



Government of the People's Republic of Bangladesh

A Research
On

**Possibility of Infrastructure Development in Municipality Town-
A Case Study on Bhandaria Municipality, Pirojpur District**

**URBAN DEVELOPMENT DIRECTORATE (UDD)
Ministry of Housing and Public Works
June, 2016**



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PREAMBLE

Urban Development Directorate (UDD) under the Ministry of Housing and Public Works undertakes socio-economic research and collects data for determination of the location and pattern of future urban development. UDD also prepares and co-ordinates regional plans, urban plans and site plans for the existing as well as the new urban centers. UDD is working to augment the quality of life of the people by improving the environment through planned development activities and to ensure a geographically balanced urbanization.

Bhandaria is one of the important upazila of Pirojpur District. The upazila headquarter is declared as Pourashava on 22 September, 2015. After the declaration the importance of the Pourashava has been increased due to possibility of establishment of administrative and other facilities. For this reason, economic activities of the Pourashava also have been increased. In this research, the possibility of infrastructure development within the existing physical set up would be explored. The study also aims to review the development status of the land use plan prepared by UDD in 1987. Moreover, it analyzed the physical setup of the town to accommodate future infrastructure development.

UDD prepared master plan for Bhandaria Upazila town in 1987 under National Physical Plan. But plan period for the upazila is over in 2007 as the plans were formulated on 20-year period. The structural change in administrative sector after 1990 the upazila system was disrupted and for that the upazila center plan was not worked. Hence, the plan has missed the ownership. In this regard, a large portion of the plan was not implemented. In this research, the general guidelines are studied from various books, Journals, best practices in the world as well as in the country. Chapter-3 literature review accommodates all the guidelines. Besides there, in chapter-5, Specific guidelines were prepared for this Pourashava.

Finally, it is expected that this research will serve as a guideline to the future infrastructure development of the Pourashava with effective management of the services and facilities.

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Executive Summary

The research work is carried on with an aim to develop a set of guidelines to develop physical infrastructure by which the authority would know the future land requirements and the priority of development.

The first chapter of this research work deals with the objectives, the methodology and the scope of the research. This chapter also describes the cause of selecting Bhandaria Pourashava as the area of case study. A brief overview of the history of Possibility of infrastructure development has been added in this chapter.

The Second chapter is dedicated for describing the physical set up of the study area to accommodate future development. This includes the existing Physical condition, the climate, topography, the geology, the surface geology etc.

The third chapter emphasis the literature review on general guidelines for theoretical aspects and practices of infrastructure development. This chapter discuss Possibility of Infrastructure Development provisions in various project by UDD, GSB, RAJUK etc and also discuss Infrastructure Development provisions indifferent countries as well as countries of ESCAP region. This chapter ends with the findings of the literature review.

The chapter four discusses the planning recommendation, provisions set in the land use plan of 1987 for the development of upazila town as a hub of development for the whole upazila. This chapter reviews the implementation status of the plan with tabular form as well as graphical representations.

The fifth chapter deals with the specific guidelines for infrastructure development followed by recommendation and conclusion. This chapter calculated the future demand of utilities as well as land. The future demands of utilities are calculated using some formula with population projection data. The future land requirements are calculated using some standards prepared by UDD for small towns of Bangladesh. It concludes with some suggestions and designs as the way forward to the addressed in future research work.

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Chapter 01

Introduction

1.1 Background

Bhandaria is a newly established Pourashavain Bhandaria Upazila in Pirojpur district which was established as a Pourashava on 22 September,2015 (S.R.O No 293-laws/2015). Bhandaria the third smallest upazila in Pirojpurzila in respect of both area and population, came into existence as a thana in 1856 and was upgraded to upazila in 1984. Nothing is definitely known about the origin of its name. It is learnt that in the past someone Mr. Rajendranath Poddar established a business center on the bank of the river poona. In course of time, it became familiar as **Bhandaria Hat**. It is generally believed that the upazila might have been named after the name of that hat **Bhandaria**.

Bhandaria is one of the important Pourashava of Pirojpur District. After the declaration of Pourashava the importance of the Pourashava had been increased due to set up of some administrative and other facilities. For this reason economic activities of the Pourashava also had been developed. In this research, the possibility of infrastructure development would be explored. The infrastructure development status according to the land use plan prepared by UDD in 1987 after the declaration of upazila in 1984 would be studied. The physical setup of the town to accommodate future infrastructure development would be studied.

1.2 Objective

- 1) To study the infrastructure development status of Land use plan prepared by UDD in 1987.
- 2) To analyze the existing physical setup of the Pourashava to accommodate future infrastructure development.
- 3) To prepare infrastructure development guidelines for the newly created Bhandaria Pourashava on the basis of planning standards prepared by UDD for the small towns of Bangladesh.

1.3 Methodology

1. **Reconnaissance Survey:** A reconnaissance survey would be made by UDD Team after finalizing the research to get a preliminary idea about the project area.
2. **Base Map Preparation:**
 - a. **Scanning of Mouza Maps:** Scanning of all the Mouza maps/sheets is done after the authentication. Scan has been done in 300 DPI resolution and saved as TIFF format

for on-screen digitization. During scanning operation, care has been taken to maintain the geographical north line alignment.

- b. Digitization of Mouza Maps:** The Mouza maps/sheets have been digitized as Arc View shape file through on-screen digitization process using GIS based Arc GIS 10 software, having the scanned image on the background.
- c. Geo-referencing of Mouza Sheets:** After completion of data base preparation, individual maps/ sheets are geo-referenced with reference to the geo-referenced aerial photograph collected from SOB.
- d. Preparation of Mosaic Mouza Maps:** After completion of individual sheets geo-referencing joining of mouza sheets was done using GIS based Arc GIS 10 software.

3. Digitization of land use plan map prepared by UDD in 1987.

4. Data & Information:

- a. Collection of Data and Information:** Data and information was collected from both primary and secondary sources to conduct the research.
- b. Primary data and information:** Field survey conducted to determine the implementation status of the infrastructure proposed in master plan prepared by UDD in 1987. Ground trothing was conducted on the existing infrastructure maps prepared using aerial photograph.
- c. Secondary Data and Information:** necessary secondary data and information (Both Spatial and Attribute) was collected from various government agencies, institutions like SOB, SRDI,GSB etc. Secondary information was collected as aerial photograph, books, journals, maps etc.
- d. Focus Group Discussion (FGD):** Two focus group discussions were arranged to share the local level development ideas with local people including councilors, local leaders etc.
- e. Preparation of Reports:** Preparation of report was done to present the study in a systematic way.

Chapter 02

Existing Physical Condition

2.1 Area and Location

BhandariaPourashava lies in BhandariaUpazila in Pirojpur district. The area of the Pourashava is 11.92 Sq.km and the population is 51,223. The Pourashava consists of 2 unions and 5 mouzas. However, Bhandariaupazila occupies an area of 163.56 sq. km. It is located between 22°22' and 22°33' north latitudes and between 89°54' and 90°08' east longitudes. The upazila is bounded on the north by Rajapurupazila of Jhalokatizila and Kawkhaliupazila of PirojpurZila, on the east by Kathaliaupazila and Rajapurupazila of Jhalokatizila, on the south by Mathbariaupazila and on the west by PirojpurSadarupazila. The upazila consists of 7 unions, 37 mouzas and 45 villages. The average population of each union, mouza and village are 21166, 4004 and 3292 respectively.

Tab-2.1: Basic Information of BhandariaPourashava and Upazila

	BhandariaPourashava	BhandariaUpazila		
Year	2015	2011	2001	1991
Area (in sq km)	11.92	163.56	163.56	163.56
Population	51,223	148159	155256	145233
Male	25,548	72,308	79081	73105
Female	25,685	75,851	76175	72128
Union	2	7	7	7
Mouza	5	37	37	37

Source: BBS, 2011 and Bhandaria Pourashava, 2016

2.2 Topography

The land is flat with very gentle general slopes from north to south and the soil is deltaic alluvial and fertile. The entire upazila is cross-crossed by a number of small and medium rivers and channels. The area is subject to annual flood during the monsoon and accumulates abundant water in the rivers, channels and depressions while during the winter internal channels and depressions almost dry up. The area is subject to semi-diurnal tidal effects with a period of 12 hours 25 minutes with pronounced tidal variation in the level of river water (UDD, 1987).

2.3 Climate: The Bhandaria Upazila like other parts of Bangladesh, has three distinct seasons, winter (November to February), summer (March to May) and monsoon (June to October). Mean daily temperature varies from 13° C-28° C in the winter, 21° C- 32° C in the summer and 24° C-31° C in the Monsoon. (UDD,1987).The Lowest temperature is observed during December to February. The average temperature in this period is 19.3° C. Sometimes the lowest temperature is observed 5.6° C in the month of February. The highest temperature is observed in the month of April at 41.1° C, SRDI, 1998.Humidity varies from 75%-80% in the winter, 76%-83% in the summer and 85%-89% in the monsoon (UDD, 1987).

2.4 Physiography: Sediments are mainly clay to salty clay, locally sandy with clays. At present, most of the tidal flat areas are protected from floods because of embankments along the river courses and coastline. The tidal landscape has a low ridge and a basin relief crossed by innumerable tidal rivers and creeks. Local differences in elevation generally are less than 1 meter compared with 2-3 meter on the Ganges flood plain (GSB, 2016).

2.5 Ground Water: Mainly deep tub wells used for private or public supply. Shallow tubewells are also used. But there are several areas where the shallow tube wells are now abandoned due to iron rich water or even some of the shallow tube wells do not produce any water. In Bhandaria upazila of Pirojpur district it has been observed that mixture of fine sand with clay is present at depth from 10-30feet (3-9meter). This is a saline rich zone, containing mica. It becomes mostly dry during the dry season. Even the deep tube well water is saline rich. At depth 120-180feet (37-55meter), the second water bearing zone present. This is the major shallow aquifer of the area. The sand is medium, less iron contain with mica. The deep aquifer lies at depth 800-1200 feet (244-366meter). It is characterized by medium to coarse sand, fresh (GSB, 2016).

2.6 Geologic and Tectonic Settings of the Area: The study area is located at the mid southern part of Bangladesh falls in the Barisal High tectonic element, located between Faridpur Trough and Hatiya Trough. The total deltaic coastline can be generalized as the western inactive delta and the eastern active Meghna deltaic plain. The eastern active Ganges-Brahmaputra delta includes Rajbari, Faridpur, Shariatpur, Madaripur, Gopalganj, Lakshmipur, pirojpur, Barisal, jhalokati, patukhali, Barguna and Bhola districts of the country. (GSB, 2016)

2.7 Sub-Surface Geology: The subsurface geology is unveiled through analyzing the borehole lithological data up to 80 meters in the study area. On the basis of lithological characteristic the area can be divided into three parts: (1) Clay /silty Clay dominating, (2) Sand dominating and (3) Alteration of thin layer of sand and clay/ silty clay dominating.

- (1) **Clay/Silty Clay Dominating:** This part covers the area falls under pirojpur, jhalokati and Barisal districts. This area is characterized by thick clay/ Silty clay deposit. The clay /Silty clay deposit extends 15 meter downward from the surface. This deposit it often interrupted by part layers.
- (2) **Sand Dominating:** This part covers the area falls under Pirojpur, Jhalokati and Barisal districts. This part is mainly characterized by thick sand deposit. The sand deposit is more than 65 meter thick, normally occurs 6 meters below the Surface.
- (3) **Alteration of Sand Clay:** This part area within Patuakhali, Barguna and southern and northeastern part of Barisal districts. Subsurface lithological data reveals that this part is consisted of alteration of thin sand and clay or silty clay layers. Peat layers are totally absent in this part. The thickness of clay/silty clay ranges from 3 meter to 10 meter and the thickness of sand layers about 3 to 15 m.

Table-2.2: The sediment characteristics obtained from borehole Logs of BhandariaUpazila:West Hetalia, Bhandaria, Pirojpur: Lat (DD) 22.473611, Lon (DD) 89.993611

Depth (m)	Depth (m) 34.4	Lithology	Description	Environment
0.0	0.3	top soil		Flood plain deposit
0.3	11.9	Silty Clay	Variegated.5Y4/1 dark gray with oxidation colors 5y3/1 very dark gray 5Y2.5 /1 black (decomposed vegetal matter) at depth up to 8'(2.4m), massive, moderately sticky, moderately compact, decomposed roots, color changes from9' (2.7m)which is 5Y4/2 olive gray, vertically leaf impression, roots present all along the clay, roots reduces downward, burrows filled 21'(6.4m) at depth 37'-38'(11.3-11.6m)very fine sand intercalation within the clay. Decomposed vegetal matter (becomes powder when thumb press),gives effervescence with dill. HCl at 37'-38' (11.3-11.6m).	
11.9	17.1	Sand	5Y5/1 gray, fine inequigranular sub angular to sub rounded. Quartz-85%. Mica – 10%,rest is dark colored minerals and organic matter. Gives effervescence with dil. HCl	Fluvio- tidal deposit
17.1	19.5	Clay	5B4/1 dark bluish gray,sticky,moderately composed laminated. Lamination plane filled with very fine sand. Sand is present may be as lenses.	

19.5	21.9	Sand	5Y5/2 olivegray, fine,mostly sub rounded,moderate to well sorted,mostly quartz. effervescence with dilHCl	
21.9	25.3	Clay	5B4/1 dark bluish gray, sticky,moderately compact,upper part contains sand lenses,Laminated.	
25.3	34.4	Sand&Clay alternation	Sand beds are 2-3'thick. Clay beds are 1-1.5' thick.Sand is 5YS/1 gray, fine,mostly subrounded,moderate to well sorted,mostly quartz, with few micas. Clay is 5B4/1 dark bluish gray,sticky,moderately compact.	
34.4	66.4	Sand	5Y5/1 gray, fine,mostly sub rounded,moderate to well sorted,mostly quartz with few micas. Gas pressure at 208- 209' No effervescence with dil. HCl	

