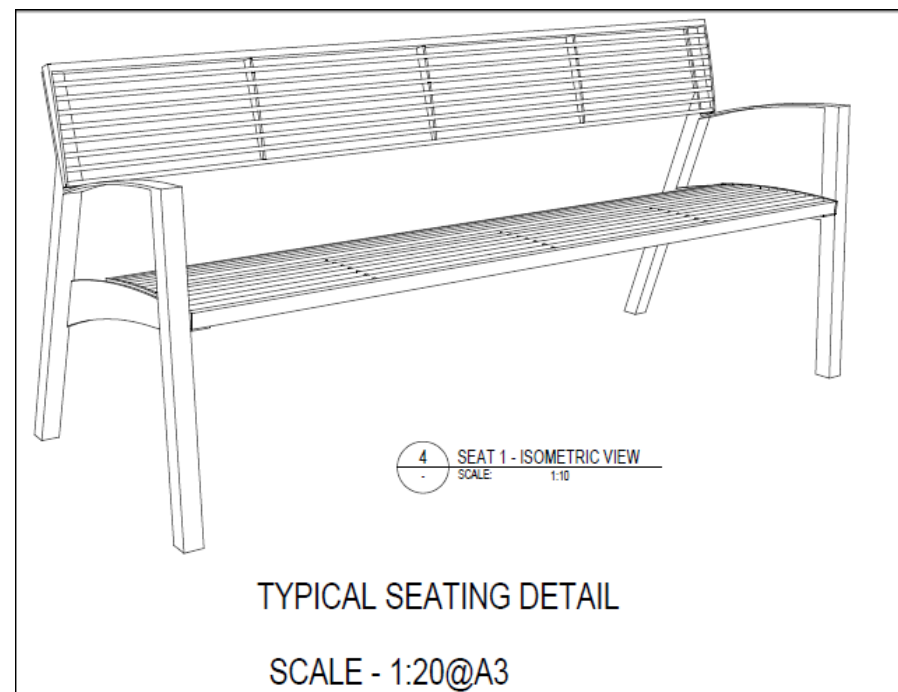
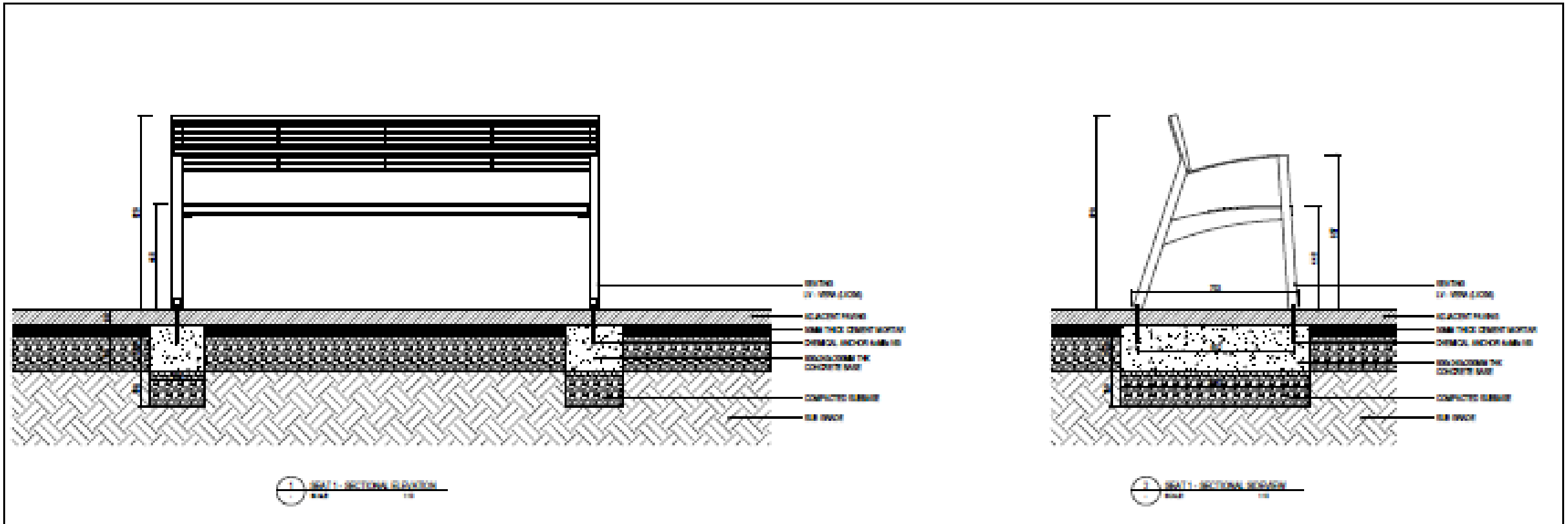
Stepped deck section-near water sports, node 3



