Chapter 2

Iloilo River

Iloilo River is an estuarine ecosystem with an approximate length of 11 kilometers. The river stretches from Rotary Park, Parola to the municipality of Oton where it joins Batiano River in Barangay San Antonio.

Iloilo River is classified as Class "C" water and is intended for the propagation of fish and other aquatic resources, for secondary recreational activities (boating) and for manufacturing processes after water treatment (DENR – DAO No. 34, 1990).

Classification	Type	Beneficial Use
A	Fresh surface water	Public water supply class II. Requires complete treatment to meet the NSWD
B	Fresh surface water	Recreation water class I. For primary contact recreation such as bathing, swimming, skin-diving, etc..
C	Fresh surface water	Fishery water for the propagation & growth of fish & other aquatic resources Recreation water class II Industrial water supply class I (for manufacturing processes after treatment)
Classification	**Type**	**Beneficial Use**
SB	Coastal & marine water	Recreation water class I Fishery water class I (Spawning areas for Bangus & similar species)
SC	Coastal & marine water	Recreation water class II Fishery water class II (Commercial and sustenance fishing) Marshy and mangrove area declared as fresh and wildlife sanctuaries.

Source: DENR

Table 2. Water Classification

The river has no main source but depends on tributaries, run-off from nearby agricultural land and seawater from Iloilo Strait. Two of its major tributaries are: Calajunan and Dungon Creek. Calajunan Creek absorbs all products of domestic wastes, leachete from Iloilo City garbage disposal site, agricultural run-off and industrial wastes from beverage industries, piggery, fishponds, and coconut oil mills. On the other hand, Dungon Creek absorbs all discharges from fishpond, domestic waste coming from nearby residential areas and hotels along the embankment, the City's slaughterhouse, gas station, restaurants and malls.

Iloilo River has varied functions. For one, it serves as a source of raw material for salt production especially along the district of Mandurriao. It is good source of brackish water for inland fisheries (fish pond cultivation); navigation; drainage for the sewerage system of the city as well as for storm surface run-off; livelihood for sustenance fishing and recreation.

Iloilo River's biological role in so far as ecological considerations are concerned, allows it to be a spawning area for bangus, shrimp and other marine species. It also serves as habitat for marine flora and fauna. One can also observe the suitability for mangrove species because there is an abundance of such along the banks. Surprisingly, most areas near the river are not flood prone. *Map 2* shows that only selected portions in the north and south banks are inundated areas. Sections west of Diversion Road, Mandurriao were affected in the July 1994 flooding and almost all parts of La Paz were under water in the Oct. 1998 flooding. Western banks on the vicinity of Arevalo and portions of Mandurriao districts have not experienced any flood in the recent years.

Interesting enough, lands along riverbanks vary between miscellaneous land types to river valley. *Map 3* illustrates the land distribution of Iloilo City. Concentrating on the areas near the Iloilo River, miscellaneous land type is noted on the southern banks along built-up areas in the Iloilo City Proper district. The same is true for portions of La Paz district except for areas connecting Dungon Creek to Iloilo River. This area, together with the rest of the western bank in Arevalo and Mandurriao districts, are classified as river valleys and therefore, are fine clayey.

Soil type around Iloilo River is classified into three types: Umingan Sandy Loam, Santa Rita Clay and Beach Sand. The southwestern banks on the vicinity of Arevalo and Molo sit on umingan sandy loam. The northwestern bank covered by the district of Mandurriao lie on Santa Rita Clay while portions of La Paz and the whole of City Proper rest on Beach Sand. *(Refer to Map 4)*

Iloilo River played a very important role in the history of Iloilo City. For it would not have been the “Queen City of the South” without its inherent physical location. The sugar industry boomed in the 1960’s because local and international trading vessels frequented the Iloilo Port.

Iloilo River Today

General Land Use

Land use along Iloilo River is a combination of residential, commercial, institutional, open space, fishpond, transport facility and mangrove areas. Based on *Map 5*, commercial and industrial spaces surround Station 1. Commercial buildings and business offices are found in this area with some spaces allotted for institutional purposes like schools. Residential land use is noted on the northern bank where Barangay Obrero and Mansaya are situated. On another end, commercial and institutional spaces dominate the southern bank of Station 2. Prominent business establishments along this area include Sarabia Manor Hotel, Ocean City, Mandaue Foam, Metrobank, Sunlife of Canada, Nena’s Manokan, JD Bakeshop and Restaurant, Residence Hotel, CAP, Health Partners and Caltex Station. Institutional spaces are occupied by hospitals like St. Paul’s and schools such as Assumption College, St. Paul’s College and University of San Agustin. The northern bank of Station 2 is presently used for residential and fishery activities. Stations 3 and 4 are predominantly utilized for fishery activities and salt beds with some residential use on the southern banks. The present land use of areas surrounding Iloilo River is expected to comply with the demand for increased/decreased spaces reflecting changes in people’s interests and activities. *Table 3* compares

Table 3. Existing and Proposed Land Use of Iloilo City

Category	Existing	Proposed
Residential	2,663.84	4,027.80
Commercial	300.44	576.22
Park and Open Space	264.46	386.53
Institutional	236.61	335.52
Agricultural	2,453.26	307
Fish Pond	673.15	2819
Planned Unit Development	-	26167
Proposed Highway	-	258.86
Industrial	4155	235.71
Transport Facility	54.65	142.75
Mangrove	122.9	95
Floodway		42.3
Cemetery	40.08	40.08
S-I		9.88
I/U	8.56	168
TOTAL	**6,880.00**	**7,023.00**

Source: City Planning and Dev't Office, Iloilo City 1998

the existing and proposed amounts allotted for each land use category as gleaned from the recently approved Comprehensive Land Use Plan of Iloilo City. Based on the table, lands needed for housing units are prioritized with the evident increase of space intended for residential use. Shift in the source of livelihood is also inferred because of increased spaces allotted for commercial purposes. In the recent years, trend in urban areas dictate a shift from agricultural activities to commercial businesses because agricultural endeavors are more expensive to undertake than commercial ones.

Map 5 shows the approved zoning of Iloilo City and residential spaces (yellow areas) dominate the area. Majority of these places are in the districts of Mandurriao, Jaro and Arevalo. Commercial zones (red areas) are concentrated on the City Proper district. Sections near the Diversion Road and La Paz are also considered commercial zones. Institutional spaces (dark blue areas) are sporadically situated all over the city. Industrial zones (violet areas) are concentrated in Lapuz, La Paz. It is interesting to note that there are limited sections allocated for open spaces and parks.