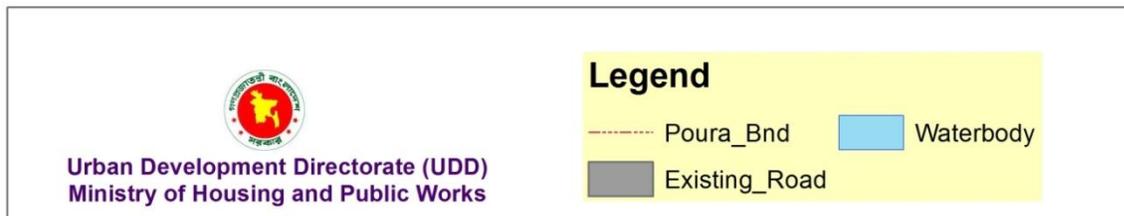
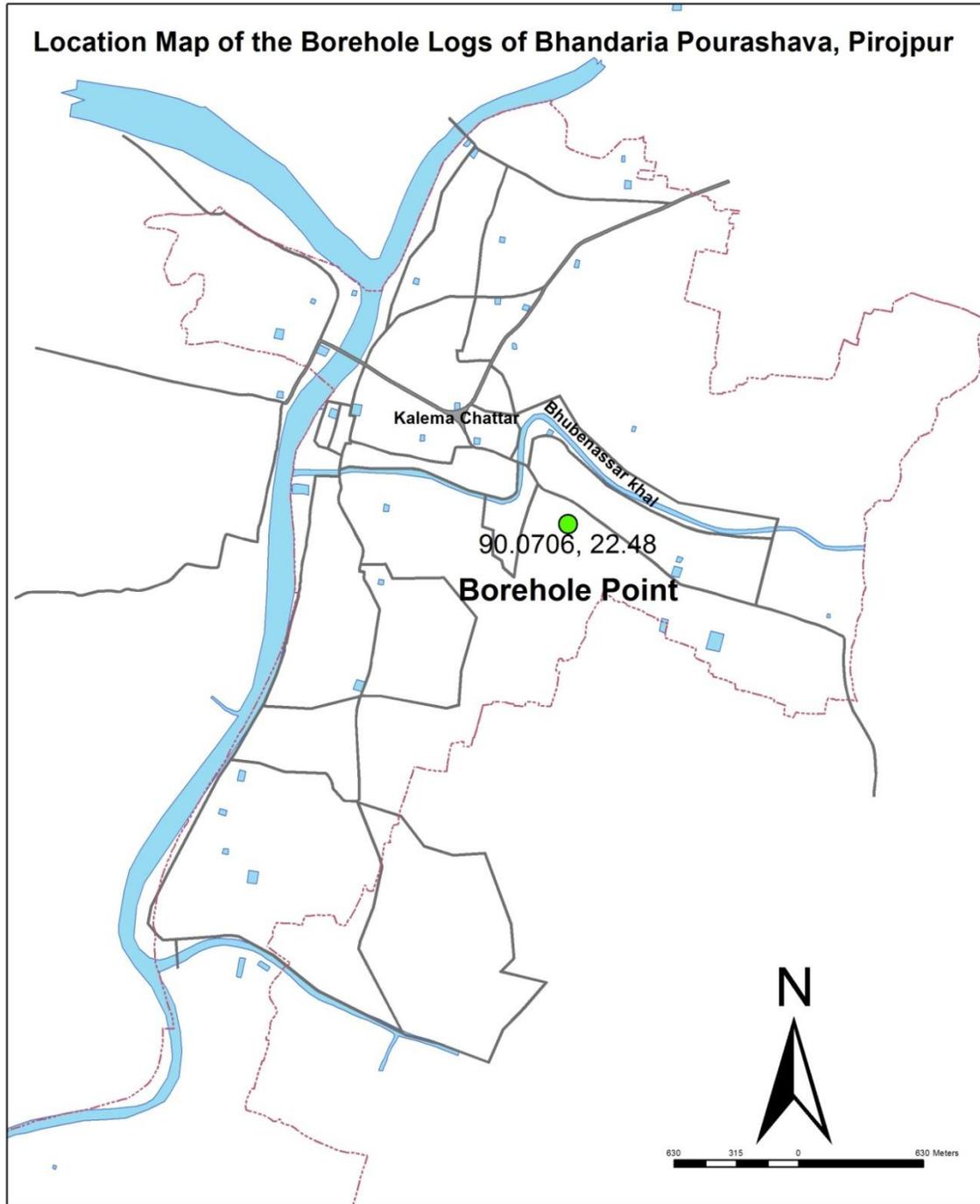
Source: GSB, 2016

Table-2.3: The Sediment Characteristics obtained from Borehole location of Bhandaria Pourashava, Pirojpur: Lat (DD) 22.48, Lon (DD) 90

Depth(m)	Depth(m)	Lithology	Description	Environment
0.0	0.3	Top Soil	Filling	Fluvio- tidal
0.3	0.6	Silty Clay with Sand	Variegated. 7.5YRN5/ gray, 7.5YRN5/ brown. Oxidation along roots (7.5YR3/4 dark brown, somewhere 10 YR.3/4 dark yellowish brown) massive, partly decomposed vegetal matter. decomposed roots	
0.6	6.7	Silty Clay (Tidalities)	2.5YN4/ dark gray, it looks like clay when wet condition , when dry, it is Silty Clay, less sticky, moderately compact, brittle whendry, thinly laminated, Silt/ very fine Sand along laminea.laminea parting color is 2.5YN7/ light gray. "tidalites" referred to sediments deposited by tidal processes in both the intertidal zone (between normal low- and high- tide levels) and shallow, subtidal (permanently submerged), tide-dominated environments less than 200 m (660 ft) deep. Tidalites are now known also to occur within supratidal environments(above normal high tide and flooded only during storms or very high spring tides) and submarine canyons at depths much greater than 200 m. Common usage has drifted toward describing tidelines as ripple-anddune-scale features rather than more composite deposits such as large linear sand ridges of tidal origin present on continental shelves or point bars associated with migrating tidal channels. Both of these larger-scale features however,would be composed of tidalites.	
6.7	13.4	Clay Sand	2.5YN4/ dark gray, sand is very fine, individual	Fluvial

			grains could not be identified .Total composition is Sand, Silt and Clay.	
13.4	55.8	Sand	5Y5/ 1 gray very fine to fine sand, sub rounded to sub angular. Composed of Quarz:85-90%, Mica: 5-7%rest is Dark colored Minerals and Organic Matters, Silt increases downward. patches of silty Clay at 106'-110', 114'	
55.8	62.5	Sand	5Y5/1 gray, fine to medium, sub angular to sub rounded,inequigranular, moderatelyscored, mostly Quartz(fresh). Mica increases > 10%. Less percentage of feldspar, few Dark colored Minerals and Organic Matters (wood cuts/ fragments of very small size). At 204'aClay band is present, 2.5YN4/ dark gray, moderately sticky, moderately compact. Contains shell fragments, gives effervescences with HCl. Poorly laminated Silt is present occasionally.	
62.5	68.8	Sand	5Y5/2 olive gray. Medium to fine moderate to poorly sorted. inequigranular, Quartz: 85% Mica: 5-7% Organic Matter and Dark colored Minerals :5-7%	

Source: GSB, 2016



Map-2.1: Location Map of the Borehole logs in Bhandaria Pourashava, Pirojpur

General Guidelines of Infrastructure Development

3.1 Introduction

For the research purpose, it is important to know the provisions of infrastructure development in theory and Practice. In this part, the theoretical provision of infrastructure development has been discussed. The provisions are given below as generalized form as general guidelines.

3.2 Water Supply

The best source water is to have a public water supply system. This usually means water of sufficient quantity and quality as to present no difficulties. However, if no public system exists, it will be necessary to provide a private system utilizing well water, if it is readily available. In dealing with detached houses, use of individual wells may be explored. Not only does the use of wells add cost but additional precautions are necessary to ensure protection of the water system from contamination from septic tanks or sewers. In addition, storage tanks most likely will be required to meet the demand or peak-hour consumption, constant pressure, and a 2-h fire-protection reserve (De Chiara, Josheph, 1995, P-12).

A water master plan could take into account such elements as available land and water resources which are likely to meet the needs of households, agriculture, industry, commerce, energy, etc.; measures required to anticipate and minimize such harmful effects of water as floods, drought, salinization and soil erosion; measures to be taken to protect water quality, namely the prevention of pollution and waterborne diseases etc (ESCAP,1979, P-134).

Although the immediate objectives of community water supply and sewerage are quite specific (to provide or improve the quality, quantity, availability and reliability of water supply and sewage disposal services), these are also inseparable ingredients of a number of broader infrastructural objectives, such as reducing the incidence of water-borne and water related diseases, creating opportunity for learning and providing employment, and promoting greater self- reliance and better social organization for the community particularly for the poor, the aged, women and children (ESCAP,1979, P-134).

Domestic water can be obtained from surface water, rain-water (e.g. from house roofs) or groundwater (e.g. springs or wells). Criteria for the choice made are:

- Reliability and volume of supply
- Safest water at reasonable cost
- Water conservation problems
- Consumer preference—some water, groundwater, may be unpleasant is hard for washing (ESCAP, 1979, P-142).

3.3 Sanitary Sewer

The best method is to have a public system available to connect with the new sewer lines. This will generally provide proper sewage treatment and disposal at a distant plant. In lieu of an available public system, it will be necessary to provide a private self-contained package type of sewage-treatment plant. Despite the initial cost, this method is acceptable. Provisions should be made to hook up to a public system, it and when one does become available. The least recommended method is to use septic tanks. The disadvantage of septic tanks is the possible contamination of nearby wells or of the water supply and the need for drainage fields. If the soil does not have proper percolation, this may seriously limit the use of the land (De Chiara, Joseph, 1995, P-12).

The Sanitary sewer mains are generally located on the centerline of the road. The line is a clay tile pipe. If it were located in the planting strip, the roots of the trees might cause breaks in the pipes. The centerline location also locates the pipe equidistant from building lines on both sides of the street. The sewer line should be located below the water supply mains (De Chiara, Joseph, 1995, P-104).

3.4 Storm Sewer

Storm sewers are generally recommended to be separated from sanitary sewers. As with the other utilities, it is best that a public system of storm sewers exist. If none exists, discharge into adjacent lakes or streams may be satisfactory. Precautions are necessary to protect these natural water courses from becoming polluted. Permission to discharge into them may also be required from local and state authorities (De Chiara, Joseph, 1995, P-12).

Storm sewers are generally located one-third the distance from the curb line to the centerline of street. It is always located on the opposite side of the street from the waterline. This is to prevent any possible contamination (De Chiara, Joseph, 1995, P-104).

3.5 Waste Treatment Facilities

In all other cases the wastes are disposed of on- site. The waste to be treated in one of three forms:

-night soil

-sewerage (nightsoil +sullage)

-sullage

- For night soil treatment in rural areas essentially two options are open: treatment in a series of waste stabilization ponds and aerobic composting. Waste stabilization ponds generally comprise a series of so-called anaerobic pre-treatment ponds, facultative ponds and maturation ponds, in which night soil or sewage is treated by means of natural oxidation of organic material and die-off or removal of micro-organisms (ESCAP,1979, P-160)

Basically, four kinds of salvage disposal systems can be distinguished.

- Casual tipping in street, house-yard or garden often resulting in muddy and insanitary and thus not generally recommended
- On-site disposal in ground pits, which may often be a feasible solution
- Disposal in open drains, commonly storm water drains. Measures as indicated in the paragraph on drainage facilities are required to prevent the breeding of mosquitoes and other insects. Connection of the drain system to a treatment facility is necessary
- Disposal in covered drains or sewers. Since no excreta have to be flushed along, smaller-diameter sewers may be used and at smaller slopes than in conventional sewerage systems. Treatment of the sullage (or sewerage) is required. (ESCAP,1979, P-160)

3.6 Garbage Disposal

In rural areas, unlike urban areas, the collection and transport of garbage is not of overriding importance, although a relatively high community service level may be required in certain in certain situations.

Garbage is often dumped on-site (on the yard or garden) or in the open storm water drains, thereby involving unsanitary conditions. If the garbage is collected and brought to a central processing site, there are three options for the rural community:

- Aerobic composting (compost production)

- Anaerobic digestion (biogas production)
- Disposal
- Aerobic composting (thermophile composting requires that moisture absorbing, biodegradable waste materials are mixed with nightsoil until the moisture content is below 60 percent. The compost can be used as a soil fertilizer or stabilizer. (ESCAP,1979, P-161)

3.7 Electricity

An adequate supply of power both for present and for future use is essential. The amount of electricity used has steadily increased over the years and, from all indications, will continue to do so in the near future. Consultation and planning with local utility companies is recommended. Service lines should be placed underground to minimize disruptions from bad weather and to improve the visual aspects of the landscape (De Chiara, Josheph, 1995, P-12).

Though best located in an underground conduit, overhead power lines are situated above planting strips, causing interference with trees, the danger of falling wires, and unsightly appearance (De Chiara, Josheph, 1995, P-104).

An alternate location for electric power lines is at the rear of the lots, either above or below ground, and then service lines is brought into the house. When this is done, proper easements are necessary for servicing of the lines when required (De Chiara, Josheph, 1995, P-104).

The trend is despite additional cost, to place electric power lines underground for two reasons. First, it reduces the chances of power failures and second, it eliminates unsightly clutter in the landscape, adding to the aesthetic appeal (De Chiara, Josheph, 1995, P-104).

3.8 Telephone, TV Cable

Similar to electric power, telephone lines can be located either above or below ground. In the past almost all lines were above ground and either utilized the electric line poles or set up an additional line. In either case, they are unsightly and subject to disruption by the weather (De Chiara, Joseph, 1995, P-104)

Telephone lines, TV cables, and other special line should all be located underground. Some attempts have been made to combine all electrical, telephone, and TV cables into a common underground trench that would simplify addition installations and maintenance. These lines may also be located at the rear-lot easement, if necessary (De Chiara, Joseph, 1995, P-104)

3.9 Storage Facilities

A distinction may be made between food crops (especially grains and legumes) and agricultural produce used as industrial raw material, since the latter invariably requires processing. The location may vary, depending on the type of crop and the quantity produced. Tea, for instance, must be processed close to the production site as the fresh leaf quality deteriorates rapidly. For other industrial crops, like rubber, the locational requirements for processing are less stringent. Planners must of course take these varying requirements into consideration, but otherwise storage and processing of industrial crops rarely pose major problems (ESCAPE, 1979, P-238)

3.10 Transportation network

The following provisions for national highway, regional highway, primary road, secondary road, tertiary road and access/local road to be considered by the concern developments.

Tab-3.1: Transportation Network

Type	Purpose	System	Futures of Construction	Speed allowed	Number of Lanes	Other Characteristics
i. National Highways	<p>-To link urban centers ,cities ,districts or national and international regions</p> <p>-To transport goods and passengers in all types of motor vehicles for long and medium length journeys</p> <p>-Uninterrupted long distance journey.</p>	<p>-Bypass Urban centers ;</p> <p>-Limited access</p> <p>-Necessary rest and supply areas;</p> <p>-Minimum number of curves;</p> <p>-Shortest route;</p> <p>-No parking along the highway;</p> <p>- Median strip.</p>	<p>- High quality of construction for heavy and intensive traffic;</p> <p>- Good and wide pavements on both sides;</p> <p>- Well managed for clearing;</p> <p>- Securely constructed shoulders;</p> <p>- Physically separated service lanes for local transport.</p> <p>- Stopping bay</p>	High speed	Minimum 04 or more	<p>-Line of building set back at 100 meters;</p> <p>-Telephone booth at every 1km for emergency calls;</p> <p>-Highly essential for industrial establishments;</p> <p>-proximity of new towns to national highway can accelerate town growth and insure its success;</p> <p>-Fence for preventing crossing of wild animals;</p> <p>-consider deliberate disruption of movement as a criminal offence in legal documents.</p>

<p>ii. Regional Highways</p>	<p>-To link various urban and rural centers within the districts and beyond; -To deliver goods within the region and locality and to ship products out on medium length journeys.</p>	<p>-By pass of cross urban centers; -Connect the new town with the national highway; -Intersections either with vehicles of regional highway Unimpeded or controlled by signals; -No stopping; -Median strips.</p>	<p>-Good quality of construction for heavy traffic; -Wide pedestrian ways with peasant landscaping on both sides; -Physically separated service lanes for local transport. -stopping bay.</p>	<p>Medium to high</p>	<p>Lanes</p>	<p>-Line of building setback at least 100 meters; -Usually have attractive landscape; -parking is not generally permitted.</p>
<p>iii. Primary Roads</p>	<p>-To link town and city with the regional highway; -To provide unity to the major land use of the town; -To provide a flow of traffic for delivery of goods to and shipping of products from industrial parks.</p>	<p>-Connected to intersections -Limited access -pedestrian will be allowed only to zebra crossing area; -Mostly curved -Median strips</p>	<p>-Good quality of construction for heavy and light traffic; -Good and ide pedestrian ways with pleasant landscaping on both sides;</p>	<p>Medium</p>	<p>As per DAP, 2010, Rajuk</p>	<p>Line of building set back 3 to 5 meters; -Established territorial boundaries for major zoned land use units such as these for residential, industrial and commercial uses</p>