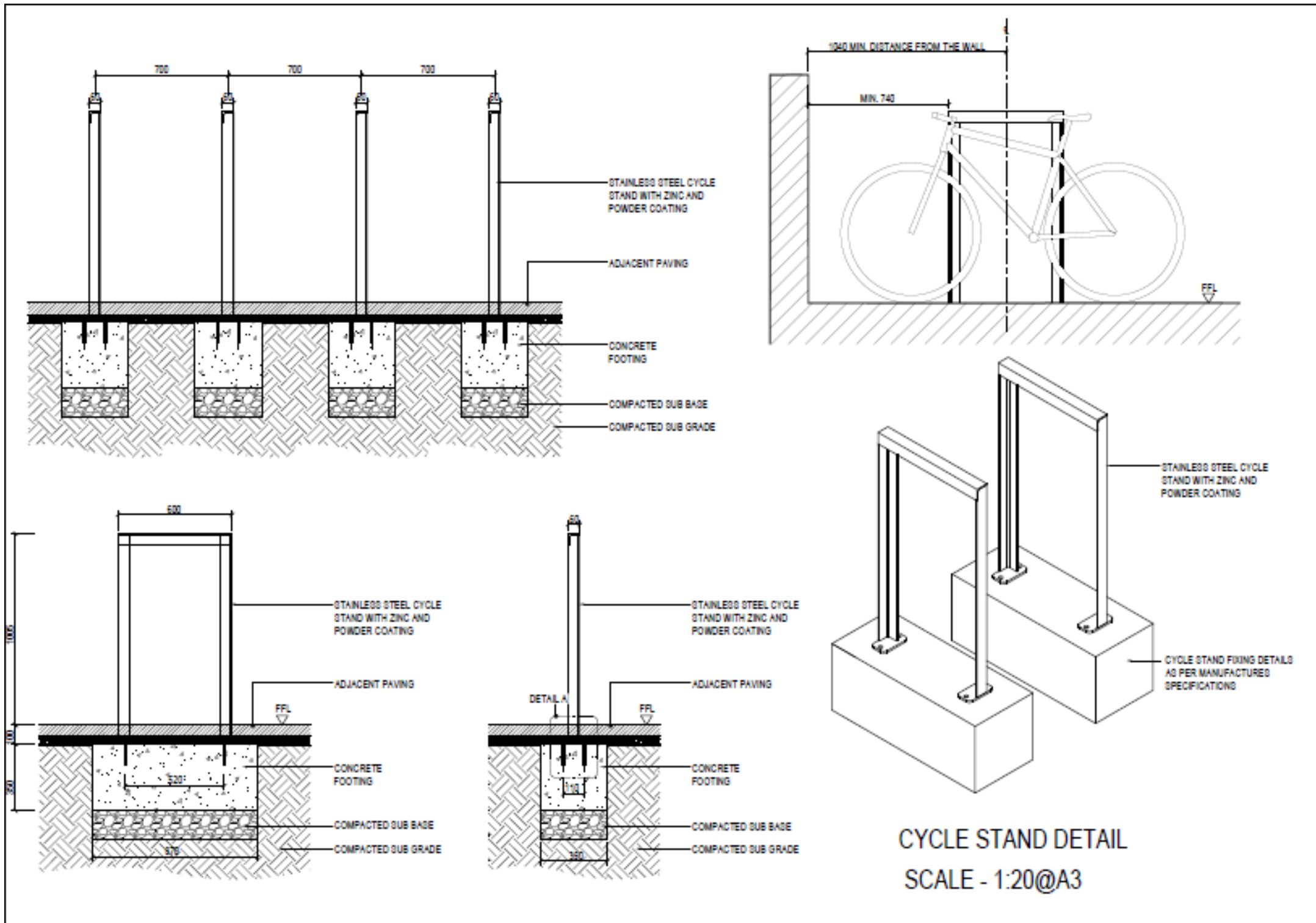
Elephant Corridor over railway and road



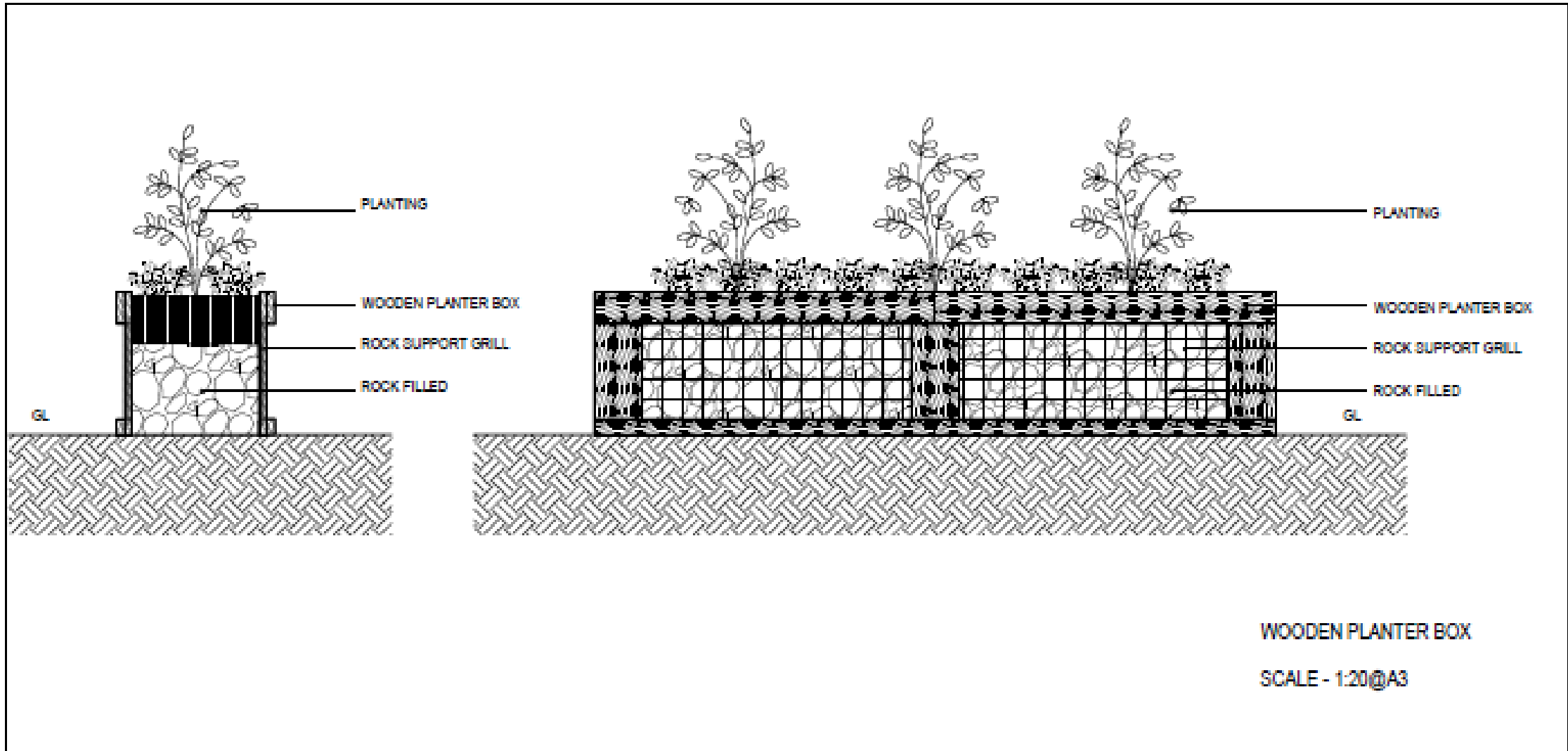
Gazebo Sitting




Bench

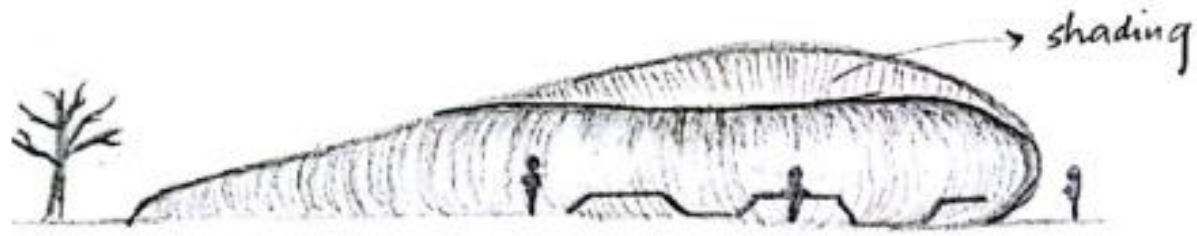


Cycle stand

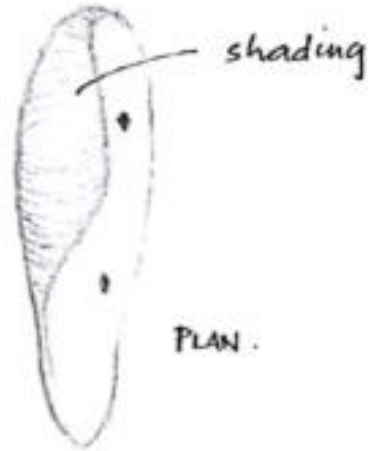


Planter box

Name: NM TH-2239_N R Mahanta	Date: 25-04-2017	Project Name: Deepor Beel Eco Park		Landscape Elements- Hardscape details	 IIT Guwahati