It is no surprise then that there is already a significant increase of land use allotted for parks and open spaces in the update of Iloilo City's Comprehensive Land Use Plan. From the existing 264.46, it was increased to 386.53 in the approved land use (see Table 3). This implies the increased need for recreational facilities and green areas. Presently, people have a minimum access to recreation and other form of leisure in the city. Built in the early 1900s, the existing parks can no longer accommodate the burgeoning population. Moreover, these parks are no longer safe for promenaders. It is not at all surprising then that roads and streets throughout the city are "blocked" and utilized for entertainment purposes and social activities such as sports fest, basketball and benefit dance on weekends and holidays.

Socio-economic Aspect

Demography

Majority of the changes occurring in the Iloilo River ecosystem originate from human activity and demographic information of dwellers along the river banks.

Out of the total 180 barangays in Iloilo City, thirty-five (35) are found along Iloilo River. Table 4 enumerates the barangays within 50 meters from the shoreline as adopted in the boundaries set by the DENR-EMB water quality monitoring stations.

Table 4. Boundary of Stations in Iloilo River

Stations	Boundary	Name of Barangays
1	From upper portion of Quirino Bridge and mouth of Iloilo River	Bo. Obrero, Mansaya, Lapuz Norte, Jaladoni Estate, Libertad, Progreso, Concepcion, Monica, Legaspi - dela Rama, Muelle Loney, Arsenal Aduana, Yulo-Arroyo and Pres. Roxas
2	upper portion of IBRD Bridge to Quirino Bridge	Lapuz Sur, Rizal, Laguda, Luna, Nabitasan, Inday, San Agustin, Sampaguita, and Danao
3	upper portion of Carpenter's Bridge to IBRD Bridge	Portion of Tabucan, San Rafael, Tap-oc, San Pedro, Taal
4	Carpenter's Bridge up to upper portion of Iloilo River	Tabucan, Navais, North San Jose, South San Jose, South Fundidor, North Fundidor, Sto. Domingo, Sta. Felomina, Sooc and Mohon

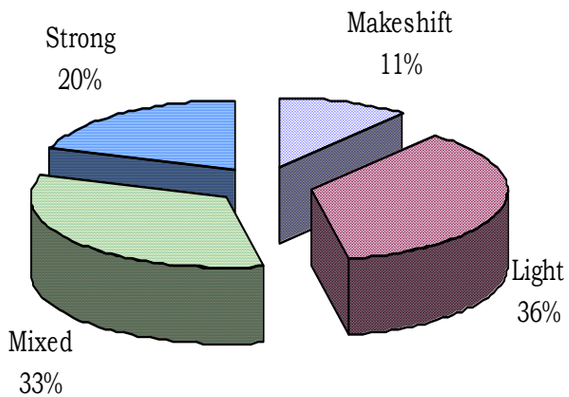
Charts 1, 2 and 3 show the total population of these barangays from censal year 1975 to 2000. There are thirteen (13) barangays located close to the mouth of Iloilo River until the Quirino Bridge belonging to the Iloilo City Proper and Lapuz-La Paz districts. Based on Chart 1, Bo. Obrero has the most number of residents with 6,494 in the year 2000, followed by Barangay Concepcion, Mansaya and Lapuz Norte. The barangay with the least no. population is Barangay Pres. Roxas with 223 in year 2000. It can be observed that there is a ten-year gap between censal years 1980-1999. While a natural increase in population is expected, only a limited no. of barangays showed a significant growth over the years. Barangays like Arsenal-Aduana, Progreso and Legaspi Dela-Rama manifested a negligible increase/decrease.

Unlike the two previous stations, barangays located along Stations 3 and 4 relatively have bigger population. Barangays Tabucan and Navais in Mandurriao and Barangays South San Jose and Sta. Felomina in Arevalo manifested high population values in the year 2000 *(please refer to Chart 3)*. This is expected because almost all subdivisions, housing projects and socialized dwelling properties are located in barangays along this area. In addition, people who prefer to live in the suburbs choose locations in the districts of Mandurriao and Arevalo because it is within significant distance from work, school and utilities but away from the bustle of daytime activities.

Population trends are important in this study because majority of the changes proposed by this master plan affects the lives of quite a number of residents. The movement of population is essential to anticipate the volume of people that will need intervention once implementation of the project is underway. In addition, it gives a glimpse of the actual number of population who has direct access to Iloilo River.

About 36% of the dwelling units along Iloilo River are made of light materials. Houses made of mixed materials comprise almost 33% and approximately 20% are made of strong materials. Only 11% are built with makeshift materials. This is reflective of the peoples' income capacity because majority of them could only afford houses made of light materials.

Chart 4: Distribution of Houses along Iloilo River, by type of material



Most prevalent water source of these barangays are deep wells, MIWD (Metro Iloilo Water District) and open wells. In some barangays where MIWD water is supplied by zone, the barangay government pays for the bills. From a survey conducted by WIT students on informal settlers along Iloilo River, the estimated daily consumption of water is about 4,897 containers. Assuming that each container holds about 5 gallons then families living near the river consume almost 24,385 gallons of water per day. To express that amount in liters or cubic meters, it will be equivalent to about 92,297 or approximately 92.3 m^3 daily. Since this estimate represent the consumption of informal settlers only, the actual amount of water-consumed everyday by all barangays within the proximity of Iloilo River will have to be higher.

Concerning waste disposal, the absence of facilities like toilets and sewerage causes river settlers to dump solid and liquid waste into the water. While commercial establishments' dispose of their garbage through the public collection system, informal settlers either burn or dump their garbage in the river. A good number of households do not have septic tanks so all of their household and livelihood liquid wastes go directly to the water. Among the barangays, San Pedro generates the highest volume of waste, followed by Arsenal-Aduana and Luna.

On health matters, leading cause of mortality includes tuberculosis, cancer, flu, pneumonia, bronchitis and many others. Similarly, most common cause of morbidity is respiratory infection, and illnesses caused by water borne organisms such as diarrhea. Typhoid fever is also prevalent. Cases of malnutrition are noted in some barangays.

Other factors also contribute to the inferior living conditions of the residents. Problems on pollution, flooding due to absence of drainage system, lack of potable water supply, poverty and crimes are just some of those that were identified.

INFORMAL SETTLERS

A survey to profile socio-economic characteristics of informal settlers was undertaken by a group of Community Development students of the Western Visayas College of Science and Technology (WVCST) utilizing the survey instrument prepared by the City ENRO. Information on Iloilo River's informal dwellers is necessary in the preparation of the master plan because implementation of the proposed developments will have a great impact on their lives.

Based on the survey, the largest population of informal settlers comes from Barangay Nabitasan in Lapaz. Barangays Tabucan in Mandurriao and Lapuz Sur in Lapaz also registered quite a good number of informal settlers proliferating in those areas.