						-Parking is not generally permitted -Usually carefully planned landscaped
iv. Secondary Roads	-To link major with the various major sections of single use -To function as the major skeletal road(Distributer) within the major areas of single use land (i.e neighborhood ,industrial park and commercial area)	-Lead to the major focus of the primary land-use unit -intersection controlled by stop signs or signals -Carefully landscaped -pedestrian will be allowed only to zebra crossing	-Good quality of construction for heavy and light traffic; -Good and ide pedestrian ways with pleasant landscaping on both sides;	Low to Medium	As per DAP, 2010, Rajuk	Line of building set relatively close(2 to 3 meters) -From boundaries for sub-neighborhood units
v. Tertiary Roads	-To function as the main network of each zone -To feed the secondary roads	Intersections with similar and other roads -Carefully landscaped at residential areas Intersections controlled by stop signs -Allow side parking -Designed for special pattern of circulation	-Good quality of construction for light traffic - Pedestrian ways on both sides	Low	As per DAP, 2010, Rajuk	-Line of building set back as per current rules -From the skeleton of the sub zoned units - Design to be used mainly by the local people and are not throughways
vi. Access/Local	-To linked zone subunits and their	-Widely integrated	- Construction	Very Low	As per	-Line of building

Roads	section -to links blocks and housing units together -To be used as the local service units	network for zoned units, especially residential areas -Usually curved roads to reduce speed and to form variations in the townscape -permits stops or parking along margins -Sometimes intersected crosswalks -provide system of local circulation	for light and slow traffic		DAP, 2010, RAJUK	set back as per current rules -Not conducive to through traffic - Also specially adjusted network used by bicycles
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Source: RAJUK, 2016, P-299

3.11 Walking

The simplest method of access to any facility would be by walking. Even though many facilities cannot be located within walking distance, effort should be made to have as many as possible of the facilities used most frequently nearby. A variation of walking is the use of bicycles. This greatly increases the range of accessibility but is still highly economical in time and money. Provisions should be made for the maximum utilization of bicycles within the housing development and the surrounding circulation network. This can be achieved by the use of special bike lanes parallel to the street or complete independent bikeways away from the vehicular traffic (De Chiara, Joseph, 1995, P-12).

3.12 Public Transportation

Aside from walking, planners generally agree that mass transportation modes provide the most rational means of circulation within urban and suburban settings. This includes trains, buses, monorails, subways, minibuses and many other variations. Public transportation is more efficient and can move greater numbers of people than any other means. Also mass transportation uses less land for right of ways and reduces air pollution in sharp

contrast to the automobile. Necessary utilities must be readily available to the site if the development is to be built. These include water, sanitary and storm sewers, gas and electricity (De Chiara, Joseph, 1995, P-12)

3.13 Architecture

- Locate buildings on the site so that they reinforce street frontages.
- Design walls and fences to add visual interest to the streetscape and enhance the pedestrian experience.

Provide convenient, safe, well – marked, and attractive pedestrian connections from the public street to building entrances (RAJUK, 2016, P-299)

3.14 Historic Character

- Respect the context of historic buildings, landmarks, and areas that give a community a sense of place or history.

Create conservation plans for new development so that city's historic character is complemented within the conservation areas where appropriate (RAJUK, 2016, P-299)

3.15 Public Space

- Establish build-to lines to frame and define public space and pedestrian streets.
- Ensure public spaces are easily accessible and open to the public.
- Encourage provision of public space in the earliest possible phase of development, as determined by the public's ability to use and access the space.
- entrances, signs, and street furniture.(RAJUK, 2016, P-299)

3.16 Lighting

- Provide lighting from a variety of sources at appropriate intensities and qualities for safety
- Provide pedestrian-scaled lighting for pedestrian circulation and visibility. Use vandal-resistant light fixtures that complement the neighborhood and character(RAJUK, 2016, P-299)

3.17 Landscaping

- Promote landscaping and beautification programmes in residential, commercial and industrial areas.

- Intensify the programs of roadside and street side planting and landscaping of open spaces and recreational areas.
- Someprivately owned open spaces, vacant sites and other undeveloped areas in the city, particularly those which are in public view or which close to landscaped open space, should be properly landscaped to improve environmental amenity.
- Ensure the provision of proper landscaping of existing private open spaces and other vacant.
- Strategies need to be formulated to incorporate the rivers and khals and canals into the environmental amenity of the city through the use of landscaping and other improvement measures.
- Ensure the landscaping of the rehabilitation of embankments.
- Initiate an appropriate strategy for integrating the major rivers and abandoned canals as an amenity and feature of the city's urban design(RAJUK, 2016, P-299)

Chapter Four

A Review of Land use Plan of 1987

4.1 Introduction

In 1982, the Government undertook implementation of administrative re-organization. The Upazila within a Zila has been regarded as the most important grass-root level tier of administration. Each Upazila center is now the central place which is the administrative headquarters. It will attract social and economic developments. Consequently, the development of upazila center is one of the key strategies for socio economic and physical upliftment of the upazila region. This also reflects the national policy of bringing development administration and service facilities to the door step of the rural masses.

For the development of upazila shahar, emphasis will be given on sectoral development which will involve diversification of activities. In order to ensure planned development of these activities in future, a physical planning framework will be required to ensure better utilization of land and promote faster development.

In pursuance of the policy of the government, the Urban Development Directorate has taken up the planning task of all upazilaShahars. EPASO Consortium has been assigned with the task of preparing a land use plan for Upazila shahar of Bhandaria. The plan of the upazila shahar will provide the necessary physical planning framework for guidance of future development. Accordingly the land use plan for Bhandaria Upazila shahar has been prepared keeping in view of the better utilization of land other resources available.

4.2 Approach, Concept, Planning Principles

The town will provide appropriate locations for administrative, judiciary, various types of industries, education, health, social and utility services, commercial and recreational facilities. These objectives will be attained in a better way through preparation of land use plan/master plan of the upazila shahar Area through utilization of land and other resources of the region.

The land use plan/master plan will provide a physical planning approach to facilitate public and private development at the upazila center. It will also provide locational and spatial guidelines for future investment and various development activities and facilitate decisions on appropriate land allocations to various uses. The physical framework provided by the land use plan will help in distribution of urban activities in different areas for a harmonious functioning of the town as a whole.

The land use/ master plan will identify the suitable locations of land uses zones, circulation network, social service and facilities that will be required during the course of development of the town in future to cater for the demand created by the increasing population of the target year. The plan will accommodate major investments and activities of both public and private agencies in the town. The plan will also indicate the possible strategy for management and development control and institutional arrangement for effective implementation of the plan.

The plan of Bhandaria Upazila Shahar has been prepared for the medium level population for the target year 2001 A.D. Land requirements to cater for the needs of development for the projected population, has been determined and land use pattern, road network and new locations of infra-structures and services have been indicated. Efforts have been made to accommodate existing facilities as far as possible.

The standards of services and housing areas are based on the anticipated level of economic growth. The gross residential density of 28 persons per acre has been considered.

In determination of the boundary of headquarter area, 10% of the total built up area has been reserved for future urban expansion and for accommodation of urban land requirements for the additional population in the even of the medium forecast of population turns out to be an under estimate.

4.3 Plan Description

The land use plan of the Bhandaria upazila shahar has been prepared for a projected population of 40,000 (population of catchment Area including the planning Area) target year of 2001 A.D. The total land requirement for the projected population has been estimated for services including housing. The existing built up area, the physical constraints and opportunities for development has been taken into consideration for further growth of the town.

The pona river runs through the planning area and divides it. UNO Complex and bazar are situated on the eastern side of the ponaRiver. Hospital and Police Station are situated on its western side. A bamboo bridge (approximately, 60 meter long) connects the two banks. This is a disadvantage for the smooth growth of the Upazila shahar. Moreover the easterner bank of the pona river runs the risk of erosion

The urban area is limited to the Bazar area and ribbon development along the main approach roads for a short distance. In future densities will increase by infilling the existing residential areas and residential lands are expected to be converted into other uses because of future demands.

The most likely future directions of urban expansion seems to be along Rajapur, Kathalia, Matbaria roads, South-side of Bhubaneswar canal, east wards into the village areas, west wards beyond the police station, north-east bank of Poona rivers (because of newly constructed bridge).

4.4 Employment Areas

The existing employment area of the town is located mainly in the bazar and other offices and service sector. The growing administrative and service sector will create sizeable employment opportunities in future. In addition industrial employment is also expected to grow.

4.5 Road Network

Although waterway is the main means of transportation, the rapid development of road connections is likely to bring big impact on vehicle traffic in the Upazila Shahar. The existing roads are very narrow for cars, buses and trucks. The maximum width of the pavement is 3.35 meter and that from boundary to boundary 5.49 meter. Most roads in the bazar area are 2.5-2.75 meter wide. To avoid future traffic congestion, problems of parking and turning of big vehicles, the following measures are suggested:

- a) Confirming the alignment of future roads;
- b) Building control to ensure adequate set-back;
- c) Acquiring additional land necessary for making extra extra road width;
- d) Construction of a ring-road to carry future through traffic from Rajapur road to the Kathalia road by passing the Shahar centre. For the time being reservation of land may be made for the alignment of the ring road from Rajapur road to Kathalia by building control;
- e) Spaces for Bus stations and truck parking on the Rajapur road and the Matbaria road have been suggested.

The plan provides widening of most of the existing roads and proposes alignment of new roads to adequately take care of the induced traffic of new roads, as well as, to take care of the future demands of traffic and traffic circulation. Roads of three categories based on width have been provided. Major arterial roads are of 60 ft. (18.3m) land reserve and 30ft (9.15m) surface pavement, secondary roads are of 40 ft. (12.19m) land reserve and 20 ft. (6.10m) surface pavement and the local roads are of 24 ft. (7.32m) land reserve and 12 ft. (3.66m) surface pavement.

4.6 Housing

Residential housing has so far developed in rural nature, on large homestead plots, at very low densities. The administrative and service facilities have been distributed over both sides of the Poona Rivers. This will create opportunities for development of self-contained residential neighborhood areas with related facilities such as schools, recreational space, shops, mosque and other urban services.

Proposal for housing estate have been given along the Rajapur road and near UNO Complex. It is expected that new housing will be built within the existing residential areas by infilling.

Although the planning area still is rural in nature, slum area has developed near the bazar which indicates lack of housing facilities for low-income group people. So it suggested that attention should be given to build housing facilities for low-income group also.

4.7 Drainage, sewerage, water supply and electricity

The present level of services and infrastructures related to drainage, sewerage, water supply, electricity etc. are either poor or non-existent. For proper identification of the present and future needs technical studies are required. Reserve lands by the side of the road pavements can meet the services demand. For that reason no additional space for the network has been suggested.

4.8 Educational

One college, four high schools, seven primary schools and one madrasa are spread over the planning area which will meet the present and future educational demand as per provisions set in the TOR. So no new proposal has been made in this respect.

4.9 Health

Besides the existing Upazila Health Complex, space for three clinics and one hospital has been suggested by the side of the main road and near residential area.

4.10 Recreation

Natural recreational facilities like flowing river, canal is available in the planning area. These can be developed for recreational purposes. Space for stadium has been proposed near the UNO Complex along the Rajapur Road. Provision of land for park has been kept near Bhuboneshwar canal by the side of the Kathalia road. Play fields within the educational institutions may be used by the neighboring people during off-period.

4.11 Socio-Cultural

Space for community center and fire service has been proposed near UNO Complex. Space for Graveyard has been proposed on the south side of the planning area and Shashan-ghat on the bank of the river Poona of the Shahar area.

4.12 Urban Services

Besides the existing facilities space for one bus stand near UNO Complex by the side of the Rajapur road and another near the Matbaria road have been proposed. Space for fire service has been proposed near the Kathalia road.

4.13 Urban Deferred

Space for Urban deferred has been proposed by both the sides of Poona river-one near the UNO Complex and nearly constructed bridge (which in future may connect Barisal), the other space by the side of Matbaria road behind the Police Station. The infrastructure development status of the plan of 1987 is enlisted below-

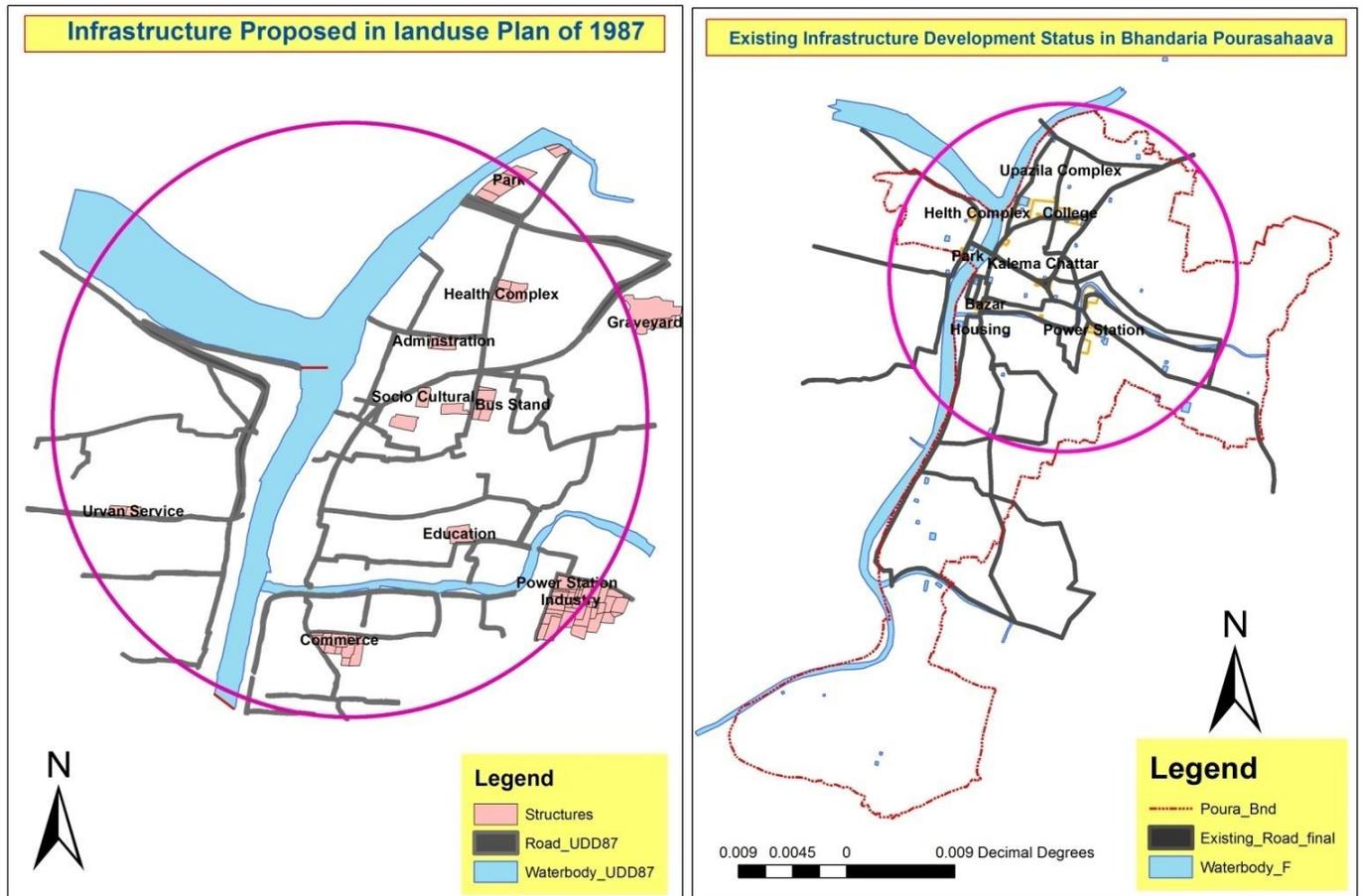
Tab-4.1: Infrastructure Development Status of the Plan of 1987				
No	Category of Infrastructure/Land use proposed in 1987 land use Plan		Proposed Location	Implementation Status
	Category	Infrastructure/Land use Name		
1.	Commerce		Bhandaria Jl. no.-21 Sheet-3 Plot: 3000,3331,3334,3335	Not Implemented but converted into residential Area
2.	Health	Besides the existing Upazila Health Complex, space for three clinics and one hospital has been suggested by the side of the main road and near residential area.	Lakshmipura Jl. no.-20 & Bhandaria Jl. no.-21 Sheet-1 Plot: 165,299 Bhandaria Jl. no.-21 Sheet-1 Plot: 512,513,514	Not Implemented but converted into residential Area
3.	Administration	Extension of UNO Complex	Lakshmipura Jl. no.-20 Plot: 270,271,272-274,288-290	Extension not done
5.	Socio-culture	Graveyard	Lakshmipura Jl. no.-20 Plot: 70,71,72,84 Bhandaria Jl. no.-21 Sheet-1 Plot: 255	Not Implemented but Some part of this service area are vacant and some part converted into residential Area