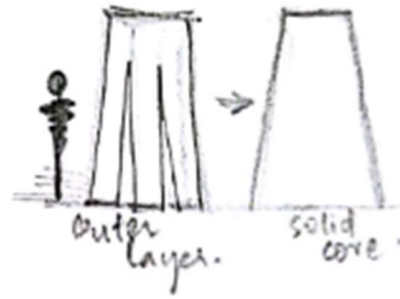
1



WASHROOM



Covered walkway and Maze inspired by Dingara

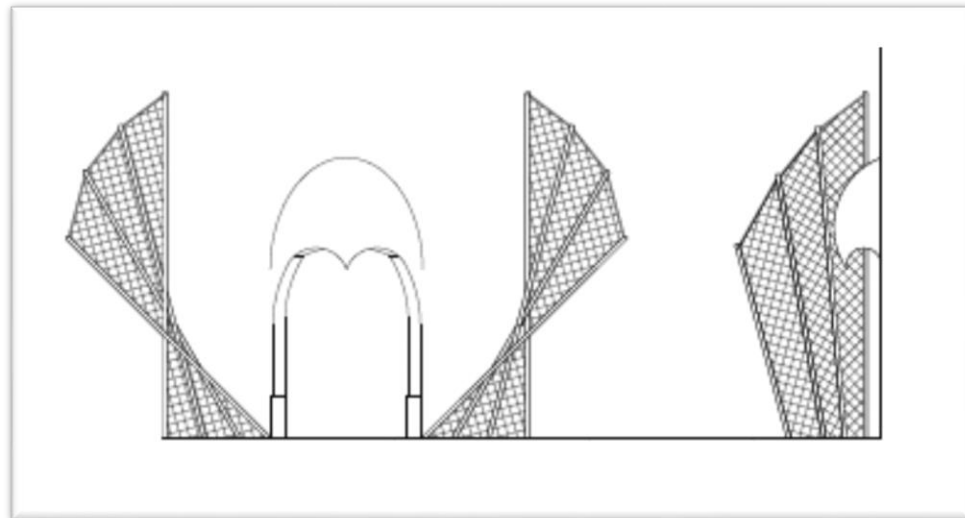


3

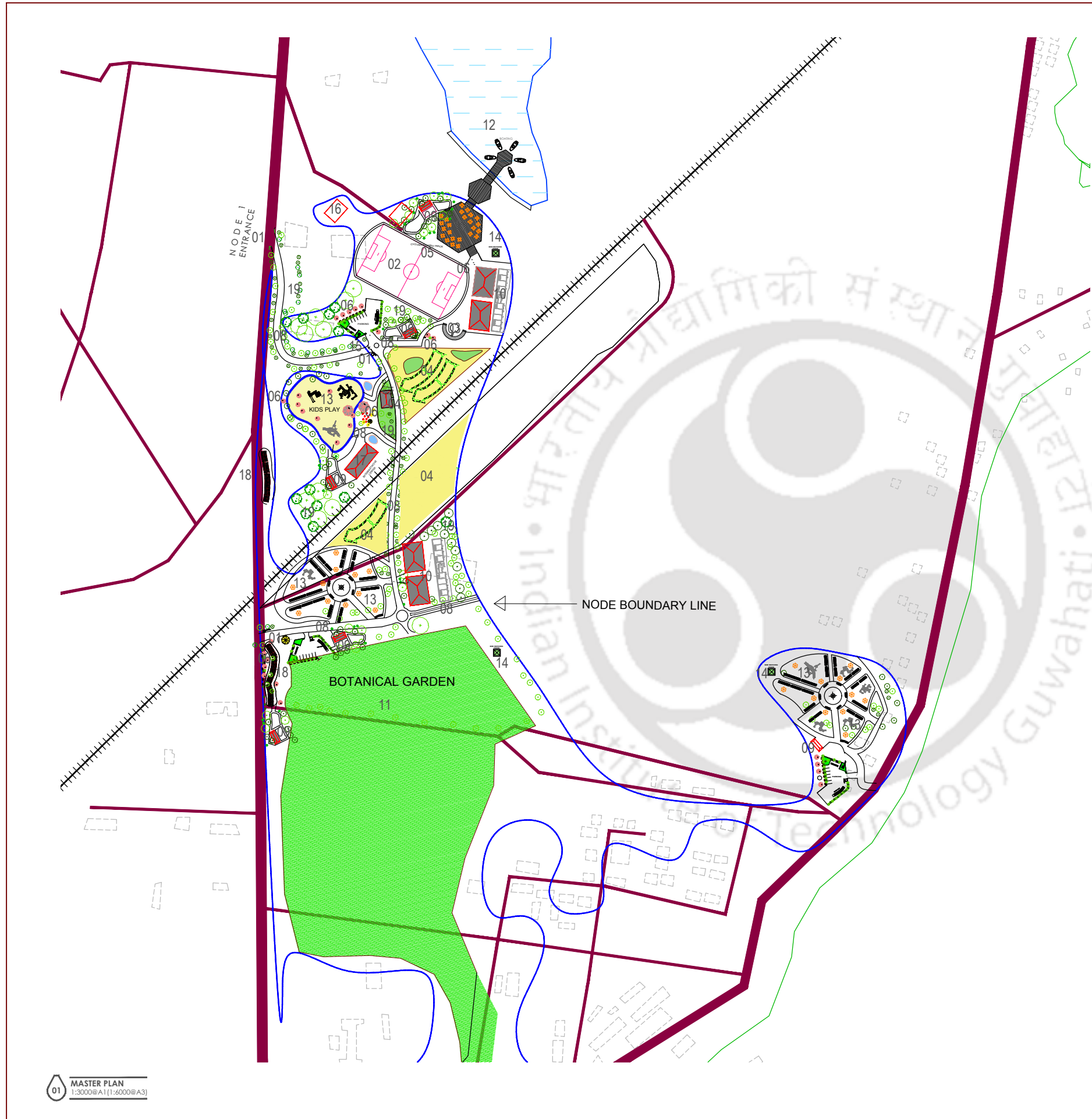


MAZE ENTRY

2



1. Solar car stand/Bus stop , 2. Entry gate for play area, 3. Semi covered walkways - Conceptual design using Bamboo (local materials)



- Node 1: Botanical garden (91°36'43"E, 26°6'4"N)**
1. Entry node:
 - Information center, admin office, booking counters, clinic with pharmacy, parking (cycle, 2 wheelers, cars and buses),
 - Security cabin
 - Cycle on rent, solar cars (golf cart type) on rent. To be provided at two points, near the main entry for pedestrian coming in public transport and inside for people coming in own vehicles.
 - Convenient store (shop)
 - Artifact shops, 2 numbers
 2. One big multipurpose playground for football, cricket, community festival ground with food court (not regular shops, stall types, temporary but facility should be provided)
 3. Amphitheater
 4. Flower culture center-office block with area marked for flower cultivation
 5. Bicycle-jogging tracks around the park, from the entry point and back
 6. Gazebo for public interaction and rest area.
 7. Big walkway (footpath on both sides) 4m width with sitting and tree in square, circular pattern
 8. Internal roads 6m wide.
 9. Toilet blocks at every 1km.
 10. Food court
 11. Botanical garden with a separate entry node and parking
 12. Boating with Promenade
 13. Children's play area
 14. Bird watching towers - 4 with a long walkway
 15. Street lighting
 16. Substation, pump room
 17. Interpretation center
 18. Bazar, weekly market
 19. Trees and soft landscape

LEGEND:

- BIRD WATCHING TOWER
- SECURITY TOWER
- WATER BODY

KEY PLAN:

CLIENT APPROVAL		DATE:	

Rev. No.	Date	Description	Rev. By	CHKD. By
0	09.04.2018	CONCEPT DESIGN		NM

REVISIONS

CLIENT: _____

INTERIOR DESIGN CONSULTANT: _____

CONTACT: _____

PROJECT: DEEPOP BEEL

PROJECT MANAGEMENT/ COST CONSULTANT: TO BE NOMINATED

MEP CONSULTANT: TO BE NOMINATED

MAIN CONTRACTOR: TO BE NOMINATED

DRAWING TITLE: **MASTER PLAN NODE 1**

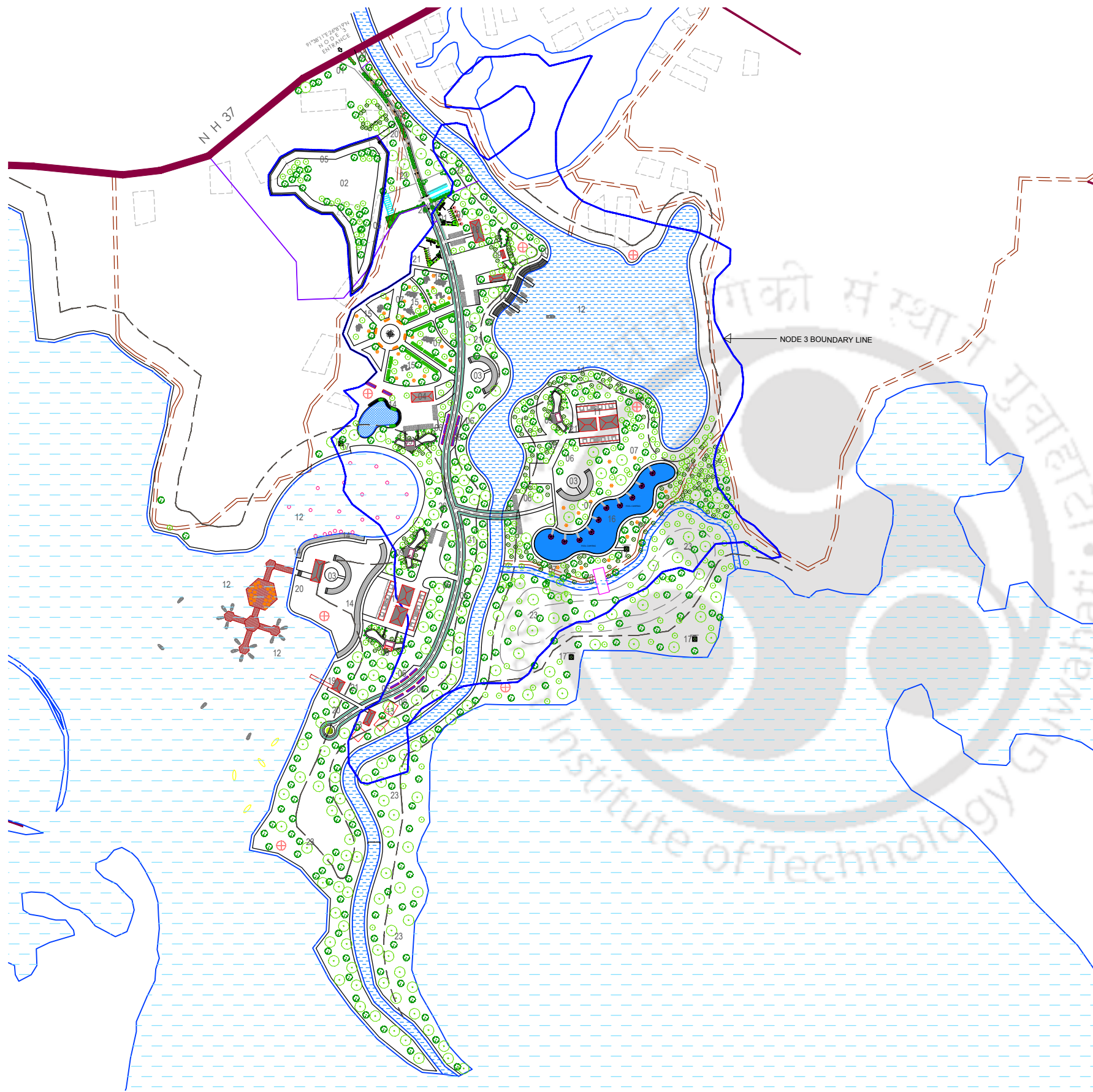
STATUS: **FOR APPROVAL**

SCALE: AS SHOWN	SHEET: A1	DRAWN BY: NM	DESIGN BY: NM
		DRW. STARTED: 14-07-17	DATE SURVEYED: NM

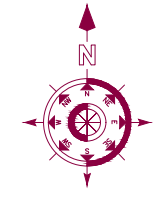
PROJECT No: DB101 DRAWING No.: 03 REVISION: 0