It was found that majority of the household heads are aged between 31-40 years old and that male household heads predominate over female household heads in number. Majority of these household heads are high school graduates who are employed either as full timeor as part time workers in various capacities. The most common occupation includes carpenter, utility workers, general laborer, household helpers, overseas workers and drivers of jeepney/taxi/pedicab. Other income generating activities are also engaged in to augment the family income generated from the aforementioned main sources. Among those identified are fishing, food vending, and selling of goods and services. When asked about what business they would want to venture into if given the chance, the most popular responses include sari-sari store business, operate an eatery or a small restaurant, hog raising, run a dress shop, and undertake a buy-and-sell business.

A good portion of Iloilo River offers livelihood opportunities with the presence of the wharf and fishery areas. Data from the City Agriculturist revealed that there are about 68 registered fishermen in the city. They usually spend a little less than eight hours a day in fishing and devote at most 14 days a month doing such. On the average, the volume of fish catch is 2.446 kilograms per day or 34.24 kilograms a month. From the sale of their catch, they earn an average oF PhP195.68 a day based on PhP80.00/kg product price. If they fish for 14 days, they get an average income of PhP2,739.52 a month.

There are at least four types of fishing gears used for fishing in Iloilo River. These are fish corrals, gill nets, motorized push nets and enclosure *(cerrada)*. However, the most prevalent are fish corrals with 58 units and motorized push nets with 17 units. The catch data per fishing gear type is described in table 5.

Table 5. Catch data per type of fishing gear

Type of Gear	Peak	Lean	Hours	Species Caught
Fish Coral	3-5 kgs	.1-2 kgs	3-11	Shrimps, Crabs, Bangus, Tilapia
Motorized Push Nets	2-6 kgs	.5-3 kgs	1-12	Shrimps
Gill Net	.5-2 kgs	.1-5 kgs	8	Tilapia, Mullets, Bangus
Enclosure Net	.1-5 kgs	.05-1kgs	3	Shrimps, Crabs, Mullets, Bangus, Tilapia

There also exist fishponds all over Iloilo River. The unique feature of Iloilo River as an estuarine body of water makes it ideal source for brackish water. However, the proliferation of fishponds meant the destruction of mangrove species that could have been supportive to the ecological health of Iloilo River.

Based on the data provided by the City Agriculturist, there are a total of 634.05 hectares of land devoted to fishponds operation managed by 80 operators in Iloilo City. Of the total fish pond areas, 47 hectares are found in Station 2; 91 hectares are located in Station 3; and 40 hectares are within Station 4. Big portions of these fishponds are prevalent in Sta Cruz, Yulo and Dulonan in Arevalo; and Loboc and Hinactacan in Lapaz. Most common species cultured are bangus, prawns, and tilapia.

A program of President Gloria Macapagal-Arroyo through BFAR Reg. 6 gave out fishing gears to various fisher beneficiaries in Iloilo City. Sixteen of these beneficiaries live in barangays near Iloilo River.

Environment

At present, the Iloilo River has become the septic tank, sewage system and dump site of various communities abounding the riverbank. Storm water carrying sewage water from households as well as canals from Jaro, Mandurriao, City Proper, Arevalo and Iloilo reaches the river through the three creeks, Calajunan, Dungon and Rizal. It carries with it all the pathogens and nutrients, which will serve as food source for other organisms found in the river. Industries, restaurants, slaughterhouse, hotels, hospitals, shipbuilders, shipping industries, private residential houses, department stores and others utilize Iloilo River as drainage out fall. To some, it serves as dumpsite and sewerage system. Decomposing organic matter from these sources provide more food for all the aquatic organisms in the river. Increase in its population increases demand of oxygen. Fortunately, Iloilo River has a flushing mechanism being a tidal inlet. Thus it brings in fresh supply of oxygen and nutrients for these organisms, lowering concentration of pollutants by dilution and flushing other liquid and solid wastes into the sea.

It is not at all surprising then that river composition alters. Its physical and chemical characteristics allow living organisms to settle, and change some characteristics of the river. Among the organisms, human beings were the only ones able to create so much alteration so that Iloilo River has changed in terms of flora and fauna, physical structure of the riverbanks and aesthetics.

Water Quality

Water quality is viewed on a layman's viewpoint as the physical attributes of a body of water. Water is conventionally clean when it is clear and free from unsightly floating materials. On another hand, polluted water body is black in color, very murky and has a distinct stench. Garbage and oil; floating feces and dead animals; and decrease in number and diversity of living organisms are often observed.

However, water quality from the point of view of scientists, is a degree in which a water body meets the criteria of its intended use. These criteria are the narrative descriptions of the physical, chemical and biological parameters which are based on scientific information. The physical parameters include color, temperature, solids, turbidity, oils and grease. Chemical parameters are comprised of biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), total organic carbon (TOC), salinity, pH, heavy metals, nutrients (N,P,K) and pesticides. Biological parameters, on the other hand, consist of counts of coliforms, fecal coliforms, and species pathogens and viruses.

The Department of Environmental and Natural Resources (DENR) through the Environmental Quality Division of EMPAS, Region VI monitors and evaluates the water quality of Iloilo River. This agency ensures that the existing quality of water bodies comply with the prescribed water quality standards.

Since Iloilo River is a "Class C" body of water, DENR – DAO No. 34 provides the following quality criteria for Class C water:

Table 6: Water quality criteria for Class C water

Parameter	Unit	Criteria Value
Color	Pcu	50
Temperature	°C	3 maxvise
Turbidity	M	1
Total solids	mg/L	2,000
Oil and grease	mg/L	2
pH	-	6.5 - 8.5
Dissolved Oxygen	mg/L	5
Biochemical Demand Oxygen	mg/L	10
Phosphate & Phosphorous	mg/L	0.4
Nitrogen as Nitrate	mg/L	10
Total Coliform	MPN/100 ml	5,000
Copper	mg/L	0.05
Arsenic	mg/L	0.05
Cadnium	mg/L	0.01
Chronium	mg/L	0.05
Cyanide	mg/L	0.05
Lead	mg/L	0.05
Total Mercury	mg/L	0.002
Silver	mg/L	0.05
Zinc	mg/L	2

Water samples are taken during both dry and wet seasons and sampling is conducted once every quarter from January to December. DENR maintains four sampling stations:

Station No.	Location
1	Parola, Muelle Loney
2	Quirino Bridge
3	Sen. Benigno Aquino Ave. Bridge
4	Carpenter's Bridge, Mandurriao

Unpolluted water is clear and characterized by high dissolved oxygen concentration, low BOD, low coliform counts, low of concentration of heavy metals, and pesticides and high diversity of species. On the other hand, polluted water is marked by low DO levels, high BOD and nutrient concentrations, high coliform counts, high concentration of heavy metals and pesticides, odor formation and black coloration.