6.	Urban Service Expansion	Rajapur, Kathalia, Matbaria roads, south-side of Bhubaneswar canal, east wards into village areas, west wards beyond the police station, north-east bank of Poona rivers (because of newly constructed bridge).	Lakshmipura Jl. no.-20 Plot: 311, 312 Bhandaria Jl. no.-21 Sheet-1 108,109,111,112, 118,123, 3967 DakhinSialkati Jl. no.-19 Sheet-2 1839,1840,1841	Partially Implemented. Power Station Established as per plan proposal,However maximum areas converted into residential area
7.	Residential/Housing using	Residential housing has so far developed in rural nature, on large homestead plots, at very low densities. The administrative and service facilities have been distributed over both sides of the Poona rivers. This will create opportunities for development of self-contained residential neighborhood areas with related facilities such as schools, recreational space, shops, mosque and other urban services. Proposal for housing estate have been given along the Rajapur road and near UNO Complex. It is expected that new housing will be built within the existing residential areas by infilling. Although the planning area still is rural in nature, slum area has developed near the bazar which indicates lack of housing facilities for low-income group people. So it suggested that attention should be given to build housing facilities for low-income group also	Bhandaria Jl. no.-21 Sheet-1 73,74,84,85,88,99,100,503, 523, DakhinSialkati Jl. no.-19 Sheet-2 2276,2277,2278, 2286,2282,2285, 2331,2384,2324,2295,2291	Spontaneous residential development was occurred earmarked as residential land use in 1987 plan.
8.	Urban Deferred	Space for Urban deferred has been proposed by both the sides of poona river-one near UNO Complex and nearly constructed bridge (which in future may connect Barisal),	Lakshmipura Jl. no.-20 385,388,406,411-413,424, 432,433 DakhinSialkati Jl. no.-19 Sheet-2 1773, 1778, 1777, 1667,	Not Implemented. Some part of the this area are vacant and some part converted into residential Area

		the other space by the side of Matbaria road behind the Police Station.	1657,1623, 1624,1625-1640,1889-1891,2094-2097,1842,1846,1834,1837, 1801	
9	Road Network	Construction of a ring-road to carry future through traffic from Rajapur road to the Kathalia road by passing the Shahar centre. For the time being reservation of land may be made for the alignment of the ring road from Rajapur road to Kathalia by building control;	The plan provides widening of most of the existing roads and proposes alignment of new roads to adequately take care of the induced traffic of new roads, as well as, to take care of the future demands of traffic and traffic circulation. Roads of three categories based on width have been provided. Major arterial roads are of 60ft. (18.3m) land reserve and 30ft (9.15m) surface pavement, secondary roads are of 40 ft. (12.19m) land reserve and 20 ft. (6.10m) surface pavement and the local roads are of 24 ft. (7.32m) land reserve and 12 ft. (3.66m) surface pavement	widening of road from Nadmullah Sialkathi to the Hospital widening of road from Hospital to Bhandaria Bridge widening of road from R.C.C new bridge to link road At the eastern part of pona river
10	Bus Stand/ Truck Stand	Spaces for Bus stations and truck terminal by the side of Rajapur-Pirojpur Road.		Not implemented but implemented nearby the area.
11	Drainage, sewerage, water supply and electricity	The present level of services and infrastructures related to drainage, sewerage, water supply, electricity etc. are either poor or non-existent. For proper identification of the present and future needs technical studies are required. Reserve lands by the side of the road pavements can meet the services demand. For that reason no additional space for the network has been suggested.		Partially Implemented. Rajapur to Bhubaneswar Bridge drainage implemented.
12	Educational	One college, four high schools, seven primary schools and one madrasha are spread over the planning area which will		One girl's School and One women College were established nearer to the power

		meet the present and future educational demand as per provisions set in the TOR. So no new proposal has been made in this respect.		station as per plan provision
13	Recreational	Natural recreational facilities like flowing river, canals are available in the planning area. These can be developed for recreational purposes. Space for stadium has been proposed near the UNO Complex along the RajapurRoad. Provision of land for park has been kept near Bhuboneshwarcanal by the side of the Kathalia road. Play fields within the educational institutions may be used by the neighboring people during off-period.		Not implemented but a new park has been established opposite to the police station.
14	Socio-Cultural	Space for community center and fire service has been proposed near UNO Complex. Space for Graveyard has been proposed on the south side of the planning area and Shashan-ghat on the bank of the river Poona off the Shahar area.		Not implemented but Banghabandhu Auditorium was establish at south-east side of the power station
15	Urban Services	Besides the existing facilities space for one bus stand near UNO Complex by the side of the RajapurRoad and another near the Matbaria road have been proposed. Space for fire service has been proposed near the Kathalia road.		Not implemented
16	Industry		Bhandaria Jl. no.-21 Sheet-3 Plot: 968, 3924, 3925, 3918, 4073, 4002,4071,4058, 4018	Not implemented

The core town of Bhandaria Pourashava is developed according to the proposal of 1987 land use plan (map-4.1). In the land use plan of 1987, the proposal of a Bridge on Poona River was a salient feature which is implemented. The changing situation of administrative structure after 1990 and the problem of ownership of the plan is the principal hindrance on the way to implement.



Map 4.1: A comparison between landuse plan of 1987 and present development status

Infrastructure Development Guidelines

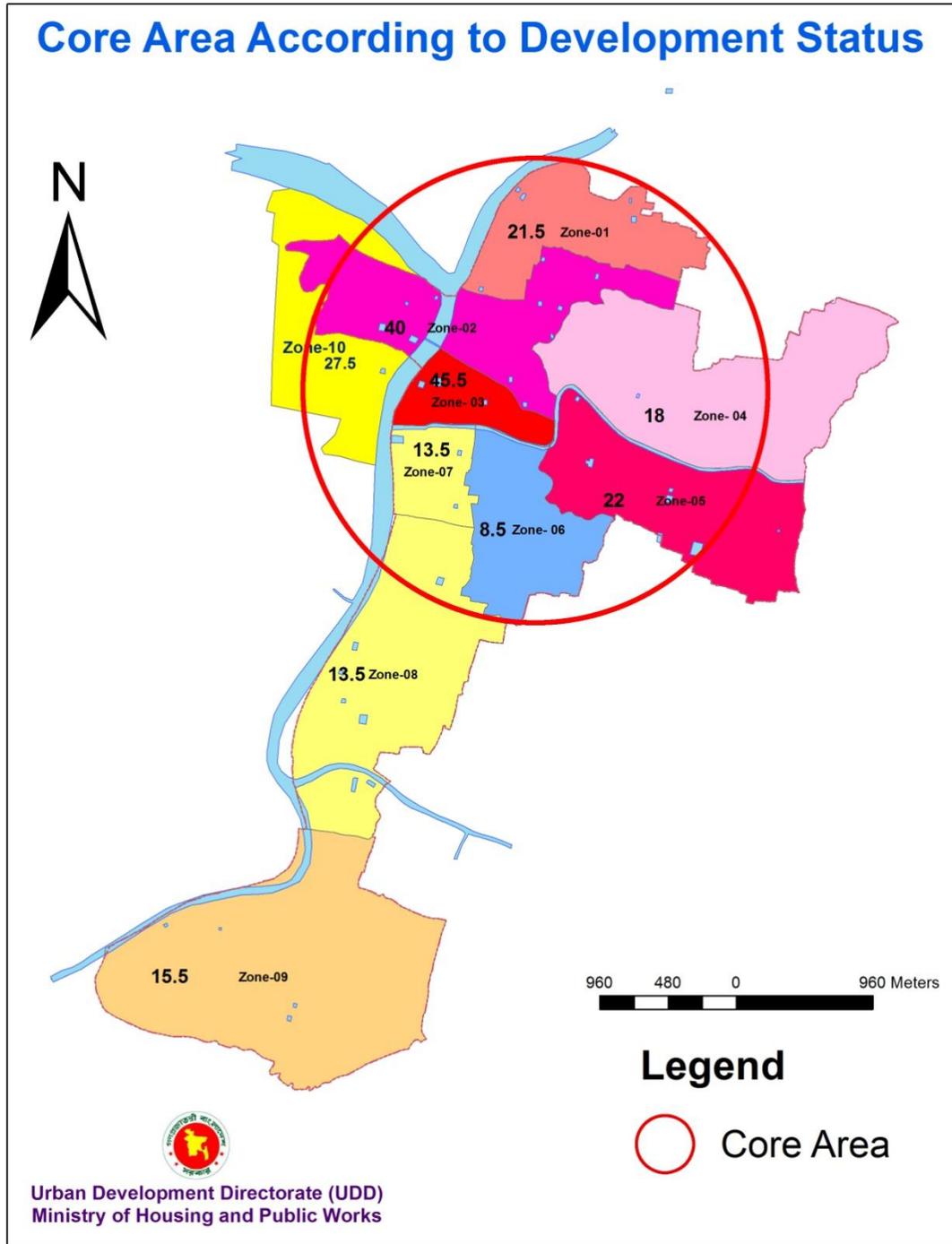
5.1 Core Area According to Development Status

Bhandaria is a newly declared pourashava. Till the ward boundaries have not been fixed with government gazette. For the research purpose the whole area is divided into 9 zones (Map-5.1). The zones are shown in the map with different colors according to their development status. The zones are given scores as below-

Tab-5.1: Weight of different factors/services

Factor/Services	Weight per unit
Education	
Primary School	1
NGO School / Kinder Garden	1
Junior High School	1.5
High School	2
High School & College	3
Madrasha	1.5
College	3
Technical Institute	3
Library / Institute	0.5
Health	
Upazila Health Complex	4
Sub-Health Center	2
Family & Welfare Center	2
Private Clinic	1

Factor/Services	Weight per unit
Recreational & Religious	
Club/Community Center	1
Cinema Hall	1
Stadium/Lawn Court	1
Mosque/Temple/Church/Majar	0.5
Administrative	
Upazila HQs Office	6
Union HQs Office	2.5
Police Station/ Fari	1
Post Office	1
Telephone Office	1.5
Commerce	
Daily Bazar	2.5
Weekly Bazar	2
Bank	3



Map 5.1: Core Area According to Development Status

Tab-5.2: Weightage Score of different zones

Zone	Obtained Score	Zone	Obtained Score
zone-1	21.5	Zone-6	8.5
zone-2	40	zone-7	13.5
Zone-3	45.5	zone-8	15.5
zone-4	18	Zone-9	15.5
zone-5	22	zone-10	27.5

Map 5.1 Show the core area of Bhandaria town. This reflects that the area within the circle would naturally attract most of the future development of the town. So, the services with higher threshold population, higher market range and the higher catchment area should be located within this area except the area with natural barrier. But the basic utilities and services would be distributed all over the Pourashava area.

A little part of 2 no. Nadmullahsialkathi is taken under the Pourashava but other area as of no.2 Nadmullahsialkathi would be developed as it is in the proximity and accessibility to the Pourashava. The obtained score of zone 10 (Nadmullahsialkathi) is 27.5.

5.2 Projection and Analysis of Urban Services

At present the population of Bhandaria Pourashava is 51,233. Using a simple linear population projection method considering 2% growth rate the projected population in 2036 would be 77,000.

In this section, demand for major urban services, like electricity water supply and solid waste management are calculated to determine future requirements. However, land requirements for infrastructure development would be calculated using infrastructure standards developed by UDD in 2013. Some standards were adjusted considering Bhandaria's local condition. The calculation is made for Pourashava and would be followed by other pourashava town.

5.3 Electricity

Provision of Electricity is most essential for supplying power and energy to this Pourashava. In the Pourashava area people are highly dependent on the electricity for both domestic and commercial consumption. For smooth functioning of the community services by public and private sectors, electricity supply has to be ensured round the year. With the growth of population and increase in the level of urbanization, electricity consumption will also increase in the future.

The length of the distribution network for the Pourashava could not be calculated at the moment. It will depend on the ability of the government to establish more power generation projects and ability of the people to pay for it. The following rules should be considered in future for better facility:

1. Location of power line should be carefully planned not to disturb the traffic movement.
2. There are provisions in the BC Rules about line clearance which should be strictly enforced.
3. There are standards in street light arrangements which should be adhered to while selection is made for light post locations.
4. The existing REB system has proved worthy, particularly in bill payment management.

The calculated electricity demand for BhandariaPourashava in 2016 is 26,000 kwh and in 2035 is 38500 kwh.

Assuming that

- Per capita electricity consumption 0.5 kwh
- Technical loss 20%
- Industrial/Commercial demand 20%

5.4 Water Supply

BhandariaPourashava has no water supply system. Majority of the people in the Pourashava have access to safe drinking water. The scenario is different for the rural areas. For the purpose of future planning of the water supply system in the Pourashava estimates of water demand over the plan period are determined.

Assuming that

- Per day per capita water consumption 120 liters
- Technical loss 20%
- Industrial/Commercial demand 20%

Using a simple formula of calculation and the above assumptions, the demand for water is estimated as in 2016 is 1648 gallon per day and in 2035 is 2441 gallon per day.

5.5 Solid Waste Management

As per Waste Concern, an NGO working on the waste management system of Bangladesh, per capita per day waste generation rate for the Pourashava is 0.25 Kg and the waste collection efficiency for the Pourashava is only 54%.

Assuming this rate of waste generation and collection efficiency is constant in the estimation of the amount of total generated waste and backlog in Pourashava.

The estimated waste generation in the Pourashava in 2016 is 26 m.ton/day and in 2035 is 38 m. ton/day

It is important that for solid waste management, a suitable dumping site is selected for sanitary land fill or solid waste treatment. Waste recycling may also be a good management option in the future. There is no facility available at this moment in Bhandaria Pourashava to treat solid waste in scientific manner. In future, depending on its resources and logistic capacities, Bhandaria Pourashava can choose one or more options for solid waste management stated in the chapter 3: Literature Review.