AREA:
NODE 1 = 320322 SQ.MT

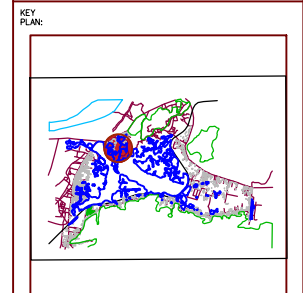
01 MASTER PLAN
 1:3000@A1 (1:6000@A3)



- Node 3: Active recreation area (91°38'11"E, 26°8'19"N)**
- Entry node:
 - Information center, admin office, booking counters, clinic with pharmacy, parking (cycle, 2 wheelers, cars and buses),
 - Toilet blocks
 - Security cabin, small office
 - Café
 - Cycle on rent, solar cars (golf cart type) on rent. These renting stations (so that one can rent and return at any convenient point) to be provided at three points, near the main entry for pedestrian coming in public transport and inside for people coming in own vehicles and at the far end of park.
 - Convenient store (shop) in the administrative block
 - Artifact shops, 2 numbers
 - One big multipurpose playground for football, cricket, community festival ground with food court (not regular shops, stall types, temporary but facility should be provided)
 - Amphitheater
 - Aquaculture center with parking and permanent exhibition space for flowers, butterfly, bird species etc. Aquarium (building only) Ornamental fish culture ponds with an office block
 - Bicycle-jogging tracks around the park, from the entry point and back
 - All 3 area should have some nodes for sculptures, fountain gates etc. to showcase cultural identity.
 - Gazebo for public interaction and rest area.
 - Big walkway (footpath on both sides) 4m width with sitting and tree in square, circular pattern
 - Toilet blocks at every 1km.
 - Internal roads 6m wide.
 - Food court
 - Water sports: Paddle boating for kids and family, paddle boarding, Zorbing, tubing, in constructed water bodies, Water ski, Wakeboarding, fly board and parasailing etc. at boating facilities connected to the wetland.
 - Buildings for water hyacinth recycle center, area for drying and collecting water hyacinth.
 - Promenade / viewing decks near water bodies
 - Children's play area
 - Camping, pool camping and nature trailing, bar-e-q and camp fire
 - Bird watching towers - 4 with a long walkway
 - Museum
 - Shade for boat repairing
 - Signage (Food & drinks not allowed etc.)
 - Garbage collection points
 - All edging details, refer chapter 7 for zoning and edging between different land uses, like hedges, short walls, landscapes sloped contours near water streams, water body etc.
 - Trees and soft landscape



- LEGEND:**
- BIRD WATCHING TOWER
 - SECURITY TOWER
 - WATER BODY



CLIENT APPROVAL: _____ **DATE:** _____

Rev. No.	Date	Description	Rev. By.	CHKD. By.
0	09.04.2018	CONCEPT DESIGN		NM

REVISIONS

CLIENTS:

INTERIOR DESIGN CONSULTANT:

CONTACT:

PROJECT: DEEPOP BEEL

PROJECT MANAGEMENT/ COST CONSULTANT: TO BE NOMINATED

MEP CONSULTANT: TO BE NOMINATED

MAIN CONTRACTOR: TO BE NOMINATED

DRAWING TITLE:
**MASTER PLAN
 NODE 3**

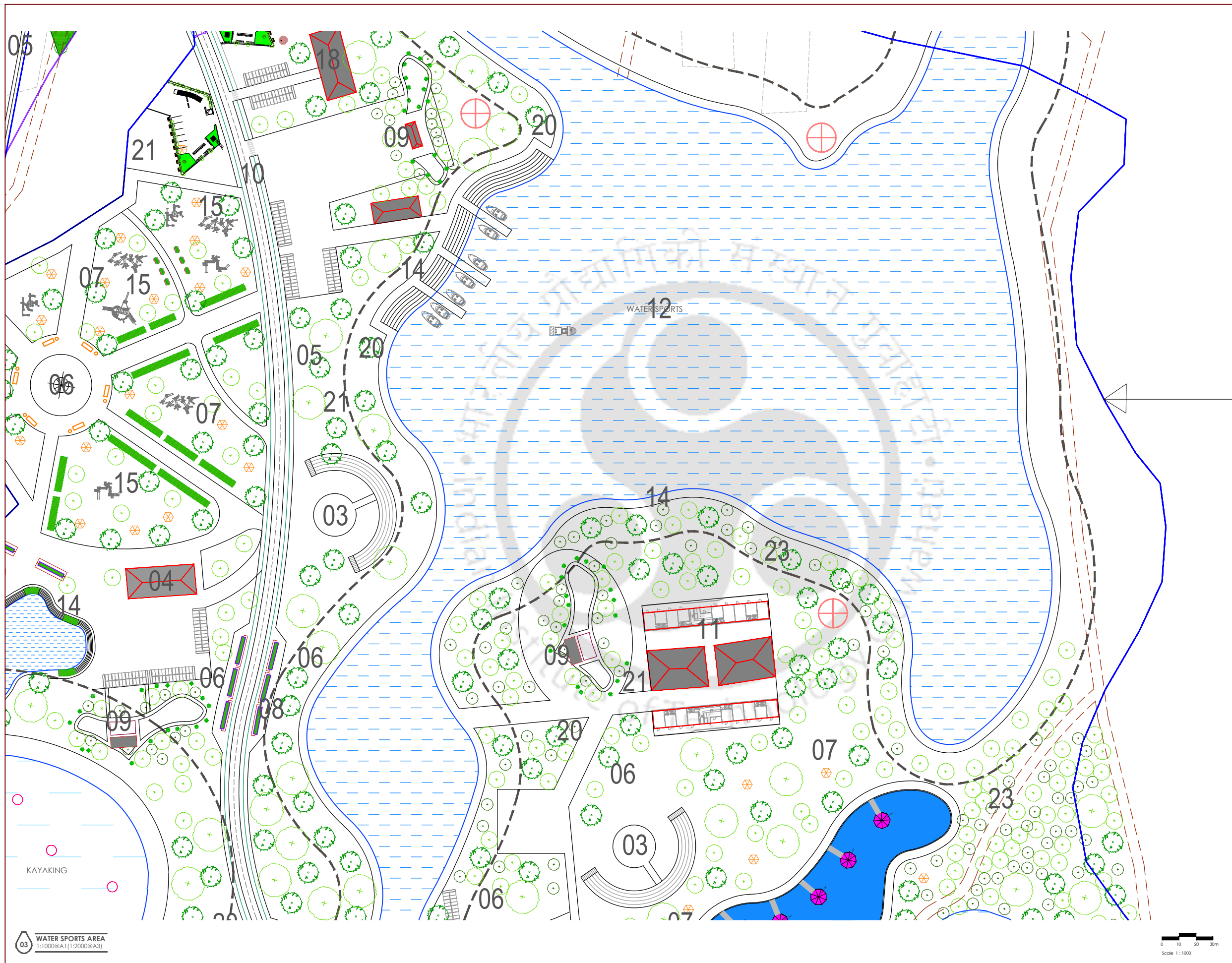
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		DRW. STARTED: 14-07-17	DATE SURVEYED: NM
PROJECT No.: DB101	DRAWING No.: 04	REVISION: 0	

**AREA:
 NODE 3 = 565377 SQ.MT**



01 MASTER PLAN
 1:3000@A1(1:6000@A3)



LEGEND:

- ECO RESORT
- WATER BODY
- BIRD WATCHING TOWER
- SECURITY TOWER

KEY PLAN:

