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PREDICTION OF SEDIMENTATION IN KAPTAI RESERVOIR

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... ABSTRACT

The study has been conducted to predict the sediment deposition and annual sedimentation rate for the Kaptai reservoir at Rangamati which lies in the south-eastern portion of Bangladesh and its catchment area is 11003 sq.km. Sediment distribution pattern at different depths and the expected life of the reservoir has also been estimated. Prediction model has been used to investigate the sediment deposition and sedimentation rate using available reservoir inflow data collected from the Karnafulli Hydropower Station. The important variables that influence the siltation in the study area are also carefully investigated and analysed. A Prediction model developed by Swamee has been used to determine the sediment deposition and silting rate of Kaptai reservoir. The rates obtained by field measurement and Prediction model are 3.33 and 4.09 ha-m/100 sq.km/year respectively. Validity and applicability of the model was then tested by comparing with field data. In the light of comparison made between the sedimentation rate obtained by both the method, it seen that the Prediction model can be applicable to the Karnafulli reservoir with reasonable accuracy.. Sedimentation rate was also estimated by using Joglekar's, Khosla's, Garde and Swamee's equation and these results were compared with the results of Prediction model and actual measurement. It is found that the maximum amount of sedimentation rate by Joglekar's equation is 6.4 ha-m/100 sq.km/year and the minimum amount of this rate by Garde and Swamee's equation is 2.25 ha-m/100 sq.km/year of watershed area. Percentage discrepancy ratio among this empirical equations with Prediction model varies from -56.48% to 41.56% and this ratio between three empirical equations and Prediction model with field measurement varies from 22.82% to 32.43 %. The sediment distribution pattern at different water level has also been estimated by using empirical area-reduction and area-increment methods. It is also found that the percentage of discrepancy ratio of sediment volume at different elevations by both the methods varies from 0.05 % to 25.19 %. Such range of variation is not significant compared to the size of reservoir. So, any one of this two methods may be suggested to determine the distribution pattern of the reservoir. Dead storage space of the reservoir was determined and it is found 47.35% of the total reservoir space. Finally, expected life of the reservoir has been predicted by the method provided by Khagawa University, Garde and Swamee's equation and Step method which is related to the Brune's trap efficiency curves. It is observed that the expected life of the reservoir by using this methods are 312, 4527 and 1110 years respectively. Method provided by Khawa University obtained by 312 years has been chosen for estimating the life of the Kaptai reservoir due to safety factor. Finally it may be observed that the Kaptai reservoir will be completely filled up by sediment within 312 years.

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LIST OF NOTATIONS AND SYMBOLS

Symbols	:	Meanings
A	:	Catchment area
A_0	:	Area at zero elevation
A_p	:	Relative sediment area
B	:	Width of the reservoir at full water level
C	:	Dimensionless constant
C/I	:	Capacity-inflow ratio
DA	:	Drainage Area
H	:	Original reservoir depth from the stream bed level
H_0	:	Height to which the reservoir is completely filled with sediment
Ha-m	:	Hectare metre
ICOLD	:	International Commission on Large Dam
KHP	:	Karnafuli Hydro-Electric Project
KHS	:	Kaptai Hydropower Station
L	:	Length of section
L/B	:	Left end bank
MSL	:	Mean sea level
m^2	:	Square meter
Mm^3	:	Million cubic meter

P	: Power production
$\bar{P}$	: Average annual rainfall
PDB	: Power Development Board
PWD	: Public Works Department
$\bar{Q}$	: Mean annual flow
Q_i	: Mean annual water flow in the i th year
Q_{i+1}	: Mean annual water flow in the $(i+1)$ th year
Rev. area	: Revised area
RRI	: River Research Institute
R.L	: Reduced Level
r	: First serial correlation coefficient
S.B.L	: Stream bed level
s	: Standard deviation
S_0	: Average initial bed slope
T^*	: Numbers of years in which the reservoir would be completely filled up.
TVA	: Tennessee Valley Authority
US	: United States
USDA	: United States Department of Agriculture
USBR	: United States Bureau of Reclamation
V_r	: Original reservoir volume
V_s	: Volume of sediment deposited in the reservoir
V_0	: Sediment volume below the new zero elevation