Results of water quality tests of Iloilo River from the year 1995-2001 are discussed in the following paragraphs.

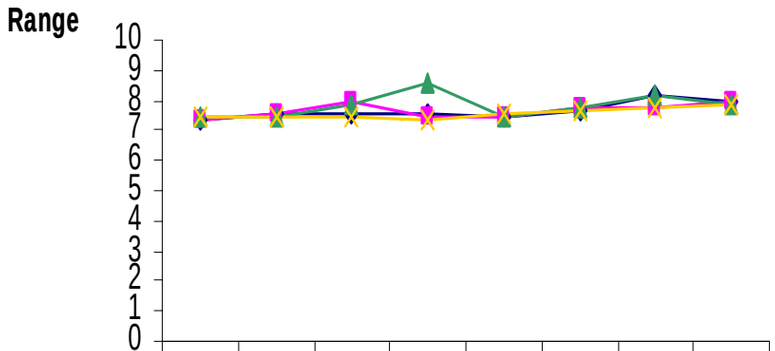
Physical Characteristics

pH

One of the important parameters in determining good water quality is acidity or "pH" level. Very high or very low pH values are unsuitable for most aquatic organisms. Young fish and immature stages of aquatic insects, for example, are extremely sensitive to pH levels below 5 and may die if it goes even lower. High pH levels (9-14) can harm fish by denaturing cellular membranes

Chart 5:

Average annual acidity (pH) of Iloilo River



	1995	1996	1997	1998	1999	2000	2001	2002
Station 1	7.3	7.6	7.6	7.6	7.5	7.7	8.2	8.0
Station 2	7.3	7.6	8.0	7.4	7.5	7.8	7.8	8.0
Station 3	7.5	7.5	7.9	8.6	7.5	7.8	8.2	7.9
Station 4	7.4	7.4	7.5	7.3	7.6	7.7	7.8	7.9

Year

Changes in pH can also affect aquatic life indirectly by altering other aspects of water chemistry. Low pH levels accelerate the release of metals from rocks or sediments in the stream. These metals can affect a fish's metabolism and its ability to take water in through the gills, and can kill fish fry.

Chart 5 shows the average annual acidity of Iloilo River since 1995-2002. From the chart, the pH value 7.3 in 1995 along Parola area increased to 8.2 in 2001. In the same manner, pH levels in Stations 2, 3 and 4 have increased in 2001 compared to its 1995 values. Over the years, however, pH values in Parola area are more stable than all other sampling stations. The average value recorded in Station 3 was high in 1998 with 8.6 and 2001 with 8.2. In 2002, values notably decreased in Stations 1 and 3. While these values are still within the prescribed acidity range, it is already on risky level and water quality is at threatened unless appropriate measures are taken.

Some factors affecting water acidity include geology and soil of the area; air pollution and concentration of carbon dioxide in water. In the case of Iloilo River, the influx of salt water from Iloilo Strait caused the slight alkalinity of the water.

Temperature

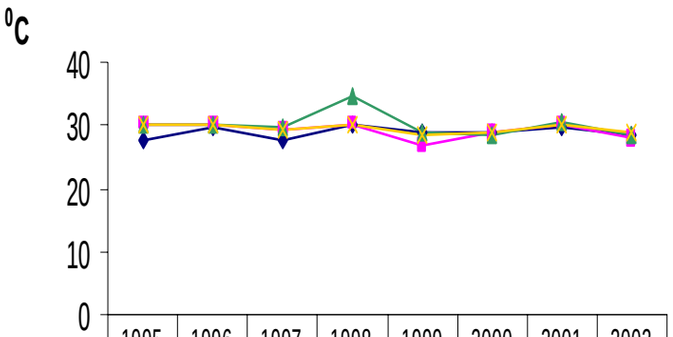
Temperature is also an important factor in determining water quality. It controls the rate of metabolic and reproductive activities and it determines which species will survive. It also affects the concentration of dissolved oxygen and can influence the activity of bacteria and toxic chemicals in water.

Chart 6 shows the average surface temperature of Iloilo River from 1995-2002. Based on the table, the average water temperature in Station 1 increased from 27.6 ^{o}C in 1995 to 29.7 ^{o}C in 2001. On the contrary, Stations 2, 3 and 4 have maintained the rate of 30 ^{o}C for the year 1995 and 2001. Notably, all values dropped in 2002.

The temperature in between years varied from 27 ^{o}C to 34 ^{o}C. Station 2 got the lowest temperature of 27 ^{o}C in 1999 and Station 3 registered the warmest temperature of 34.6 ^{o}C in 1998.

The rise and fall of water temperature is affected by the presence of riparian vegetation and paved surfaces like roads; amount of industrial discharges and sewage outflow; and the speed of water flow.

Chart 6 Average temperature of Iloilo River



	1995	1996	1997	1998	1999	2000	2001	2002
Station 1	27.6	29.5	27.7	30.0	29.0	29.0	29.7	28.3
Station 2	30.0	30.0	29.2	30.0	27.0	29.0	30.3	28.1
Station 3	30.0	30.0	29.7	34.6	28.8	28.6	30.7	28.5
Station 4	30.0	30.0	29.3	30.3	28.4	29.0	30.3	28.8

Year

Total Suspended Solids

Another significant physical characteristic of water is total suspended solids. Total suspended solids or TSS are particles in water that can be trapped by a filter. It can refer to silt, decaying plants and animal substance; industrial wastes and sewage.

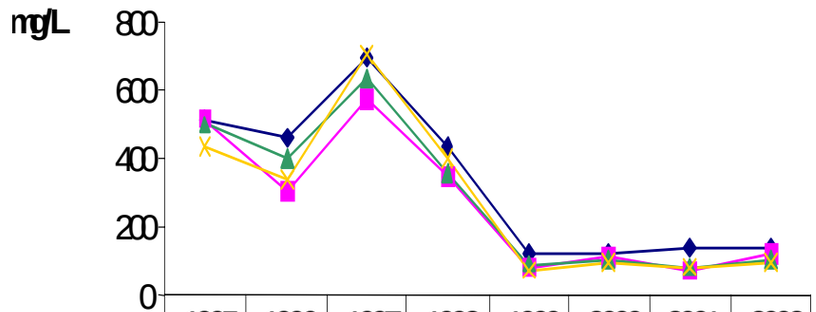
In the past 7 years, Iloilo River has not complied with the TSS standard of 10 mg/l. Average TSS results from 1995-2002 are shown in Chart 7 and it can be observed that values are high and erratic. Suspended solids in Station 1 ranged from 124 mg/l to 691 mg/ while in Station 2 sampling station it ranged from74 mg/l to 578 mg/l. The area near the Station 3 has TSS ranging from 85 mg/l to 630 mg/l and along Station 4, it ranged from 75 mg/l to 704 mg/l. Interestingly all the sampling stations registered high TSS values in 1997. But it can be noted that values have dropped significantly from 1999-2001 as compared to values from 1995-1998. This may be the result of clean-up efforts of concerned government agencies like the Iloilo Coast Guard Auxiliary Station. However, all these projects are again wasted with the rise of TSS values in 2002. From the four areas covered in the water quality monitoring, the Station 1 consistently has the highest values from 1995-2002.