5.6 Future Land Requirements and Locational Guidelines:

Bangladesh is one of the densely populated countries of the world. Every inch of land here should be utilized in a planned way to ensure sustainable development in the field of land use planning. Therefore the necessity of land for a particular use should be calculated carefully, so that misuse of land can be avoided. Appropriate planning standard is necessary to attain this goal. In this study, a set of planning standard which has been formulated in a research done by UDD in 2013 named "Formulation of Planning Standard for small towns of Bangladesh" is used. Some standards were slightly adjusted considering the local conditions of Bhandaria Pourashava.

Tab 5.3: Future Land Requirements for Infrastructure Development

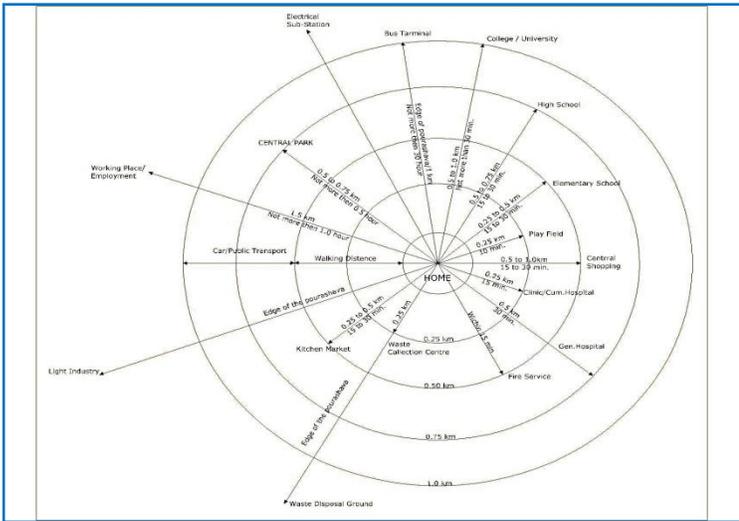
Type of infrastructure	Proposed standards	Req. Land (Acres)	Nos. as per standards	Existing infrastructure (Nos.) *	Recommendations/ Locational guidelines
Residential					
General residential	100-150 persons/acre	776-517			Densification in existing residential area
Real Estate-Public/Private	150-200 population/1 acre	388-517			Land Readjust Technique, Guided Land Development Method to be implemented in existing residential area where low density temporary type of development is taking place.
Education					
Nursery School/ Kindergarten/ NGO School	0.5 acre/10,000 pop	3.88	8	10	1 New nursery school for ward no.3, 5,6 and 9 each
Primary School	2 acres/ 5,000 pop	31.04	16	19	1 New Primary school for NadmullaSialkhati
Secondary / High School	5 acres/ 20,000 pop	19.4	4	5	1 New High school for ward no.5 & ward no.9 each
College	10 acres/ 20,000 pop	38.8	4	2	1 New college for ward no. 8 (Kanua)
Vocational Training /polytechnic Institute Centre	5 acres/Pourashava	5	1	-	1 New Vocational Training /polytechnic Institute Centre at ward no.5
Others (Library, Public library)	5 acres/ 20,000 pop	19.4	4	2	1 New Public library for ward no.3 and 7 each
Open Space and Recreation					
Central park	5-10 acres/ Pourashava/Upazila HQ		1	1	Existing river side park at NadmullahSialkathi would be used as central park with extension towards the south beside the river
Stadium Complex (Indoor & Outdoor)	5-10 acres/ Pourashava/Upazila HQ		1	-	Stadium complex to be located in ward no. 8 (Kanua)
Play field / ground	3 acres/20,000 pop/Pourashava/ UP HQ	11.64	4	2	1 New Play field at ward no.5. Each Schoolplaygrounds would be used as play field.
Neighborhood /Community Park	1 acre/10,000 pop	7.76	8	-	One community park would be considered for each neighborhood

Cinema Hall/ Town Hall/ Complex	0.5 acre / 20000 pop/Pourashava/ Up HQ	1.94	4	2	Newly established Bhanghabandhu Auditorium at Ward no. 5 would be used as town hall
Health					
Upazila Health Complex	10-20 acres/Upazila HQ		1	1	Would be remained as present location
Specialized Hospital	1 acre/ Pourashava/ Up HQ		1	-	1 New Specialized Hospital at ward no. 8 (Kanua)
Maternity/ Child Care Center	1 acre/ 20000 pop	3.88		2	1 New Maternity/ Child Care Center at ward no.1,2,5,6,7 and 8 each
Clinic	0.25/ 20000 pop	0.97		2	1 New Clinic at ward no.1,4,5,6,7,8 and 9 each
Commerce and Shopping					
Wholesale market	3-5 acres/Pourashava /Up HQ		1	1	Bhandaria Hat would continue its role as Wholesale market.
Retail sale/Kitchen/Nei ghborhood market	0.5 acre / 10000 pop	3.88	8	1	1 New Retail sale/Kitchen/Neighborhood market at ward no.1,2,4,6,7,8 and 9 each
Shopping Complex	0.5acre/20000 pop	1.94	4	-	1 Shopping complex would be developed at the Place of TafsirMaydan considering its present use. Another Shopping Complex would be developed at ward no. 2.
Cattle Market (Hat)	1-2.5 acres/Pourashava		1	1	Would remain at present location us till a new Cattle Market would be set up at Gazipurmuja.
Industry					
General/ Agro/Cottage Industry/ EPZ	2.5 acres/10,000 pop	19.4	8		Would be located at ward no. 9 in Gazipurmuja
Administration					
Urban Deferred	5-10% buildup area/ Pourashava/Up HQ		1		Would be located at ward no 4 and kanuamouza
Upazila complex	10 acres / Upazila		1	1	The upazila Complex Would be used as administrative hub of the upazila, upazila level new office would be placed here.
Pourashava office	3 acres / Pourashava	3	1	-	Would be located at ward no. 5 near to Power sub Station
Ward Office	0.10area/office	8	8	-	Would be located in each ward at suitable location

Jail/Sub-Jail	10 acres/Upazila HQ	10	1	-	Would remain at the present location at ward no. 1
Community Facilities					
Central Mosque/ Church/Temple	0.5 acre/ 20,000 pop	1.94	4	4	Existing Bus Stand Masjid would be developed as Central masjid
Eidgah	2 acres/20,000 pop	7.76	4	2	Tafsir Eidgah would be continue its role as Eidgah and another Eidgah would be located at Qazir Mosque at ward no. 5
Graveyard	1 acre/20,000 pop	3.88	4		A central Graveyard would be developed at ward no. 2 near Hospital Complex, another would be located at Kanua mouza, ward no. 8
Cremation Ground	1 in a Pourashava	1.00	1		Would be placed in the west bank of Poona river and west near to the Hospital
Community Center/Auditorium	0.5 acre/20,000 pop	1.94	4	2	Newly established Banghabandhu Auditorium at Ward no. 5 would be used as Community center. Another would be developed at ward no. 2
Club/Gymnasium	0.25 acre/ Optional	.25	1		Would be placed in ward no. 2
Day Care Center	0.10-0.25 acre / Optional	.10	1		Would be placed in ward no. 2
Utilities					
Electricity supply/ Electric sub station	1 acre/20000pop	3.88	2	1	1 new Electricity supply/ Electric sub-station Would be placed in the west bank of Pona river
Water Supply treatment plant	1 acre/20000pop	3.88	1		Would be placed in ward no. 2
Waste Disposal Ground/ Treatment Plant	2-3 acres/Dumping ground/Up HQ/ Pourashava		1		Would be placed in ward no. 4
Sewerage Treatment plant	Local requirement		1	-	Would be placed in ward no. 4
Drainage Treatment Plant	Local requirement		1	-	Would be placed in ward no. 2
Transportation					
Bus terminal	1 acre/Pourashava		1	-	Bus Terminal Would be located Near Bottala.
Truck terminal	1 acre/20,000 pop/ Pourashava/Up HQ	3.88	4	-	Would be placed Near Bottala
Bus Stand	0.5 acre/20000 pop/Union	1.94	4	1	Existing Kalema Chattar would be used as Bus stoppage for Passenger

					loading and unloading. This area would be designed as per requirements.
Launch/steamer terminal	2 acres/Pourashava /Up HQ	2	1	1	In the existing location. Connectivity would be developed with Bus terminal, Truck terminal, Bus and tempo stand.
Railway station	4 acre/per station/Dist HQ/Up HQ	4	1		At the entry point of the pourashava near Bottala
Rickshaw/van/Baby taxi/tempo stand	0.25 acres/only baby taxi/tempo stand				Existing KalemaChattar would be used as Tempo/ Rickshaw stand for Passenger loading and unloading. This area would be designed as per requirements.
Fuel/ Filling Station	0.5 acres/20000pop/ Up HQ/Pourashava	1.94	4		At the entry point of the pourashava beside Rajapur-Bhandaria Highway
Government Services					
Police Station	3-5 acres/Pourashava /Up HQ		1	1	At the existing location
Police Box	0.5 acre/box/Union	3.5	8		1 New police box at ward no.1,3,4,5,6,7,8 and 9 each
Post Office	0.5acre/20000 pop/Pourashava/ union	1.94	4	1	1 New Post office at ward no.1,5 and 8 each
Fish Landing station	0.5 acre optional	.5	1		Would be placed in bank of river Pona or Bhubaneswar canal at ward no.3
Fire Service	1 acre/20000pop/Di st, HQ/Up HQ	1.94	4	1	Present location would be remain unchanged
Telephone Exchange	0.2 acre/20000pop/Di st, HQ/Up HQ	0.776	4		Present location would be remained unchanged
Miscellaneous					
Slaughter House	0.15/20,000 pop, 1/ Pourashava	0.15	1		Would be placed at ward no.3

*Number of Existing infrastructure was collected from FGD on 30 March,2016 held in UNO complex, BhandariaPourashava.



Note: 1) Location of Light Industry should be at the edge of the pourashava which is not less than 3 km from the center. If the radius of a pourashava is less than 3.0 km. it is suggested that there should not be any heavy industry unless it is predominantly an Industrial Growth Centre.

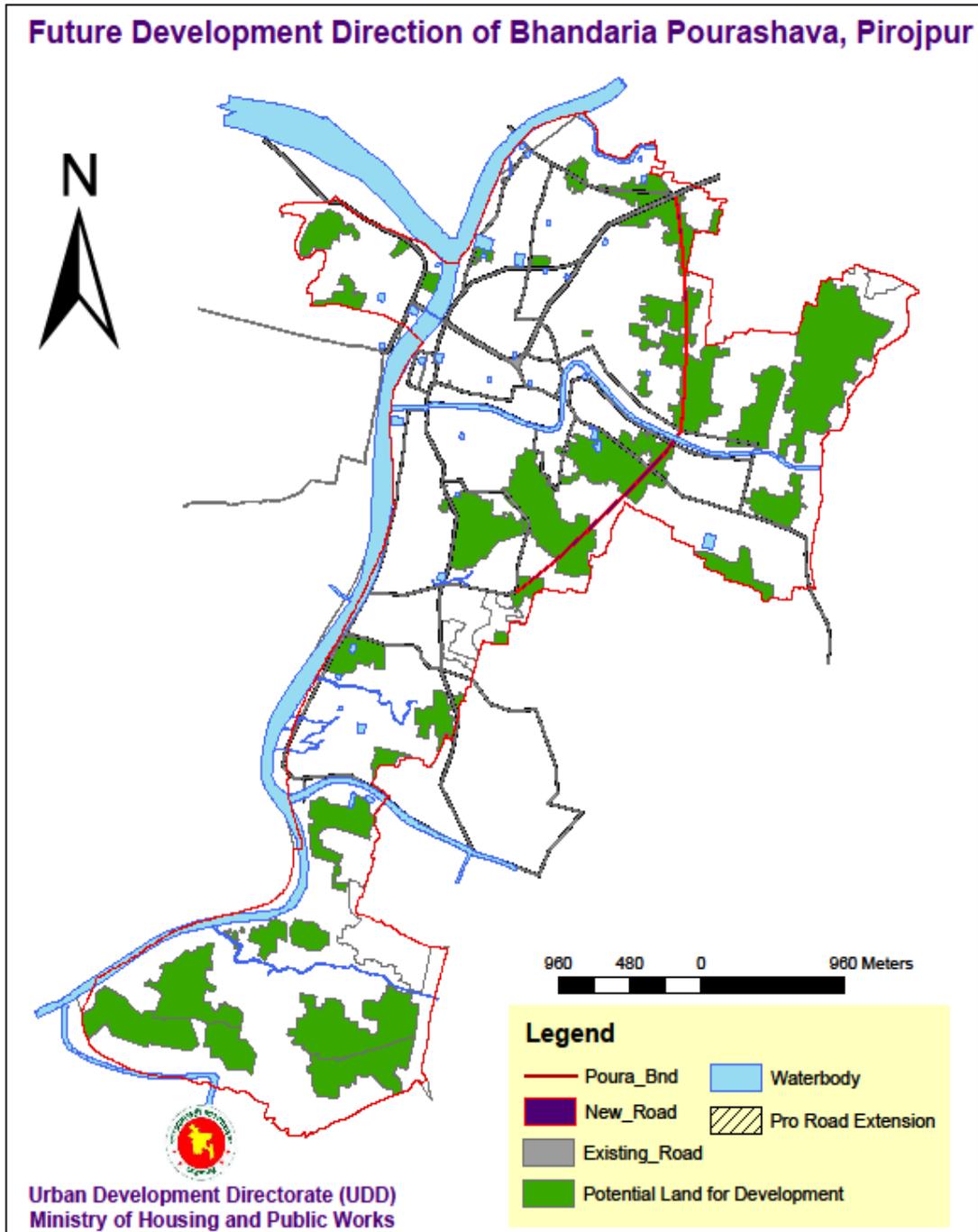
2) Circle-3 represents walking distance (0.50 km) from home.

3) Facilities beyond Circle-3 to be availed by car/public transport.

4) The time distance is measured on walking time.

Fig 5.2 : Time distance diagram. Source: UDD, 2013

5.7 Geometric Design Standards



Map-5.3: Map of Future Development Direction

5.7. a. Primary Road

The purpose of Primary Road within the Pourashava is to bear the pressure of major traffic circulation so that traffic distribution is balanced over the Pourashava area. These roads are also to serve for pedestrian commuting.

The primary roads should be made with pedestrian walks on both sides as it is assumed that a large section of the people will be walkers for varying distances. The paved areas are separated with a median and vegetation lines on both sides making footpaths safer for pedestrians.