CLIENT APPROVAL: _____ **DATE:** _____

Rev. No.	Date	Description	Rev. By	CHKD. By
0	09.04.2018	CONCEPT DESIGN		NM

REVISIONS:

CLIENT: _____

INTERIOR DESIGN CONSULTANT: _____

CONTACT: _____

PROJECT: DEEPOP BEEL

PROJECT MANAGEMENT/ COST CONSULTANT: TO BE NOMINATED

MEP CONSULTANT: TO BE NOMINATED

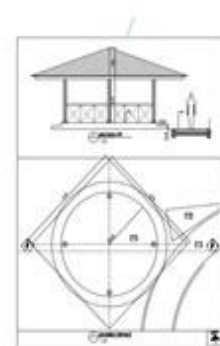
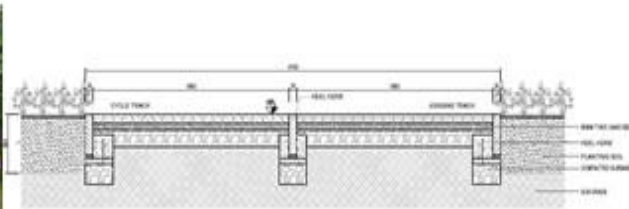
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DRAWING TITLE: WATER SPORTS AREA

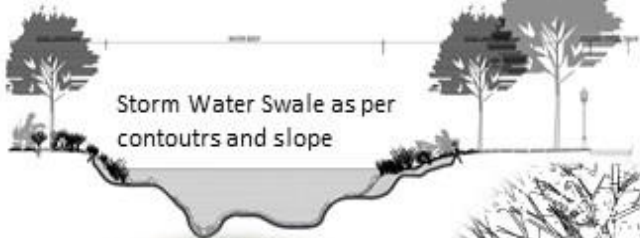
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PROJECT No.:	DRAWING No.:	REVISION:
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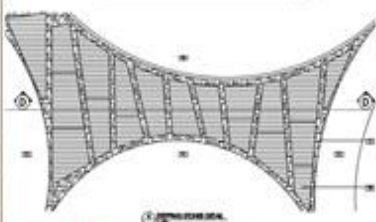
Active circulation corridors



Storm Water Swale as per contours and slope



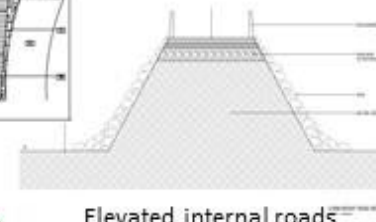
Gazebos and semi covered walkway as interactive outdoor spaces.



Use of native vegetation for landscaping



Outdoor seating with different types of street furniture



Elevated internal roads



Children play area in all three nodes



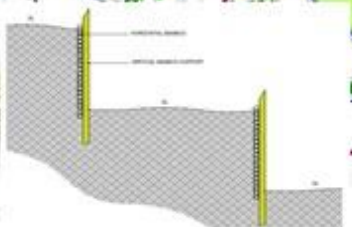
Elevation planning for promenade for maximum viewing angle



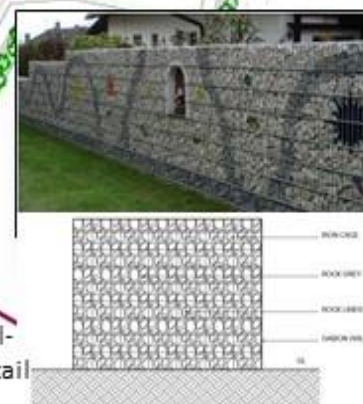
Wayfinding Signages



Use of local materials and techniques, Bamboo retaining wall



Gabion wall- Sectional detail



NOTE: All pictures are for representative purpose only.




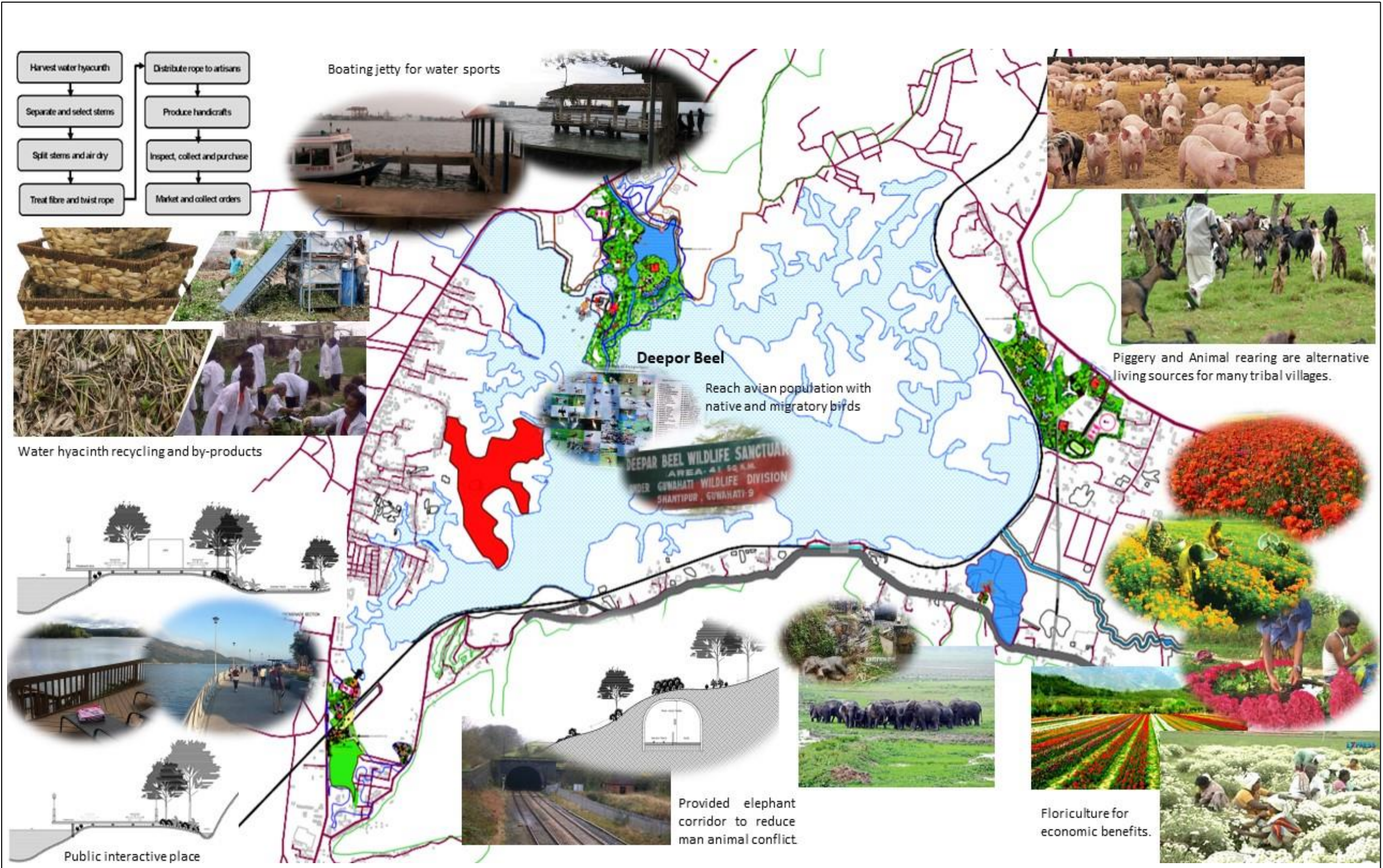
- Node 3: Active recreation area (91°38'11"E, 26°8'19"N)**
- Entry node:
 - Information center, admin office, booking counters, clinic with pharmacy, parking (cycle, 2 wheelers, cars and buses),
 - Toilet blocks
 - Security cabin, small office
 - Café
 - Cycle on rent, solar cars (golf cart type) on rent. These renting stations (so that one can rent and return at any convenient point) to be provided at three points, near the main entry for pedestrian coming in public transport and inside for people coming in own vehicles and at the far end of park.
 - Convenient store (shop) in the administrative block
 - Artifact shops, 2 numbers
 - One big multipurpose playground for football, cricket, community festival ground with food court (not regular shops, stall types, temporary but facility should be provided)
 - Amphitheater
 - Aquaculture center with parking and permanent exhibition space for flowers, butterfly, bird species etc. Aquarium (building only) Ornamental fish culture ponds with an office block
 - Bicycle-jogging tracks around the park, from the entry point and back
 - All 3 area should have some nodes for sculptures, fountain gates etc. to showcase cultural identity.
 - Gazebo for public interaction and rest area.
 - Big walkway (footpath on both sides) 4m width with sitting and tree in square, circular pattern
 - Toilet blocks at every 1km.
 - Internal roads 6m wide.
 - Food court
 - Water sports: Paddle boating for kids and family, paddle boarding, Zorbing, tubing, in constructed water bodies, Water ski, Wakeboarding, fly board and parasailing etc. at boating facilities connected to the wetland.
 - Buildings for water hyacinth recycle center, area for drying and collecting water hyacinth.
 - Promenade / viewing decks near water bodies
 - Children's play area
 - Camping, pool camping and nature trailing, bar-e-q and camp fire
 - Bird watching towers - 4 with a long walkway
 - Street lighting
 - Substation, pump room
 - Signage (Food & drinks not allowed etc.)
 - Garbage collection points
 - All edging details, refer chapter 7 for zoning and edging between different land uses, like hedges, short walls, landscapes sloped contours near water streams, water body etc.
 - Trees and soft landscape