High concentrations of suspended solids threaten the river's health and aquatic life. The process of photosynthesis is slowed down when light is prevented from reaching submerged vegetation or if light passing through the water is reduced. When this happens, there is less dissolved oxygen released into the water by plants. In some instance, the lack of light will cause plants to die and as it decomposes, bacteria will use up even more oxygen from the water. Since there is less dissolved oxygen present in water, fish kill results.

High TSS also causes surface temperature of water to increase because suspended solids absorb heat from sunlight. With warmer water, levels of dissolved oxygen fall and again life of aquatic species are threatened.

Chart 7

Average annual total suspended solids (TSS) of Iloilo River



	1995	1996	1997	1998	1999	2000	2001	2002
Station 1	520	460	691	436	127	124	142	138
Station 2	520	310	578	350	82	116	74	122
Station 3	500	400	630	358	93	106	85	107
Station 4	430	340	704	404	75	104	84	102

Year

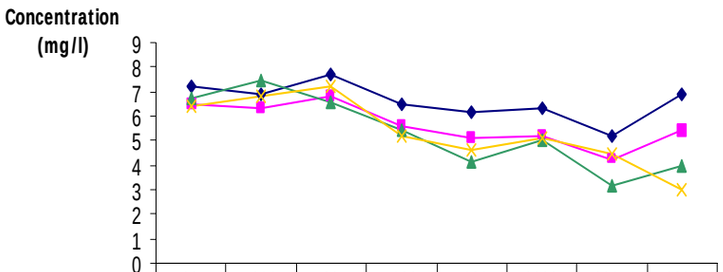
Solids that were dissolved but remain suspended in water may come from those elements carried by the running water during rainy season or from the garbage that are dumped by inland settlers found along the river. TSS may also affect turbidity and color of water.

Chemical Characteristics

Dissolved Oxygen

Dissolved oxygen or DO is an important indicator of a water body's ability to support aquatic life. Oxygen enters water through two ways: direct absorption from atmosphere and through photosynthesis. Conversely, respiration and decomposition of organic matter removes oxygen from water.

Chart 8 **Average annual dissolved oxygen (DO) of Iloilo River**



	1995	1996	1997	1998	1999	2000	2001	2002
Station 1	7.2	6.9	7.7	6.5	6.2	6.3	5.2	6.9
Station 2	6.5	6.3	6.8	5.6	5.1	5.2	4.2	5.4
Station 3	6.7	7.5	6.6	5.4	4.1	5.0	3.2	4.0
Station 4	6.4	6.8	7.2	5.2	4.6	5.1	4.5	3.0

Year

Chart 8 displays the dissolved oxygen results of Iloilo River from 1995-2002. Compared to the other three sampling areas, the dissolved oxygen level in Station 1 is relatively high. This is due to the constant change of water brought about by tide activity and high wave current in the area. DO levels in the other three sampling stations complied with the prescribed standard for Class "C" water which is 5 mg/l. However, there was an instance in 1999, where Stations 3 and 4 got low DO levels with 4.1 and 4.6 respectively. Comparing the DO levels over the years, all sampling stations got the lowest results in 2001. In 2002, DO in Station 4 registered the lowest value in years. This is a reason for concern because some species are intolerant of low oxygen. Eventually, species that are more tolerant to low oxygen will replace the sensitive species, thereby reducing the diversity of aquatic life forms. When dissolved oxygen level goes below 2mg/l for even a few hours, fish kill results.

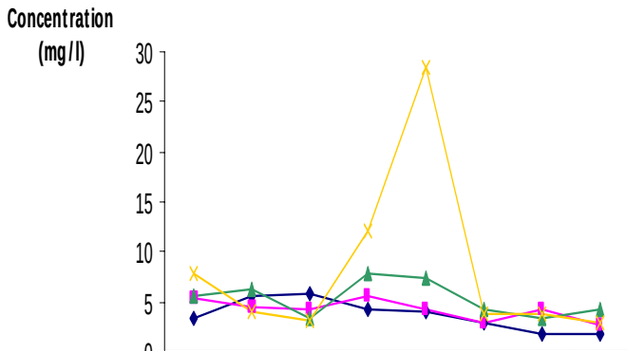
Other factors that affect DO include volume and velocity of water flowing in the water body; climate/season; dissolved or suspended solids; and organic wastes.

Biochemical Oxygen Demand

Biochemical oxygen demand is the commonly used parameter for determining the oxygen demand on receiving water of a municipal or industrial discharge and utilized to evaluate the efficacy of the treatment process. Also referred to as BOD, it is also an indirect measure of biodegradable organic compounds in water.

Chart 9 details the BOD test results from 1995-2001. Observing the trend over the years, BOD levels are very erratic. In Station 1 for example, BOD values increased in 1996 and 1997 from a 3.4 mg/l in 1995 but continuously decreased in 1998 to 2002. This means that the microbial activity near the mouth of the river is very little as manifested by the very low BOD values.

Chart 9 **Average annual biochemical oxygen demand (BOD) of Iloilo River**



	1995	1996	1997	1998	1999	2000	2001	2002
Station 1	3.4	5.5	5.8	4.2	4.0	2.9	1.7	1.7
Station 2	5.4	4.5	4.2	5.7	4.2	3.0	4.2	2.7
Station 3	5.7	6.3	3.3	7.9	7.4	4.2	3.3	4.3
Station 4	7.9	4.0	3.2	12.1	28.4	3.9	3.7	3.0

Year

Station 2 showed an equally unpredictable trend. Its BOD improved in 1996 and 1997 after registering a high 5.4mg/l in 1995. In addition, the last three years (1999-2002) have continuously improved after a high 5.7 mg/l in 1998. This indicates that decomposition of organic matter is quite low and only a very small quantity decomposed because the oxygen demand is also low. The areas in Stations 3 and 4 show almost the same trend of BOD over the years. Both areas obtained high BOD levels in 1998 and 1999. The presence of mangroves and commercial fishing activities in those areas contribute to the high oxygen demand.