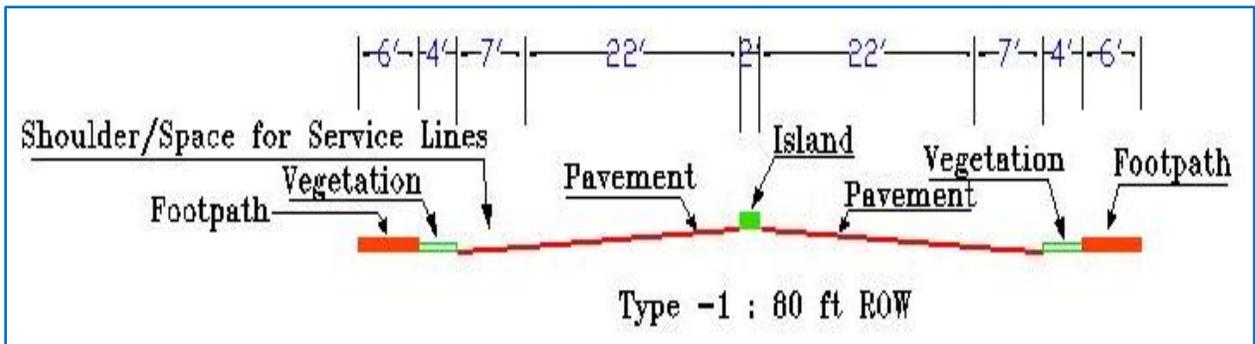


Figure 5.4: Standard Cross-Section of Primary Road

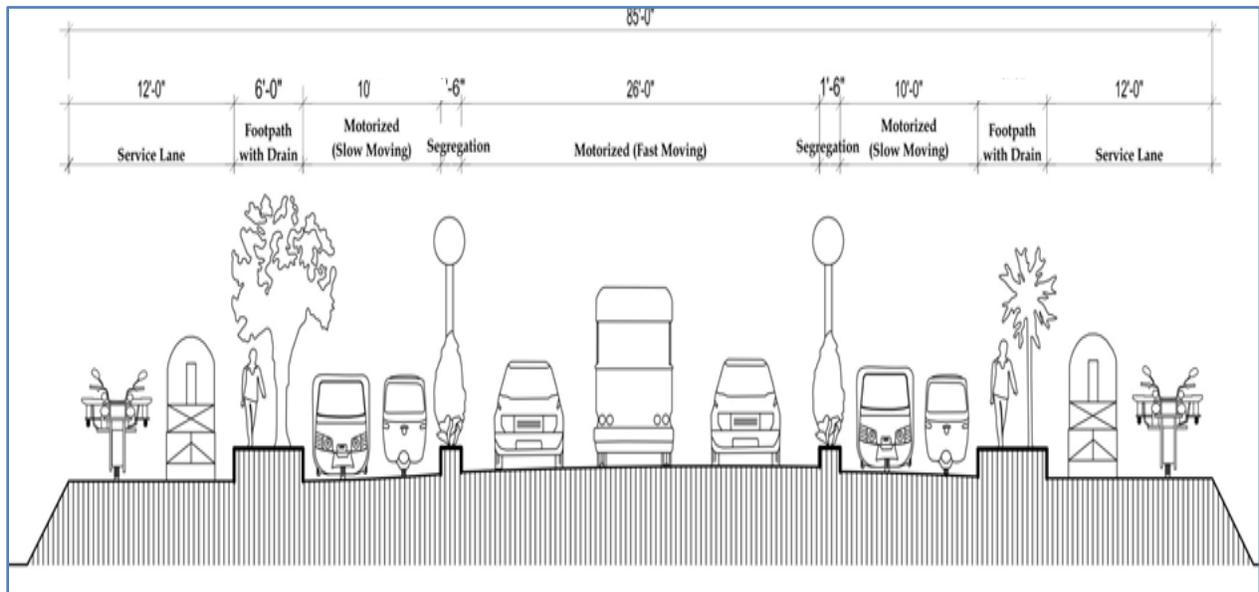


Fig 5.5: Proposed cross-section of Barisal Bhandaria Pirojpur High way

b. Secondary Road

The secondary roads are required to link primary roads with tertiary roads within the Pourashava.

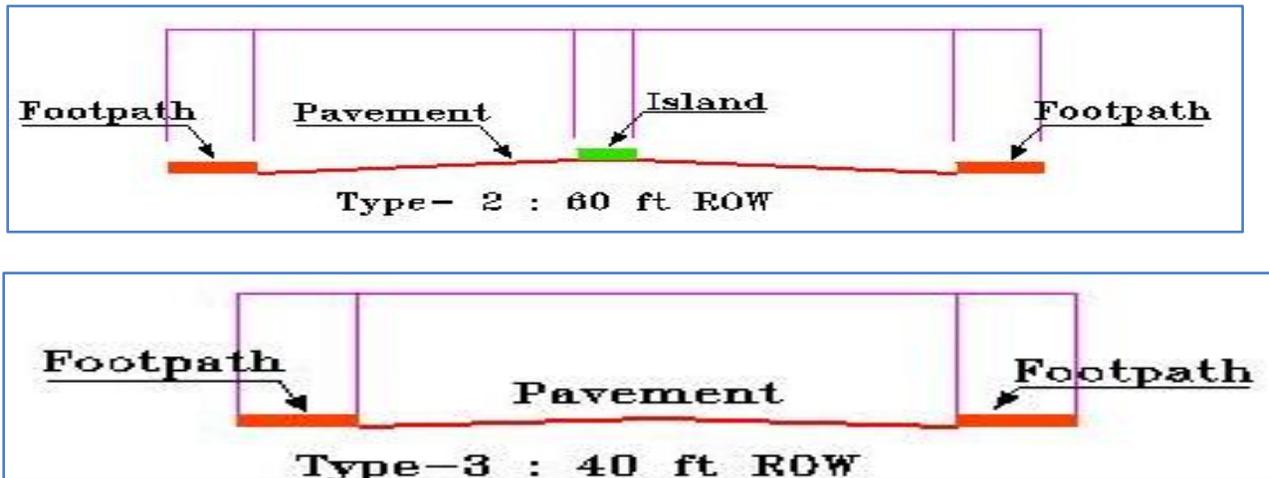


Figure 5.6: Standard Cross-Section of pourashavaSecondary Road

c. Tertiary Road& Local Road

The tertiary roads are link between secondary and access roads within the Pourashava. These roads are important for block level traffic circulation. Footpath is necessary on both sides as pedestrians will large in number.

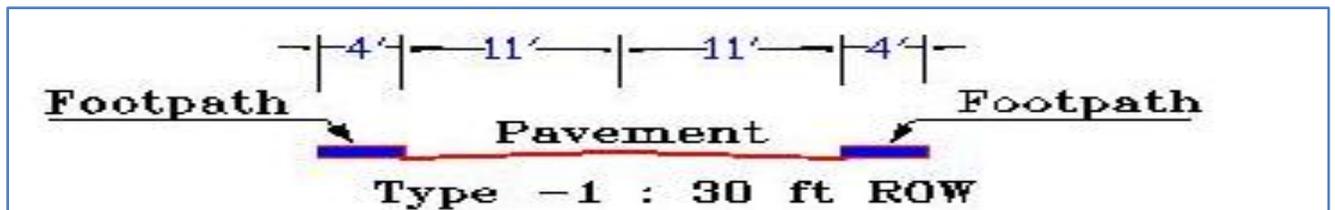


Figure 5.7: Standard Cross-Section of Tertiary Road/ Local Road

d. Access Road

The Access roads are meant for connecting residential units and other buildings and functional units with tertiary roads or next higher order of traffic circulation corridor.

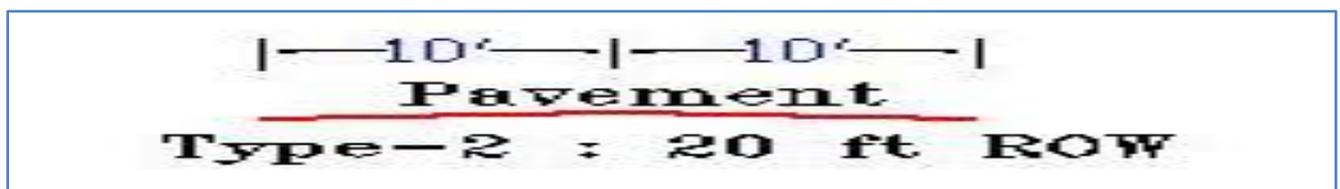


Figure 5.8: Standard Cross-Section of Access Road

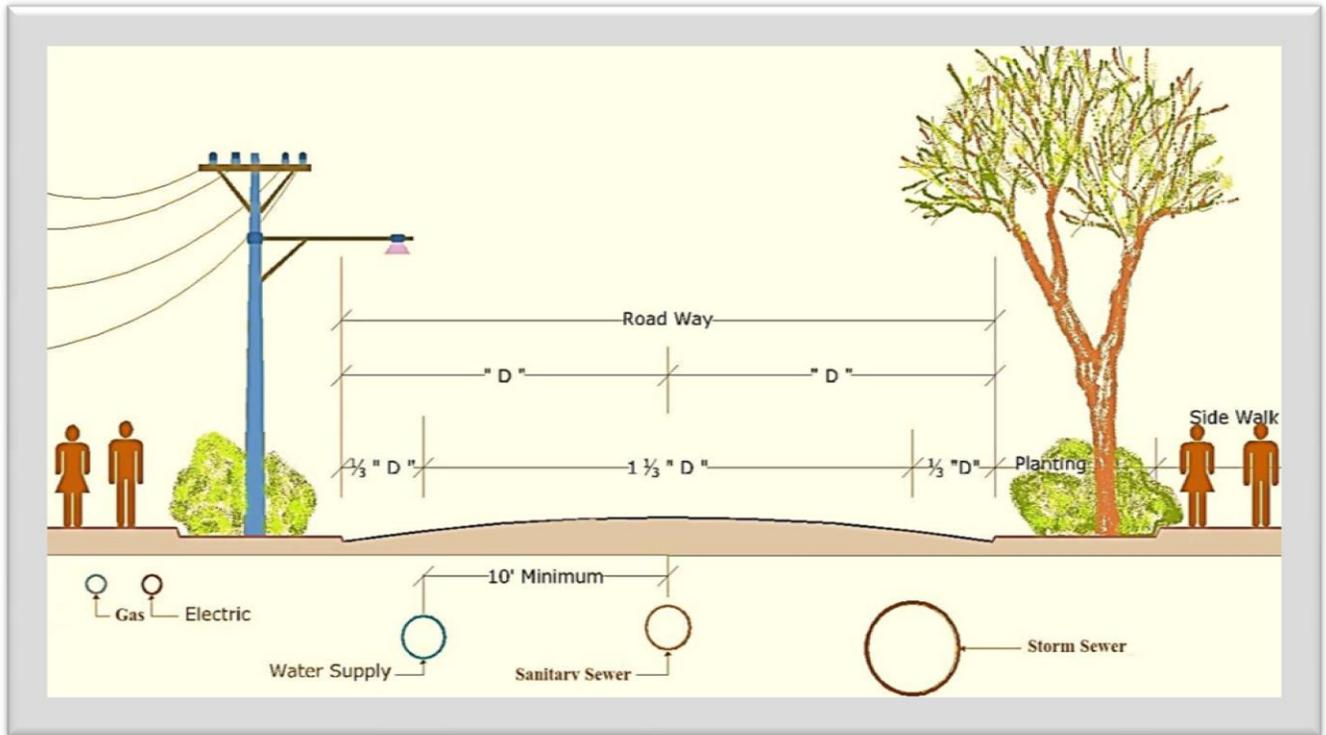


Fig 5.9: Composite picture of a road cross-section with utility options

e. Principles of Drainage System

The drainage system will have a hierarchy with primary, secondary and tertiary drains in the Pourashava. The diagrams show comparable design standards for various categories of drains that can be considered for an urban area.

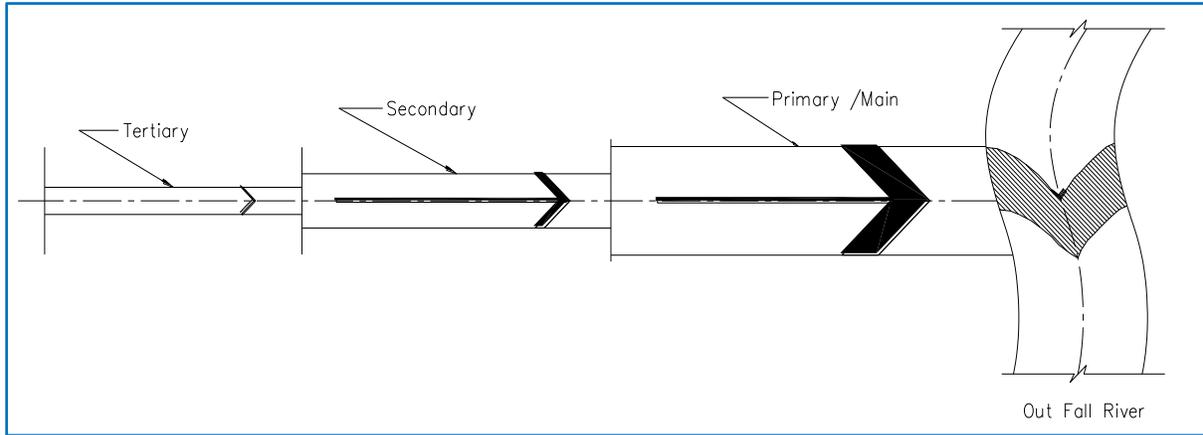


Figure 5.10: A Schematic Diagram showing flow directions from Tertiary drains to Outfall

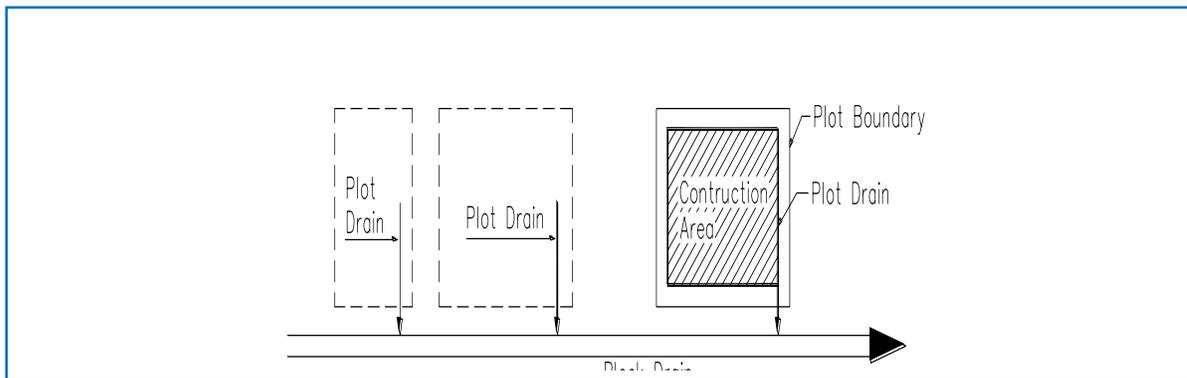


Figure 5.11: A Sketch showing plot drain and Block drain

f. Primary Drain

Primary drains are called as the main drains. Primary drains cover larger storm drainage area than tertiary and secondary drains. In ascending order its position is third. Its cross-section is larger than other types carrying capacity is high and is constructed of brick, cement concrete and sometimes reinforced concrete. Primary drains may be of earthen structure provided sufficient land is available and land value is low. Contributing drainage water comes from tertiary and secondary drains. Primary drains discharge its drainage water to outfall, natural khal, river or large lowland area/Beels Figure /figures below show the typical cross-section of the primary drains:

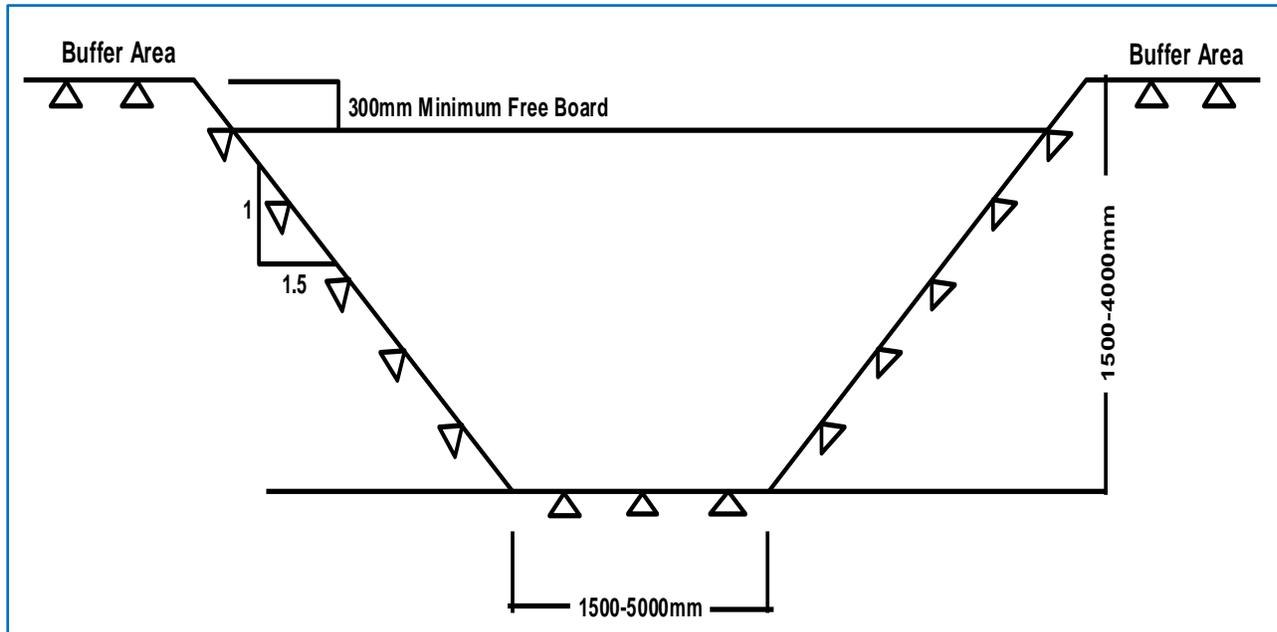


Figure 5.12: Earthen Primary Drain

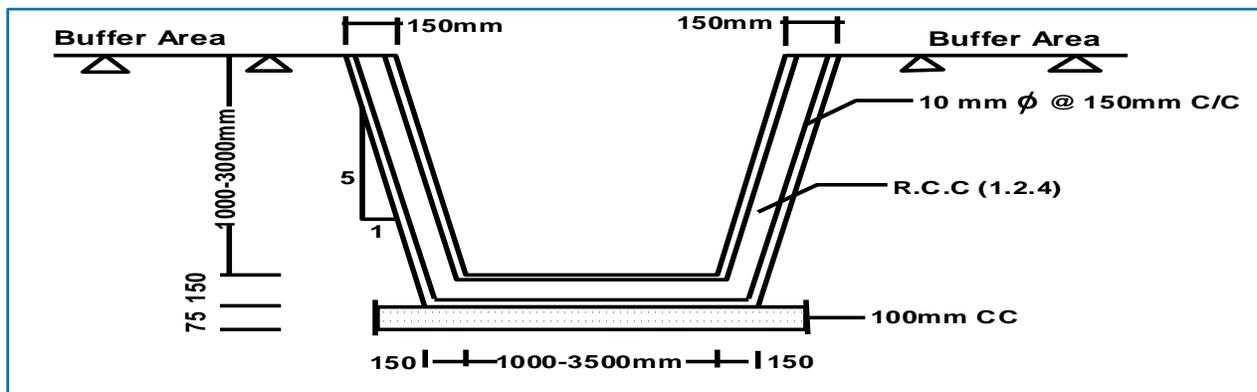


Figure 5.13: Typical RCC Primary Drain

g. Secondary Drain

Secondary drains collect discharge from tertiary drains. One secondary drain may receive drainage discharges from several tertiary drains in its course. Size and capacity of secondary drain is much bigger than tertiary drains, its catchment area is also bigger than tertiary drains. Like tertiary drains, it may run parallel to bigger roads. Secondary drains may run along and through the middle of its storm water contributing area. The typical cross-section, size and shape, and its construction material are shown below:

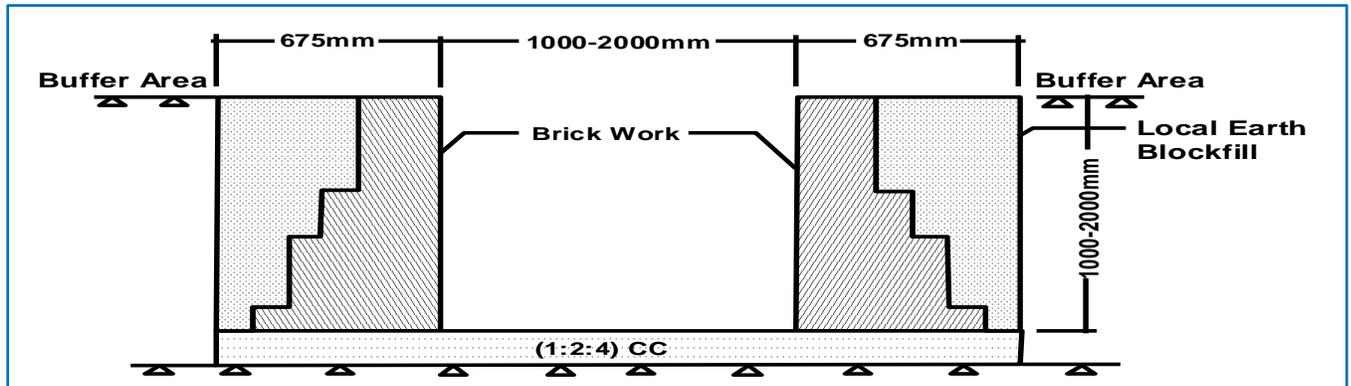


Figure 5.14: A Typical Secondary Drain

h. Tertiary Drain

Tertiary drain carry run-off or storm water received from the above mentioned plot drains and block or Mohallah drains. Their catchment area or storm water contributing area is bigger than Mohallah drains. Tertiary drains generally are the under jurisdiction of municipality. These drains or drainage networks are constructed and maintained directly by municipalities. These drains are constructed by brick, cement concrete and sometimes by excavating earth in their alignments. These drains may run parallel to road or across the catchment area. Sometimes borrow pits of the road serves as drains provided borrow pits are uniformly and continuously excavated. Borrow pits that serve as drains may be channeled or lined by brickworks. Tertiary drains deliver its discharge usually to secondary drains. A typical tertiary drain is shown below:

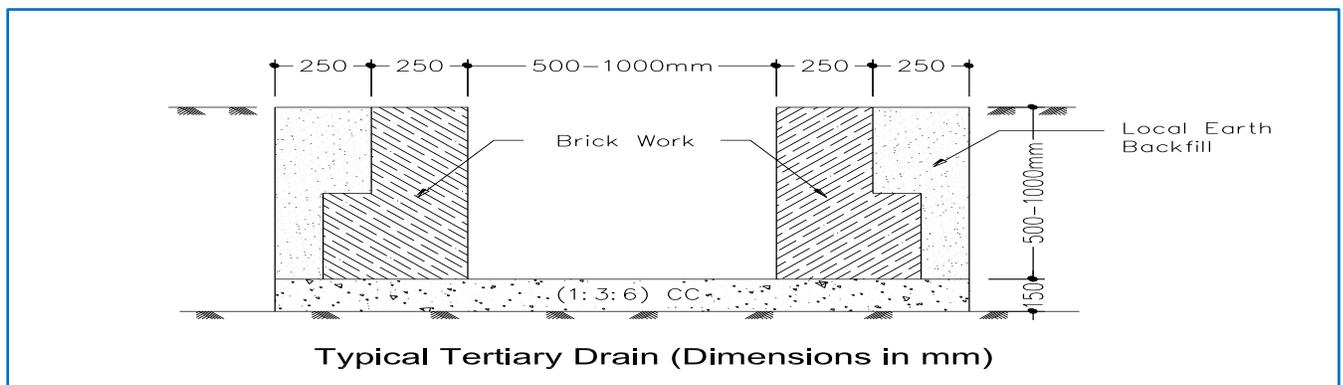


Figure 5.15: A Typical Tertiary Drain

i. Affordable Housing Designs

There are scopes to minimize or limit the cost of constructing housing units that may be considered The House Building Research Institute (HBRI) has developed some designs through their research and action programs. Some examples of their designs of housing units for different environments are shown here.



Figure 5.16: Eco-House -Urban Type 1

Eco House – Rural/Semi

Eco- House – Rural Type 1

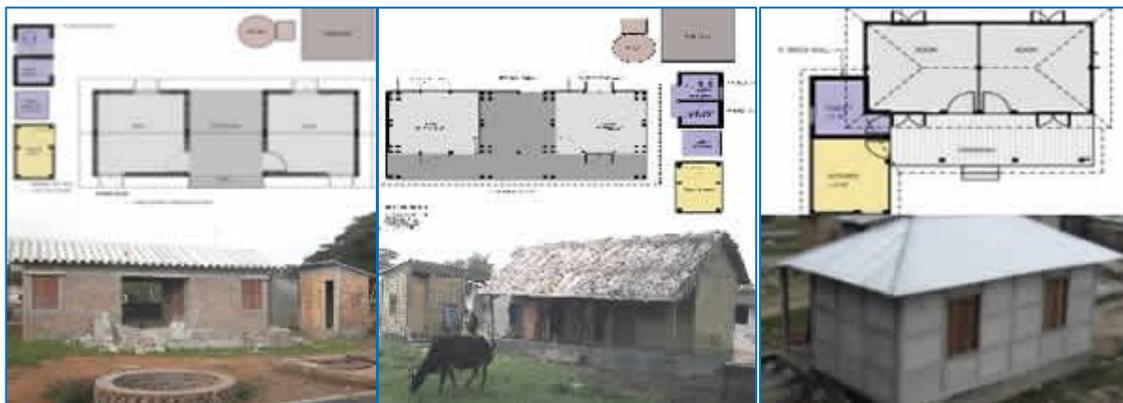


Figure 5.17: Eco-House– Rural Type 2 Eco- House – Rural Type 3 Eco- House – Rural Type 4

j. Garbage Disposal

In selecting sites for dumping care should be taken not to contaminate the ground water or nearby surface water bodies and to prevent odour and insect nuisances. Thus a form of dumping should be selected in which the fresh waste material is covered daily by an earth layer: sanitary landfill or controlled tipping.

k. Low-Cost Sanitation Designs

The low-cost sanitation system has been introduced in Bangladesh for many years. The Department of Public Health and Engineering (DPHE) has been working in this sector with great success. Some of the low-cost designs can be considered for improving public health and sanitation system in the Pourashava

The Local Government Engineering Department (LGED) with the assistance of UNDP has developed some designs that may be useful in different locations of Bangladesh. These designs are shown below-

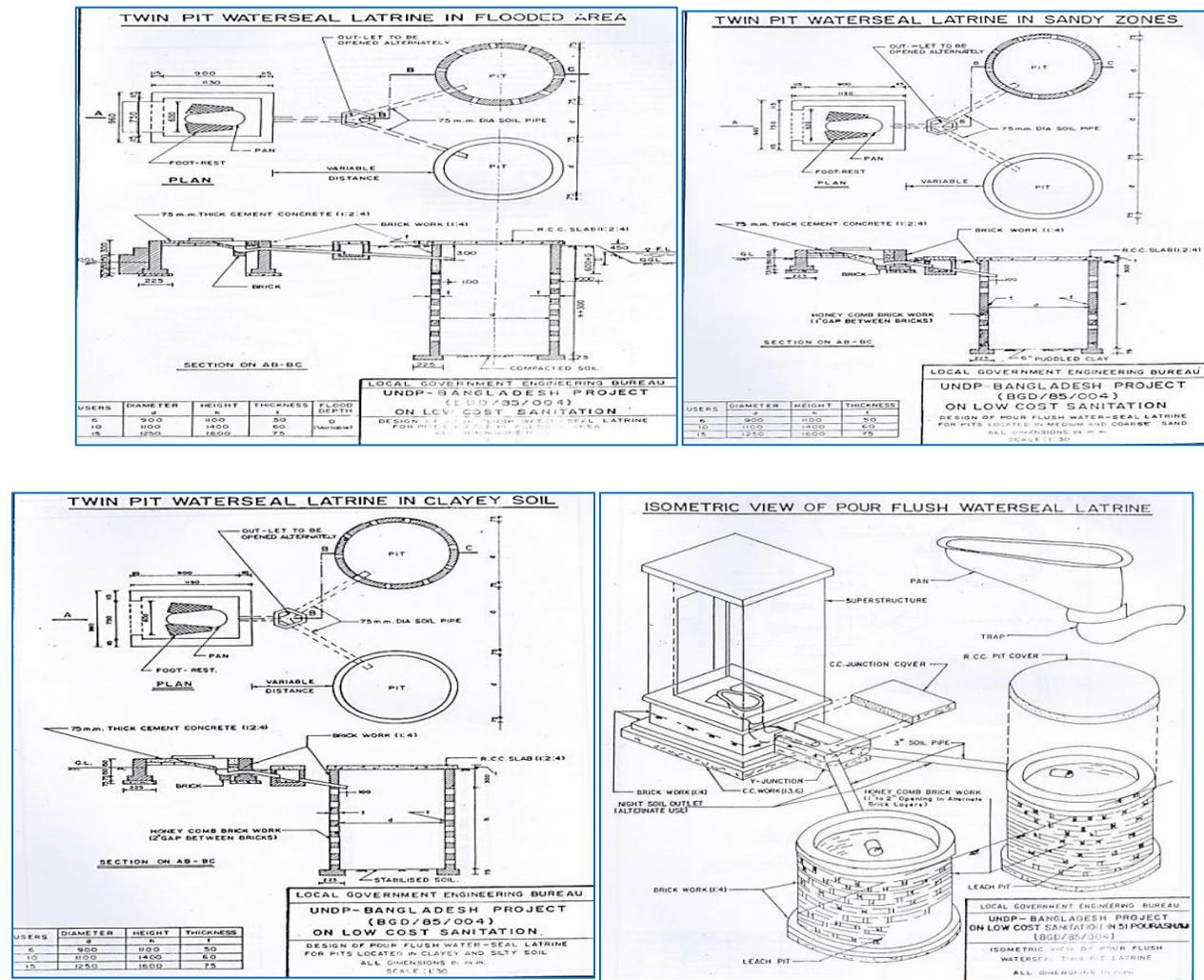


Figure 5.18: Low cost Sanitation System

I. Roadside Plantation

There should maintain an appropriate distance between street light and plantation as follows

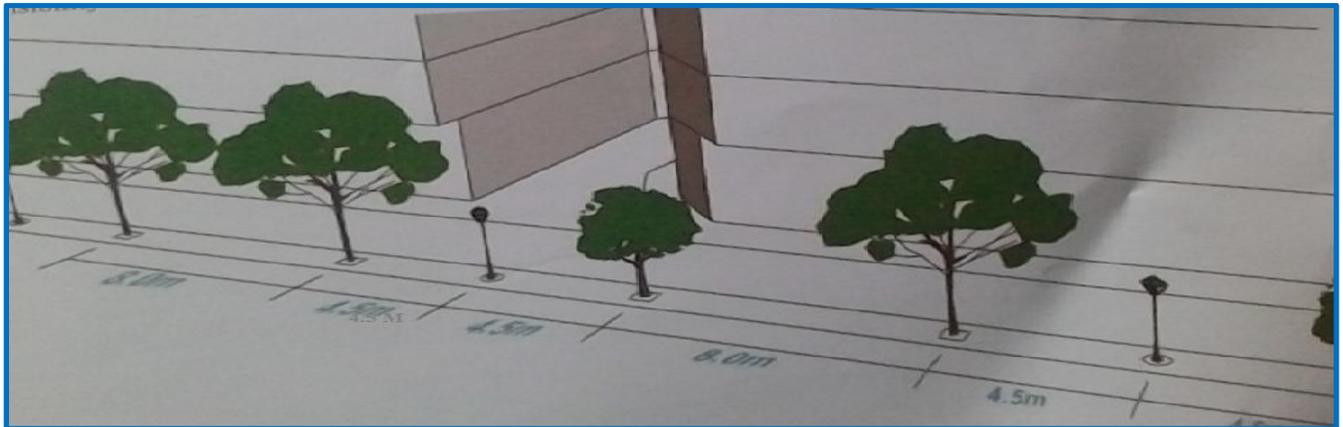


Figure 5.19: Roadside Plantation

m. Designing Plaza

Plaza, a pedestrian space, which provides a variety of seating arrangement, should be accessible to all