Any landscape design contains 3 major components, **patch (both human settlements and wild life habitat), matrix and corridor**. The patches around the wetland are the forest in the south, human settlements and wetland extent in all other directions in variable size, shape and structure. Corridors like the rivers (inlet and outlet to the wetland), railway track sides (right of way) and the roads, particularly along the foot hill of Garbhanga forest was designed to be made into an effective corridor by planting natural vegetation buffer area. The conservation buffer of 25meters along the rivers and 50m along the wetland edges with no development are provided to protect wild life habitats as barrier corridors.


Ecological benefits through design: Ecological design is defined as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes" (Sim Van der Ryn, 1996). **Patch-corridor-matrix model** (elephant corridor, vegetation along the stream), edge, core area (bird sanctuary), buffer, and supporting design principles were used to protect nature and biodiversity at all levels of scale . Percolation beds / storm water control ponds (constructed along contour lines) for ornamental fish culture, nature camping, water sports **Economic benefits:** Handicraft / traditional weekly market / ornamental fish culture / floriculture / use of recycled water hyacinth / Reed grass, Revenue from sports and recreation for economic benefits **Education and Research:** Aqua culture center, museum for birds, flowers and butterfly in the N-E region (with interactive devices for bird monitoring) **Energy efficiency:** Building orientation, shading, use of traditional and local materials and low rise structures (except bird watching and life guard's towers)

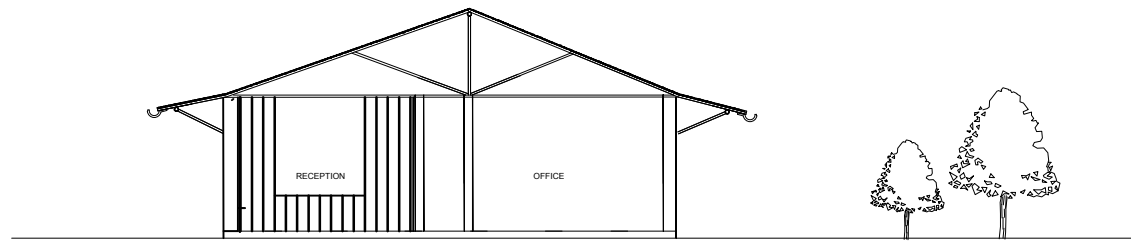
Note: All images are for representative purpose only

Name: NM 11-2259_N R Mahanta	Date: 25-04-2017	Project Name: Deepor Beel Eco Park	Landscape Elements	 IIT Guwahati
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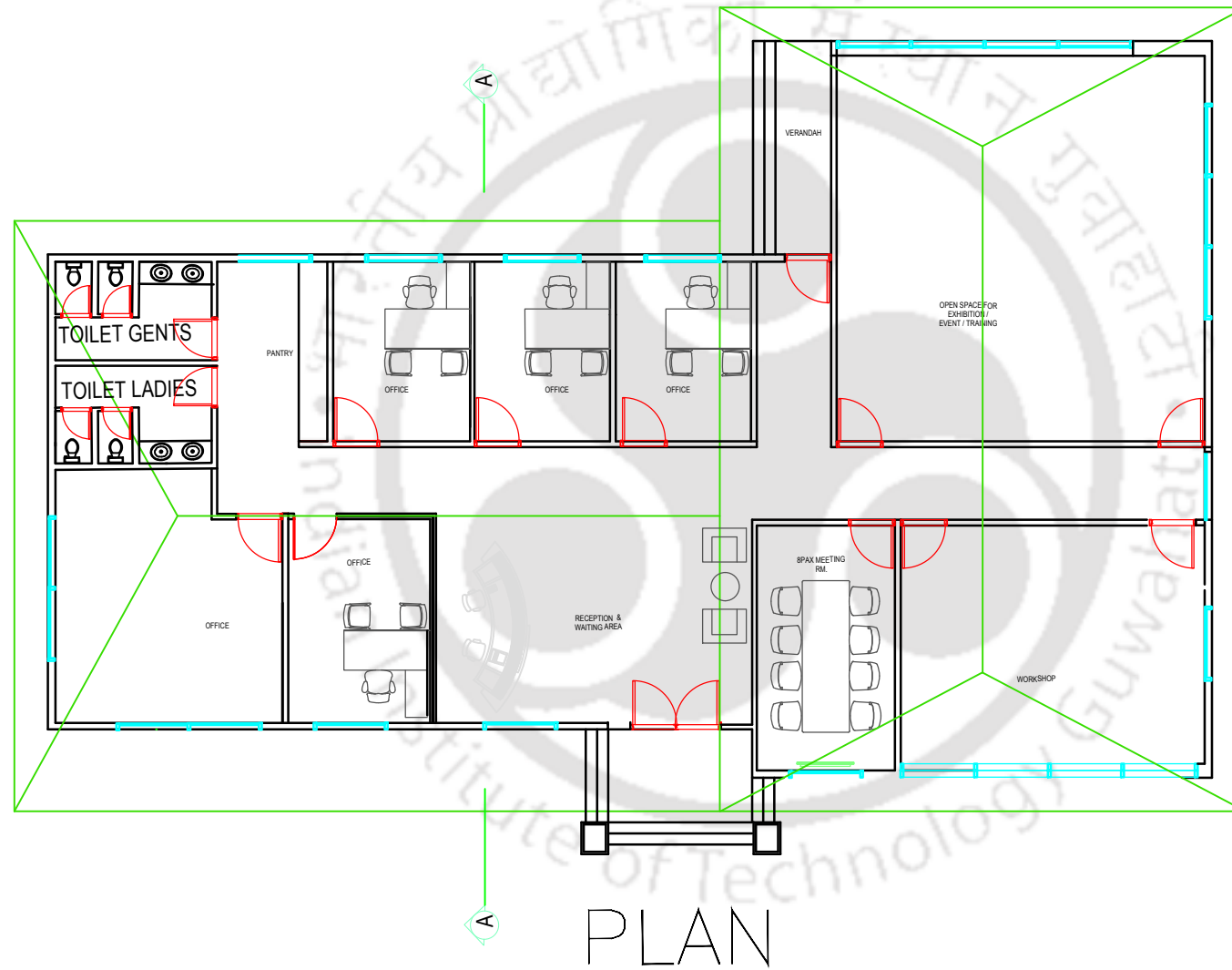


NOTE: All pictures are for representative purpose only.