The study prepared by WOOD Field consultant for EIS for the Flood Control of Iloilo City includes analysis of chloride as Cl in mg/l and phenols in mg/l. The test was made in 1994 and the results are shown in Table 7.

On the other hand, Table 8 summarizes the test results of other chemical content of water in Iloilo River. This data are results of the leaching test conducted by Ostrea Mineral Laboratory Inc., in Metro Manila on test samples taken from Iloilo and Jaro Rivers from May 28 to June 2, 1999.

The test involves determination of presence of heavy metal in Iloilo River. Based on the table, values in the middle and lower areas did not exceed the prescribed standard.

Table 8: Heavy metal analysis in Iloilo River, 1995

Parameter	Standard	Middle	Lower
O – Hg	Not detected	<0.0002	<0.0002
T – Hg	0.0005 mg/l	<0.0001	<0.0001
Cd	0.1mg/l	<0.003	<0.003
Pb	0.1mg/l	<0.01	<0.01
O – P	1mg/l	<0.0001	<0.0001
Cr	0.5 mg/l	<0.01	<0.01
As	0.1mg/l	0.01	<0.021
CN	1mg/l	<0.005	<0.005

Source : DENR Region 6

The chloride concentration of Iloilo River is higher than the standard value of only 350 mg/l and is relatively high at the center and the middle portion of the river during the months of July and August. At the lower portion samples registered high Cl concentration also. This probably comes from surface waters that reach into the river during heavy rains.

The water quality of Iloilo River's two important tributaries are also discussed.

Calajunan Creek

Calajunan Creek is the recipient of liquid wastes coming from Pepsi Cola Products, Visayan Coco Development, domestic sewage and lechate from the City's dumpsite. DENR has classified it as Class D but others insist it to be Class C because it discharges in Iloilo River, which is a Class C river. Table 8 shows the summary of monitoring at Calajunan Creek from September 1995 to April 1996 as conducted by EMPAS-DENR now EMB. The pH and temperature readings obtained from the various locations along Calajunan creek show that it conforms with the standard criteria even for Class C waters except for the total suspended solids which exceeds the maximum value. Total dissolved solids' is also high in station 5 and at Brgy. Sooc. This is due to sea water reaching into this part of the creek. Color is quiet higher at the downstream portion of the Visayan Coco and Brgy. Sooc.

Table 7: Results of Water Quality Analysis for Iloilo River

	Middle Reach						Lower Reach					
Parameter	Center			Side			Center			Side		
	Jun-94	Jul-94	Aug-94	Jun-94	Jul-94	Aug-94	Jun-94	Jul-94	Aug-94	Jun-94	Jul-94	Aug-94
Chloride Cl (mg/l)	4,000	16,895	16,985	3,950	5,498	5,498	13,550	5,598	5,598	15,300	18,394	18,394
Phenols (mg/l)	0.003	<0.001	<0.001	0.003	<0.001	<0.001	0.001	0.003	0.003	0.002	0.005	0.005

Table 9: Summary of Monitoring at Calajunan Creek by EMPAS - DENR
September 1995 - April 1996

Station	Location	Color	Temperature	pH	TSS	TDS	DO	BOD
No.		(units)			mg/L		mg/L	mg/L
1	Upstream of Pepsi Cola	17.5	29	-	164	175	10.2	6.85
2	Downstream of Pepsi Cola	27.5	28.5	7.8	115	512	2.62	184
3	Downstream of Visayan Coco	48	28.4	6.8	126	988	2.32	747
4	Hibao-an Creek	25	28	7.4	211	276	6.62	8.74
5	Calajunan/Oton	24.17	28	7.7	127	2370	6.63	52.9
6	Brgy. Sooc	37.5	29.8	7.5	224	5460	6.98	15.2

Source : EMB - Region 6

Table 9 show the results of physical of characteristics of quality analysis taken by the consultants of SWEEP Project taken from the three sampling stations near the Iloilo City's dumpsite: upstream and downstream.

The analysis show the pH level still within the standard for Class D River. However, color is noted to be higher in the upper portion of the dumpsite in the month of January because of the wastewater discharges of Pepsi Cola Bottlers and Visayan Coco. The lechate that seeps through the creek also contribute color to the waste flowing in the river. However, this is diluted to the large volume of water as it flows towards the Iloilo River.

High TDS value is attributed to the salt water that reaches the upper portion of the creek. This is usually takes place in the month of March. The value of the total suspended solids (TSS) is also observed to be higher than the standard value.

For the chemical content, consultants of the SWEEP project analyzed water samples from the identified stations in Calajunan Creek from September 1995 to April 1996. The water quality report showed that dissolved oxygen (DO) concentration at the down stream portions of Pepsi Cola and Visayan Coco are below the standard of 5.0 mg/L. In fact, the upstream and downstream of the Calajunan dumpsite has zero values in June 1998. This confirms the high organic load of the water coming from the bachate of the dumpsite, Visayan Coco and Pepsi Cola Bottlers causing its high organic content. The highest BOD reading is noted month of June.

Table 10: Physical characteristics of water in Calajunan Creek, 1998

Parameter	Mid Upstream				Downstream		
	Mar-98	Jan-98	Mar-98	Jun-98	Jan-98	Mar-98	Jun-98
pH	8.1	8.1	8.4	n/a	8.2	7.9	n/a
Color (pcu)	30	1000	25	50	250	25	50
TDS mg/L	25.005	n/a	52,923	795	n/a	2,104	792
TSS mg/L	110	373	114	20	73	109	70
Settleable							
Solids mg/L	n/a	n/a	n/a	15	n/a	n/a	1

Source: SWEEP, EIA Calajunan Dumpsite

Heavy metals such as As, Cd, Cu, Fe, Pb², Hg, Al, and Cr are present in the creek. Table 11 details the heavy metal concentration of the water including that of chlorides and BOD and DO values.

Chlorides and phosphates concentration exceeded the minimum standards set for class C and D waters. Heavy metals like As, Pb, and organic mercury are toxic to human beings. However, concentrations of these metallic elements in the water are less than the minimum allowable concentrations.