Figure 5.20: Pedestrian space designing as plaza

n. Maintaining Flood flow zone

Ponariver and Bhubaneshwar canal as well as enormous number of canals are the salient features of natural landscape of Bhandaria. But there are encroachment in many places occurred as shown in fig- 5.21 and 5.22



Fig 5.21 :Encroachment in pona river



Fig 5.22 :Encroachment in Bhubaneswar canal

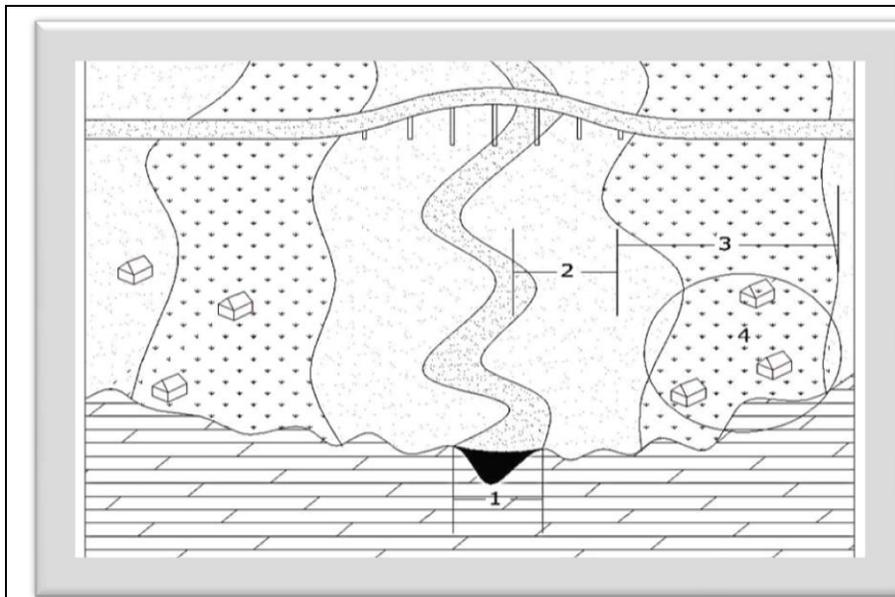
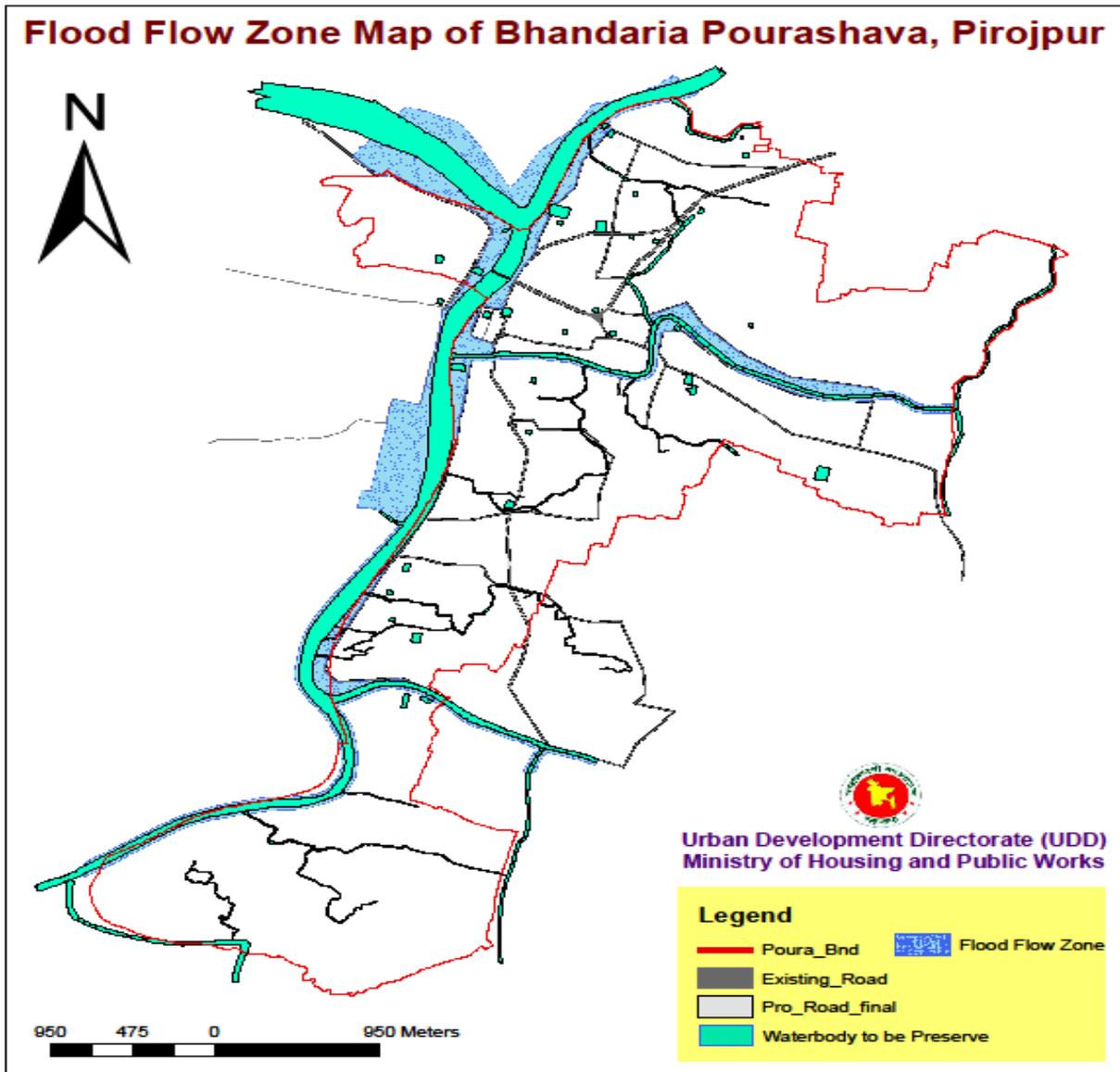


Fig 5.23 : Schematic diagram of river infrastructure considering flood flow zone of river/canal

Legend:

1. River/ Canal
2. Main flood flow zone
3. Sub flood flow zone
4. Low level construction considering flood flow zone

River infrastructure should be constructed considering flood flow/ sub flood flow zone. Main flood flow zone should be free from any structure that impedes the flow of flood water. The sub flood flow zone should be free from any permanent structure. Structure with higher plinth level would be allowed in this area without obstructing the flood flow



Map 5.24: Flood Flow zone Map

Flood flow/ Sub flood flow zone to be maintained in BhandariaPourashava area. No permanent structure to be constructed in this zone.



Fig 5.25: Riverside encroachment



Fig5.26: Beauty of Riverside



Fig 5.27: Riverside Design



Fig 5.28: Riverside Design

o. Designing the Pond in Bhandaria Bazar

There are two important ponds/ reserve tanks exist in Bhandaria Bazar area. One of these, the pond at the eastern part of the image in fig 5.24 is maintained properly, but the another one at the western portion, is not maintained properly. Dasana pond to be designed as below-



Fig-5.29:Dasana pond in the image

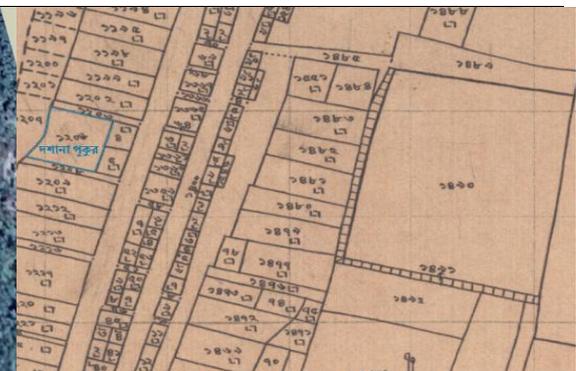


Fig-5.30:Dasana Pond in Mouza map

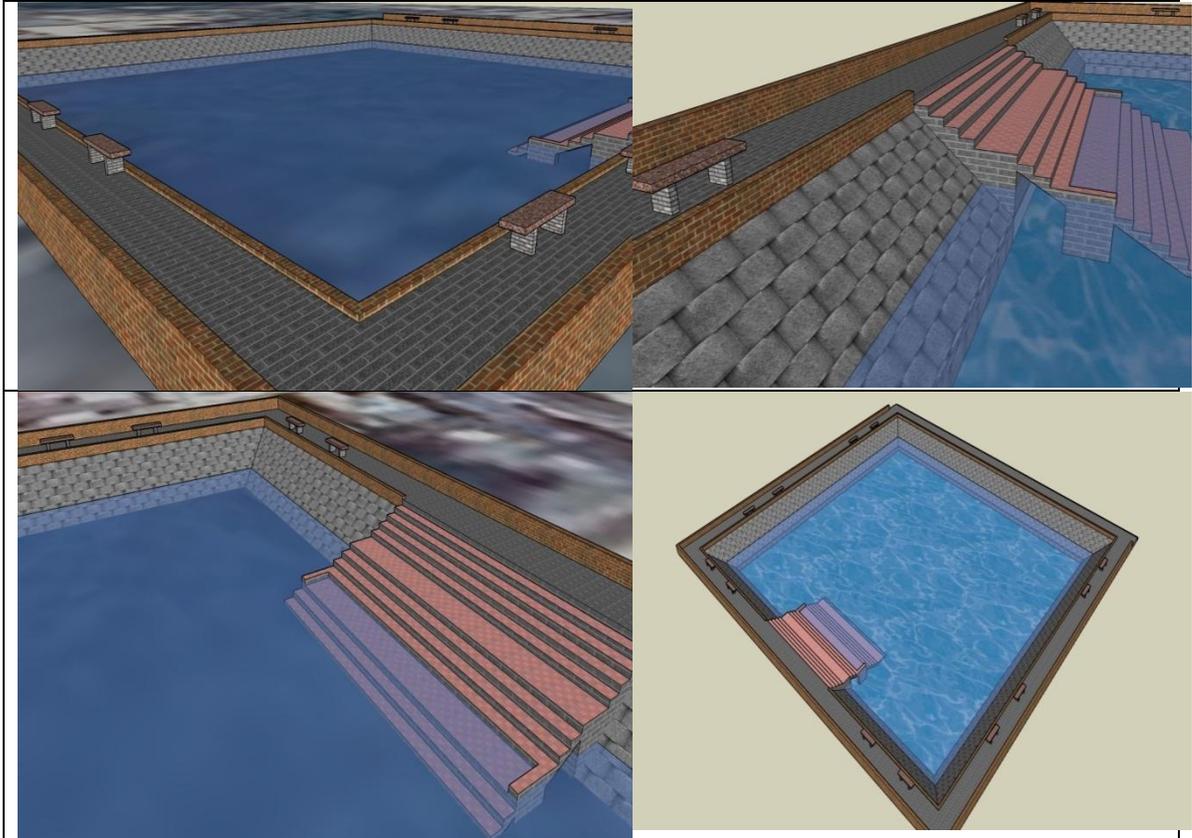


Fig 5.31: Landscaping Dasana pond

5.8 Way Forward

This research work tries to prepare some guidelines of infrastructure development in a municipality town. It reviews some guidelines, design criteria and possible options followed by various countries in infrastructure design like Drainage System, Water Supply, Solid waste management, Garbage disposal, low cost Sanitation, Road Network, Affordable Housing, Flood management etc. This research also addressed and calculated the demands of Electricity, Drinking Water, and Waste generation considering next twenty years up to the year 2035 for BhandariaPourashava. As Bangladesh is a land hungry country, every piece of land to be used properly. For these reasons we should consider-

- More Research Work should be carried out to establish an infrastructure guidelines at the national level planning;

- Other issues like environment, water management, disaster (Natural and Manmade) should be added to determine an infrastructure guidelines in the respective fields;
- Orientation, Climate change issue or Socio-economic condition etc. should be addressed in infrastructure design;
- Comprehensive community participation should be assured;
- The role of different actors in developing infrastructure should be defined.

Use of infrastructure guidelines in planning process is very important for such a densely populated country like Bangladesh. Some standards and guidelines that were prepared by some countries for their own are not blindly applicable in our country. We should follow these guidelines to prepare our own. This research is a step towards the process.

Although the research work deals with the infrastructure guidelines in the lower tier of plan preparation, it tries to draw the attention of national level policy makers so that the planning professionals can avail planning guidelines at national level. Like Bhandaria, a newly established Pourashava, a complete Master plan should be prepared for future infrastructure development. This research would be used as a useful tool for the master plan preparation.

Research Team

Sl. No	Name	Designation
Key Personnel		
01.	Sharif Mohammad Tariquzzaman	Team Leader & Senior Planner
02.	Asaduzzaman	Senior Planner (Addl. Charge)
03.	Md. Rashadul Islam	Research Assistant
Supporting Staff		
01.	Md. Zia Hasim	Draftsman-2
02.	Mir HabibulAlam	Survey Supervisor
03.	Md. Rashidul Islam	Steno typist cum computer operator
04.	Md. Anwar Hossain	Tracer
05.	Md. Sujon Hossain	Chainman

Bhandaria Pourashava at a Glance

01. Name of Pourashava	:	Bhandaria Pourashava
02. Establishment	:	22 nd September, 2015
03. Area	:	2944 Acres
04. Total Population	:	51,233 person (M-25,548/F-25,685)
05. Density of Population	:	4,302 Person/sq.km.
06. People engaged in non-farm Activities	:	75%
07. Internal river of the Pourashava	:	Pona River
08. Important Establishments	:	a. Shisu Park- 1 b. Kalema Chattar c. Tapsirul Mahfil Moydan
09. Rate of Education	:	75%
10. Govt. College	:	01(One)
11. Govt. Girl's High School	:	01(One)
12. High School	:	01(One)
13. Staffs of the Pourashava	:	13 (2 officer, 11 Staff)
14. No. of Voter of the Pourashava	:	18,267
15. Pourashava Office	:	Run in a rented house

(Source:Bhandaria Pourashava, 2016)

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List of Abbreviations

ADT	: Average Daily Traffic
DMDP	: Dhaka Metropolitan Development Plan
ESCAP	: Economic and Social Commission for Asia and Pacific
FGD	: Focus Group Discussion
GSB	: Geological Survey of Bangladesh
LGED	: Local Government Engineering Department
ROW	: Rights of way
RAJUK	: Rajdhani Unnayan Kartripakha
SRDI	: Soil Resource Development Institute
SOB	: Survey of Bangladesh
UDD	: Urban Development Directorate
UTIDP	: Upazila Town Infrastructure Development Project
UNCHS	: United Nations Center for Housing and Settlement