Name: NM 11-2259_N R Mahanta	Date: 25-04-2017	Project Name: Deepor Beel Eco Park		Suggested Bio rights & recreation	 IIT Guwahati
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SECTION AA'

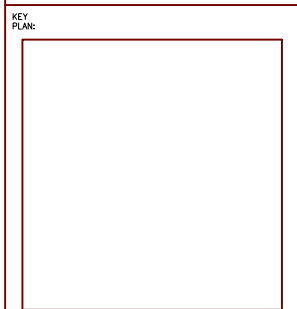


PLAN

TYPICAL PLAN FOR FLOWER CULTURE, AQUA CULTURE AND ADMINISTRATION OFFICE



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0	15.09.2017	CONCEPT DESIGN	NM	

CLIENT APPROVAL: _____ DATE: _____

CLIENT: _____

INTERIOR DESIGN CONSULTANT: _____

CONTACT: _____

PROJECT: DEEPOR BEEL

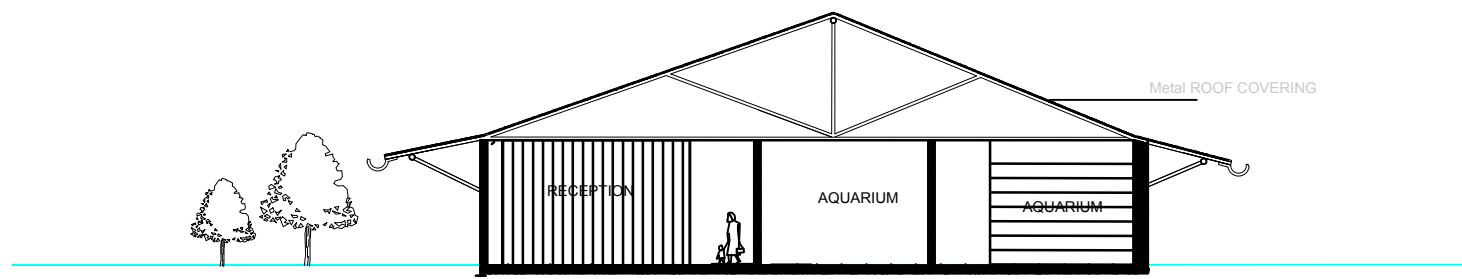
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MEP CONSULTANT: TO BE NOMINATED

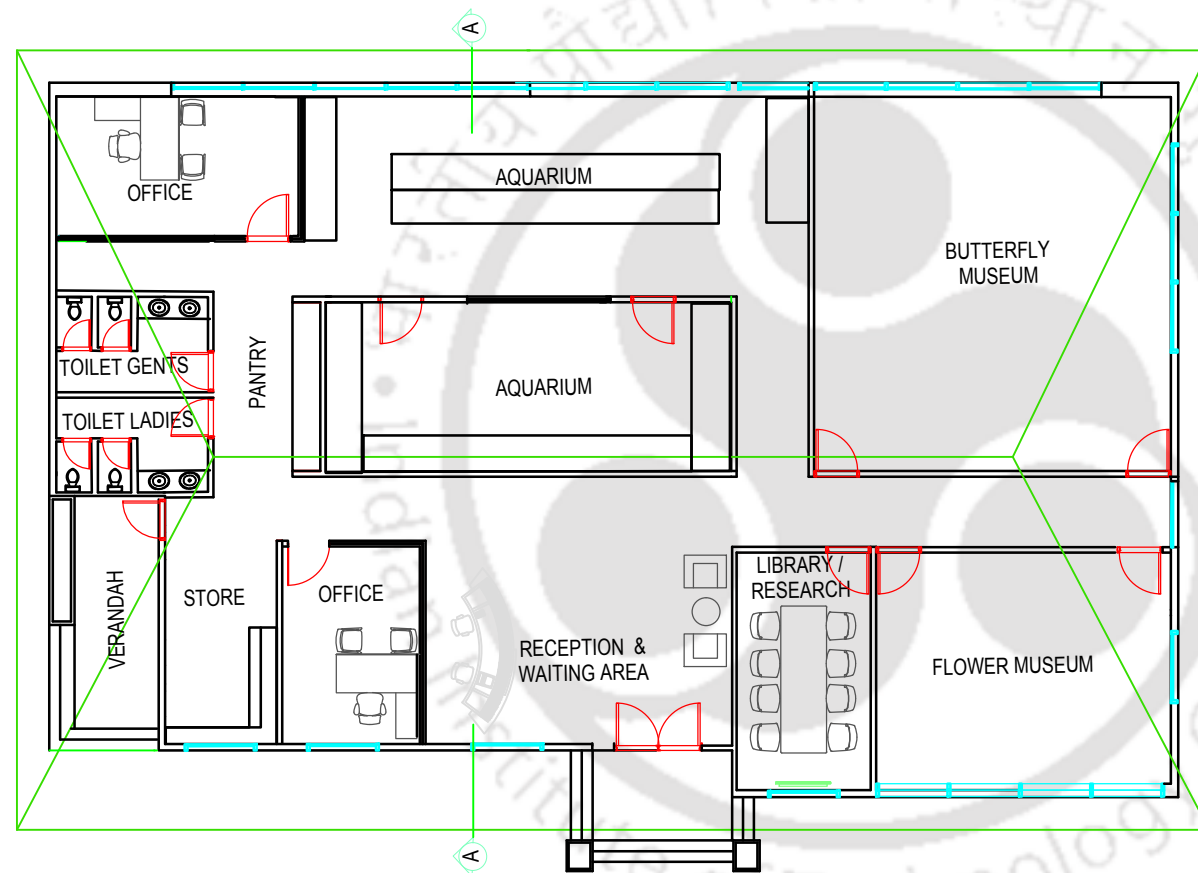
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DRAWING TITLE: ADMIN

STATUS: FOR APPROVAL			
SCALE: AS SHOWN	SHEET: A1	DRAWN BY: NM	DESIGN BY: NM
PROJECT No: db-1217		DRW. STARTED: 140721	DATE SURVEYED: NM
SCALE: 1:100		REVISIONS: 0	



SECTION A-A'



PLAN

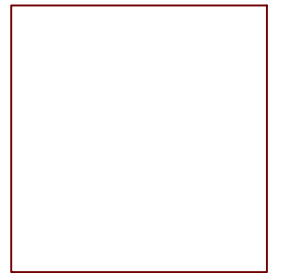
ADMIN BLOCK -LAYOUT AQUARIUM AND MUSEUM FOR FLOWER AND BUTTERFLY



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KEY PLAN:



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Rev. No.	Date	Description	Rev. By	CHKD. By
0	15.09.2017	CONCEPT DESIGN		NM

REVISIONS

CLIENT: _____

INTERIOR DESIGN CONSULTANT: _____

CONTACT: _____

PROJECT: DEEPOR BEEL

PROJECT MANAGEMENT/ COST CONSULTANT: TO BE NOMINATED

MEP CONSULTANT: TO BE NOMINATED

MAIN CONTRACTOR: TO BE NOMINATED

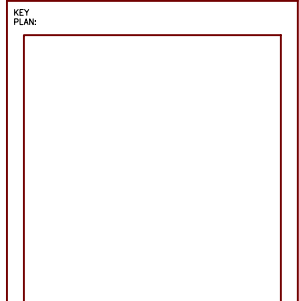
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STATUS: FOR APPROVAL

SCALE: AS SHOWN	SHEET: A1	DRAWN BY: NM	DESIGN BY: NM
PROJECT No: db-1217	SCALE: 1:100	DATE SURVEYED: 140721	REVISION: 0



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Rev. No.	Date	Description	Rev. By. / CHKD. By.

REVISIONS

CLIENT:

INTERIOR DESIGN CONSULTANT:

CONTACT:

PROJECT: DEEPOP BEEL

PROJECT MANAGEMENT/ COST CONSULTANT: TO BE NOMINATED

MEP CONSULTANT: TO BE NOMINATED

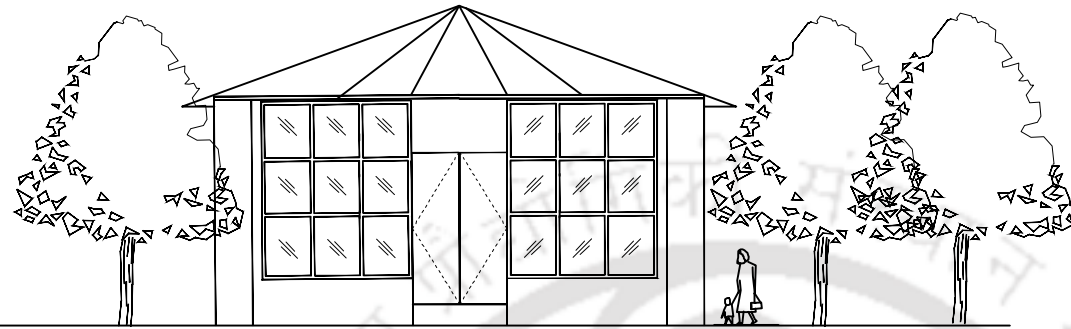
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DRAWING TITLE: POOL COTTAGE LAYOUT