Table 11. Detailed heavy metal concentration of Dungon Creek

		Midstream	Downstream Of Dumpsite			Upstream of Dumpsite		
Parameters	**Std. Values**	**Mar-98**	**Jan-98**	**Mar-98**	**Jun-98**	**Nov-98**	**Mar-98**	**Jun-98**
BOD mg/L	10	26	N/a	37	50	N/a	4	60
DO mg/L	5	1	N/a	1	0	N/a	5	0
PO4 P mg/L	0.4	2147	N/a	3108	N/a	138	109.25	N/a
Total N mg/L	10	N/a	64.96	N/a	N/a	6.44	N/a	N/a
Cl mg/L		13,306	16,537	29,076	N/a	180.89	870.39	N/a
As, ppm	0.05	0.023	N/a	0.01	N/a	N/a	<0.001	N/a
Cd, ppm	0.01	0.053	0.055	0.093	<0.003	<0.003	<0.005	0.03
Cu, ppm	0.05	0.108	0.134	0.216	0.03	<0.005	<0.005	0.03
Fe, ppm		N/a	1.141	N/a	1.796	3.335	N/a	2.984
Pb, ppm	0.05	0.354	0.307	0.556	<0.02	<0.002	<0.002	<0.02
K, ppm		300.437	457.09	577.029	N/a	20.628	61.995	N/a
Hg, ppm	0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cr, ppm	0.05	N/a	N/a	N/a	<0.01	N/a	N/a	<0.01
Al, ppm		N/a	N/a	N/a	4.808	N/a	N/a	7.05

Source: EIS, Calajunan Dumpsite, SWEEP, Test consultants

N/a = not analyzed

Dungon Creek

The information on Dungon Creek's water quality is culled from the study on River Environment Improvement Solid Waste Management Plan last September 1999. According to the book, organic load in Dungon Creek is evident because of the 54 mg/l BOD value in the upper reaches and 44 mg/l in the lower reach. Apparently, these pollutants flush into Iloilo River and subsequently into the sea during the rainy season. In addition, certain areas in the creek specifically in Bolilao-Jalandoni Bridge have depleted dissolved oxygen. The water in this area is nearly anaerobic as manifested by the dark coloration due to the black pigmentation. Liquid waste in this area is a combination of domestic industrial, commercial and institutional wastes. Moreover, phenol concentration is slightly over the standard in value 0.02 mg/L in the lower reach of Dungon Creek.

Flora and Fauna

Birds

There are at least six species of birds existing in the Iloilo River ecosystem. These are Kingfisher, Maya, Trivis, Tikling, Tigbabalang, and Tarurok. However, the continued deterioration of mangrove population and loss vegetation cover along the river threatens the survival of these species.

Flora

Patches of mangroves still abound in Iloilo River. Majority of it are found in Station 3 from Molo Bridge until just below Brgy. Nabitasan, Lapaz. In addition, leech growth of mangroves also proliferates at the mouth of Dungon Creek until a portion of Brgy. Cuartero. Among the species identified are nipa (Calajunan Creek), alipata (or Avicennia), Bakhaw (or Bahowan), Bali-Bali. Table 12 hows selected barangays along Iloilo River with mangrove species and the quantity thriving in the area. The necessity of preserving these mangroves is foremost in this master plan because of its natural support to the river ecology.

Table 12. Listing of Mangrove species along Iloilo River

Barangay	Species	Population	Barangay	Species	Population
1. So-oc, Arevalo	Bakhaw		6. Tabucan, Mandurriao	Pagatpat	11
	Pagatpat				
	Bungalon		7. San Rafael, Mandurriao	Alipata	6
	Alipata			Pagatpat	9
				Bungalon	20
2. Sta. Felomina, Arevalo	Bakhaw			Bakhaw	12
	Pagatpat				
	Bungalon		8. South San Jose, Molo	Bungalon	50
	Alipata			Pagatpat	28
				Bali-Bali	2
3. Sto. Domingo, Arevalo	Bungalon			Alipata	8
	Tabigi			Bakhaw	16
	Alipata				
	Gaway-gaway		9. North San Jose, Molo	Bungalon	46
				Pagatpat	23
4. Nabitasan, Lapaz	Bungalon			Alipata	13
5. San Pedro, Molo	Bakhaw	12	10. Libertad, Lapaz	Bungalon	39
	Pagatpat	8		Bakhaw	23
	Bungalon	9			
	Alipata	7			
	Balabago	5			

Fish Species

A study conducted by Kahublagan sa Panimalay (KSPFI) in 1998 revealed several fish species that exist in Iloilo River. Among those abundant in the upper portion of the river are fin fishes like sea bass, milkfish, catfish, tilapia, and grass carp. Moreover, fisher folks fishing in Iloilo River mentioned on an interview done by some WIT students, other species that could also be found such as sili-sili, nipa-nipa, gamya, uldok, bagtis, gusaw, palo-palo, and bulan-bulan. There also exist fresh water species like pantat, gurami, and mudfish. A good volume of fish catch is evident in the district of Arevalo particularly in barangays Sooc, Sta. Felomina, and Sto. Domingo. Average daily fish catch in the barangays vary from a maximum of 52 containers to only two kilos to one pail.

Crab and shrimp species also inhabits Iloilo River as confirmed by a study done by KSPFI in 1995. Particularly, KSPFI identified mud species like mud crab, fiddler crab, and hermit crab.

Bentic organisms like shells are similarly found in the muddy portions of the Iloilo River especially in the mangrove area. This was revealed in a recent survey done by WIT students and species like saka-saka, bagongon, susu, were identified as most common in areas near fishponds. River banag and igi also thrives and bornacles are observed in the upper portion of the river. Other shellfish noted in Iloilo River includes oysters, green shells and mudclams.

There is a need to support, regulate and monitor fishery activities along Iloilo River because it is still a good source of food and livelihood.

Infrastructure and Transportation

Roads and Bridges

Iloilo City has a 156,547 km. road network of concrete, asphalt and gravel facilities and about 16 bridges that make up the land transportation network. A National road run parallel to Iloilo River's length and a combination of city and barangay roads make up the southern bank. Only a limited number of access roads are found in northern banks because almost all the areas there are utilized for aquaculture activities. Accessibility to the riverbank is limited to the promenade area near the wharf.

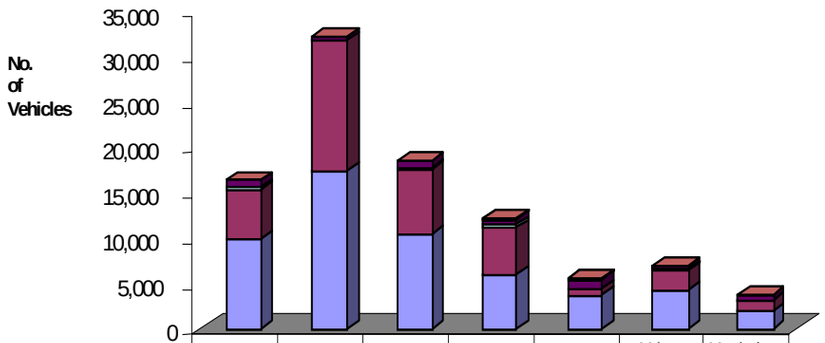
Five bridges cut across Iloilo River. These are Carpenter's Bridge in Mandurriao, Iloilo Benigno Aquino Bridge in Diversion Road; Forbes Bridge and Sen. Franklin Drilon Bridge in La Paz; and Quirino-Lopez Bridge in City Proper.