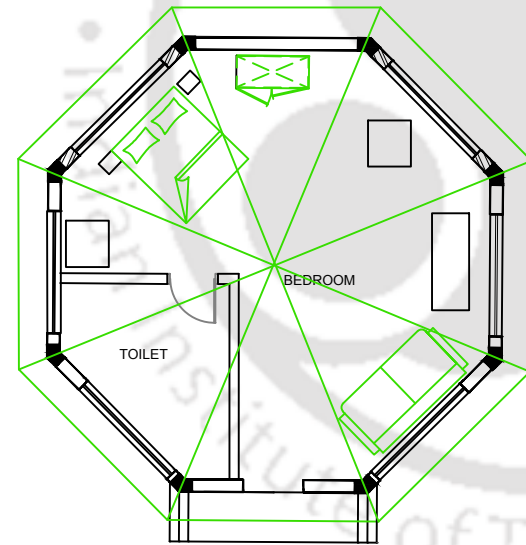
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PROJECT No.:	SCALE:	REVISION:
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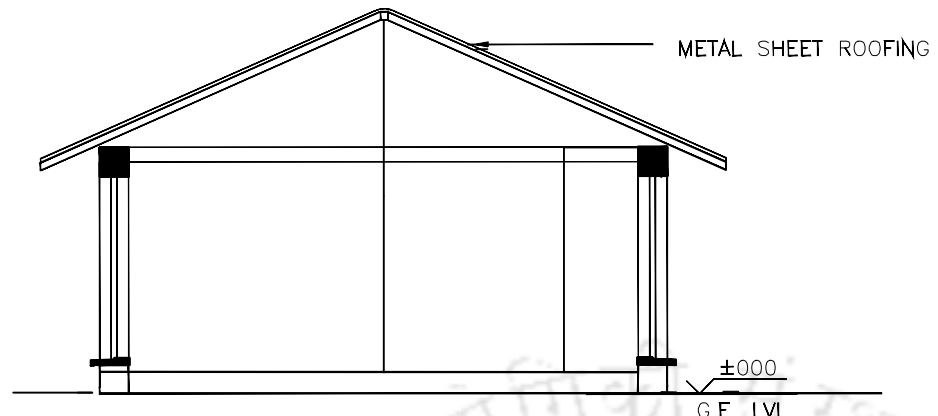


ELEVATION

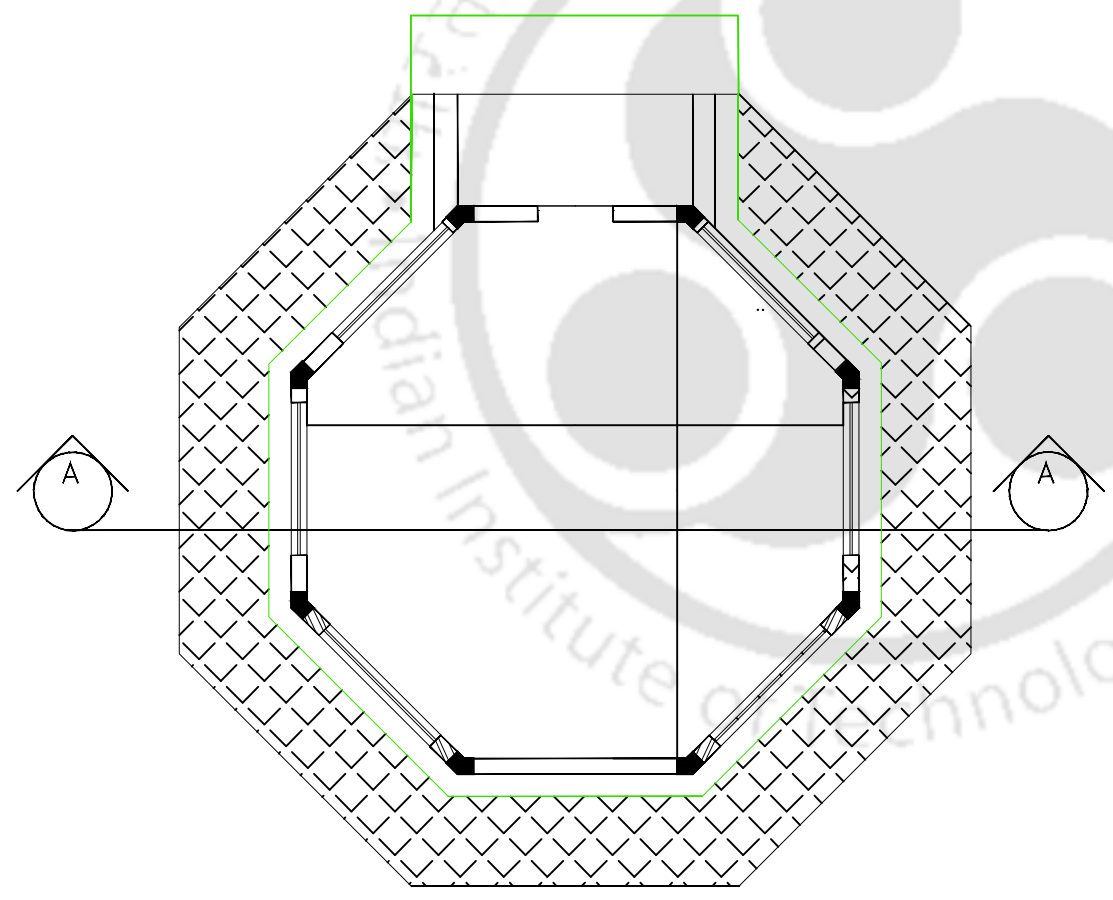


PLAN

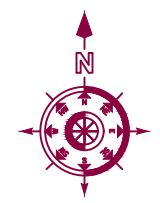
POOL COTTAGE (on stilt)



SECTION



PLAN



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KEY PLAN:

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Rev. No.	Date	Description	Rev. By	CHKD. By
0	15.09.2017	CONCEPT DESIGN		NM

REVISIONS

Rev. No.	Date	Description	Rev. By	CHKD. By

CLIENT:

INTERIOR DESIGN CONSULTANT:

CONTACT:

PROJECT: DEEPOR BEE

PROJECT MANAGEMENT/ COST CONSULTANT: TO BE NOMINATED

MEP CONSULTANT: TO BE NOMINATED

MAIN CONTRACTOR: TO BE NOMINATED

DRAWING TITLE: RECEPTION KIOSK

STATUS: FOR APPROVAL

SCALE: AS SHOWN	SHEET: A1	DRAWN BY: NM	DESIGN BY: NM
PROJECT No.: db-1217	SCALE: 1:100	DATE STARTED: 140721	DATE SURVEYED: NM
		REVISION: 0	

ANNEXURE 13: LIST OF PUBLICATIONS

1. Jointly presented "Community participation and bio rights possibilities in the conservation of urban wetlands: a study of Deepor Beel (lake), Guwahati, India" with Mr. Abraham Samuel and Banafsha Rajput in ICEIL 2018, Noida on 21-12-2018.
2. Jointly published research paper "Thermal Comfort in Built Environment through Shading: The Case of Guwahati City" in AJET Volume 1, No. 2, November 2016, Amity University Dubai. ISSN: 2518-6493
3. Presented Conference paper "Adaption of Vernacular Architecture as a Sustainable Identity for the Contemporary Built Environment" at the South Asian Vernacular Architecture, SPA Bhopal, India 11-13 Dec 2015.
4. Presented jointly authored paper at the Manipal international symposium, "Integration of Green Palette in Desert Cities: Mitigating Challenges under the Stewardship of Dubai Municipality 2015". Abstract published conference proceedings.
5. Presented conference paper titled "From Persian gardens to parks of the 21st century; a cross cultural study on constructed landscape of Dubai and India" at the Manipal Colloquium April, 2014, in Manipal University India. Abstract published in the proceedings.

Number of conference/ Seminar attended (During the last 3 academic years in related field of research)

1. Was invited as key note speaker and panel discussion at the 4th International Conference on Sustainable Architecture & Urbanism (March 7th & 8th 2018) at the Holiday Inn, Knowledge Village organized by Islamic Azad University in Collaboration with Masdar, (3:30 to 7:30 pm). Jointly presented on the topic "Design decisions: Urban wetland, resilience & sustainable water front design" with Abraham Samuel.
2. Conducted and attended World Architectural Summit at Amity University Dubai. February 2017
3. Key note speaker at The Second International Congress on Sustainable Architecture and Urbanism. Arranged by the Islamic Azad University-Dubai Academic City, Dubai, United Arab Emirates on 11th March 2016. Topic was "Urban Wetlands and the built environment".
4. Attended the World Architecture Festival (WAF), Meydan, Dubai. 10th & 11th February, 2016.
5. Mentored and accompanied Architecture students for South Asian Students Design Competition, held at School of Planning and Architecture, Bhopal, India on 10th and 11th December, 2015. Students were honored as the 1st special mention category.
6. Attended 2nd Annual Arab Future Cities Summit- 2nd & 3rd November, 2015, Dubai. "Smart Solutions for Sustainable Cities"