In general, there is indeed a need for improved circulation to increase mobility in Iloilo City. Perennial problems in transportation include absence of road signs, road obstructions, and inadequate road network. With the expected increase in population, improved trade and diversity of activities engaged in by the people, there is indeed a need for more road networks and alternative links.

Traffic

Iloilo City already exceeded its capacity in accommodating vehicles because of changes in its level of service. Presently, Iloilo City's annual average daily traffic in major links is shown in Chart 10.

Chart 10: Annual Average Daily Traffic (AADT) in Iloilo City, 2000



	Jaro-Leganes	Iloilo-Jaro	Molo-Arevalo	Jaro-Pavia	Jaro-Dversion	Molo-Mandurriao	Mandurriao-San Miguel
Arti Truck	9	6	1	11	6	1	2
Rigid Truck	721	388	827	648	922	358	575
Big Bus	290	0	47	263	68	13	1
Mini Bus	0	1	10	4	4	15	2
Jeepney	5,414	14,469	7,317	5,368	662	2,214	1,295

Road Section

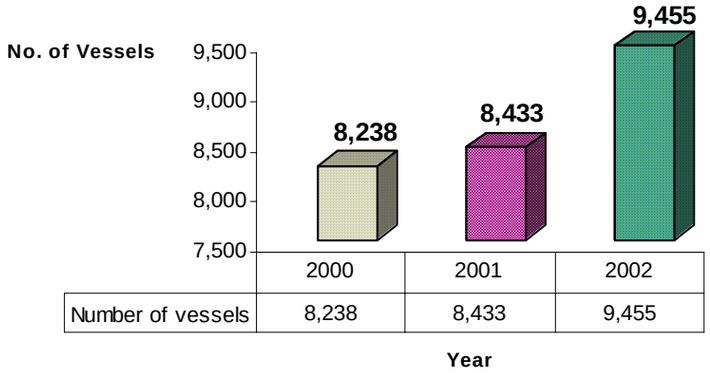
From the table, the road section from Iloilo to Jaro has the most number of traffic with 32,205 vehicles daily. This section is followed by Molo-Arevalo, Jaro-Leganes and Jaro-Pavia. Cars and jeepneys have the most number of units present on the streets.

Iloilo City is not spared of the problem on traffic congestion. Although the level is not the same as that of Manila, a lot of factors like population, business activity, and increased number of vehicles contribute to the gradual rise. While some people consider traffic a good indication of progress, the adverse effects are more damaging. Traffic congestion increase the number of traffic related accidents. For one, the behavioral characteristics of Filipino drivers make things difficult on the streets. Delays on scheduled appointments cause patience and temperament to flare up. Money and time is wasted with the prolonged wait on the road. There is also the increased utilization of fuel. With the frequent stop and go, vehicles exhaust more fumes that concentrate on one area. Respiratory diseases and other health problems are natural consequences of air pollution. The long-term effect of pollutants to the environment is also a huge reason to be concerned.

Serious measures to address traffic problems need to be undertaken. Alternative roads and links can help but an urban transport development master plan is needed to provide long-term solutions. In addition, the institutional mechanism needs to be strengthened.

ILOILO RIVER WHARF

Chart 11: Total Number of Vessels Serviced by Iloilo River Wharf (2000-2001)

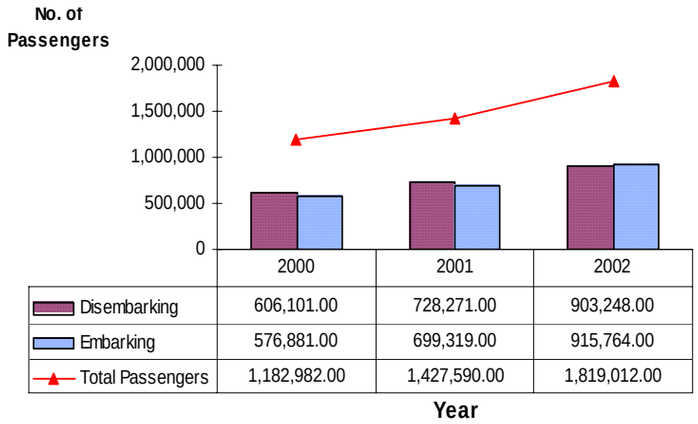


Iloilo River wharf occupies about 68,000 square meters of land and is presently managed by the Philippine Ports Authority. The wharf offers various facilities like warehouse, berthing space, storage, and container freight station. Over the past three years, the total number of vessels *(per ship call)* docking at Iloilo River wharf has grown significantly *(see Chart 11)*. In 2002 alone, there is a 10.8% increase in the vessels serviced by Iloilo wharf. Vessels docking at the wharf vary from passenger, general cargo, fishing, barging and towing vessels. Cargo boats usually carry agriculture (rice, fruits and vegetables), chemical and petroleum products. About 67% of these come from Bacolod and 33% come from various places like Cebu, Palawan, Iligan, Zamboanga and Manila.

Sizes of sea crafts that frequent Iloilo River wharf vary depending on their specific use but normally they have an average length of 33 meters, beam of 8 meters and draft of about 1.5 meters. The average service time of these boats at the Iloilo River wharf is two hours. This means a vessel takes about this much time to load/unload passengers and/or cargo, and do necessary maintenance procedures.

Fast crafts that transport Iloilo-Bacolod passengers and vice-versa, average to almost three to four trips a day. The designated docking station for these passenger vessels, as provided by the Philippine Ports Authority in the Iloilo River wharf, is located at Muelle Loney. Chart 12 discloses the average count of passengers disembarking/ embarking these boats. Based on the chart, there is an increase in the total passengers in 2002. Actually, there is an increasing trend of passenger population in the last two years. However, the number of passengers disembarking in the year 2000 and 2001 is more than the number of passengers embarking. This usually happens when some passengers have longer destinations and experience more than one ship call. Interestingly, the quantity of disembarking passengers dropped in 2002 and embarking passengers registered a higher figure.

Chart 12. Distribution of Passengers in Iloilo River Wharf



Iloilo River has indeed a dynamic environment but because of its inaccessibility to the public, only a few people enjoy the rewards. Now that it is starting to manifest deterioration, the whole community of Ilonggos must come together and do whatever is necessary within their means to bring back life in Iloilo River. With the expected increase in population, business activity, environmental awareness and demand for recreational spaces, Iloilo River development is the way to the future.