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CHAPTER-ONE INTRODUCTION



1.1 General

Reservoirs are man made lakes created to store water during the times of excess flow and supply it from storage when the demand exceeds the inflow. The construction of the dam impounds the river water which increases the cross-sectional flow area. Due to increase in flow area, the velocity of flow in the reservoir decreases. This lower flow velocity causes the sediment transport ability of the river to drop. The drop in sediment transport ability causes the sediment to settle out and accumulate in the reservoir. One of the most important problems in the development and maintenance of reservoirs is the loss of storage capacity due to silting. Decrease of storage capacity prevents the reservoirs from supplying the services for which it was designed, thus disturbing the economic life of the reservoir which it serves.

All rivers bring down sediment which depends on the catchment characteristics, pattern and intensity of rainfall and flood. The erosion is contributed to the detachment and removal of soil by the action of wind and water. Erosion is occurred due to the impact of raindrops, wind and surface runoff which are also the agents of sedimentation process. Sediment yield is a collective term meaning an accumulation of sediment particles transported or deposited by flowing water. The impact of reservoir sedimentation are diverse and numerous (Bruk, 1985). These impacts are felt on upstream and downstream as well as in the reservoir itself. Impacts of reservoir sedimentation on a hydropower facility are essentially an extension of the impacts felt by all reservoirs (Pearce and Fred 1991). The problem of sedimentation is an important

problem that should be investigated by all reservoir operators. In general, a comprehensive plan is needed for all reservoirs to combat the destructive nature of reservoir sedimentation.

1.2 Background of the Study

The deposition of sediment in reservoir will automatically reduce its water storing capacity. If this process of deposition continues longer a stage is likely to reach when the whole reservoir may get silted up and become useless. Sheet, gully and stream channel erosions are by far the most important sources of the sediment load to river and reservoirs. The ultimate destiny of all reservoir is to get filled with sediment. Worldwide reservoir storage is being depleted due to sedimentation at an estimated rate of one percent per year (Mahmood, 1987). Many reservoirs in China are filling at rates considerably faster than one percent (Chunhong, 1995), while some reservoir in Poland receive extremely low amount of sediment (lajczak, 1994). The impact of most of the reservoirs operations is the loss of storage capacity. Storage loss is a direct degradation of the usefulness of the reservoir. One such example is the Hushan reservoir on the Hitou river in northern China. This river lost 54% of the initial storage capacity of $4.23 \times 10^6 \text{ m}^3$ in a period of 7 years (Bruk, 1985). Reservoir sedimentation is a problem that plagues all reservoirs (Fan and Jiahua 1992). So, sedimentation studies have led to a better understanding of the various aspects of reservoir sedimentation and their effect on the life of reservoirs. In order to combat this problem of silting and extent the useful life of the reservoirs various measures have to be adopted. Bed load is difficult to measure and data is also scarce. When the observed data on suspended sediment is not available, empirical equations can be applied. Under the circumstances, the empirical equations are used to estimate the quantity of sediment likely to deposit in the reservoir. Kaptai Lake is the only reservoir of Bangladesh. Its catchment area of 11003 km^2 and capacity is 6170 Mm^3 . This is the only hydropower generation unit of the country and has contributed significantly to countries power grid. Many studies on

reservoir sedimentation had been carried out in USA and India (1980). However, no mentionable works have been carried out to find out the volume of sediment deposition and sediment distribution pattern for Kaptai reservoir. Therefore, the present study is directed towards the prediction of sedimentation rate in Kaptai reservoir by applying a prediction model. This model has been compared with other empirical equations and observed data of the reservoir. In addition, life of the Kaptai reservoir has been estimated by Brune's trap efficiency relationship and sediment distribution pattern in the reservoir has been obtained by using available Empirical area reduction /increment methods.

1.3 Objectives with specific Aims

The objectives for this study are as follows :

- (a) To predict the volume of sediment deposition and sedimentation rate for Karnafulli reservoir from the existing inflow data and sediment distribution pattern by using the elevation- storage data.
- (b) To compare of sedimentation rate between the prediction model and the three empirical equations and also compare with the survey result of existing reservoir.
- (c) To estimate the expected life of the Kaptai reservoir.
- (d) Finally to compare of sediment distribution pattern for Karnafulli reservoir obtained by Empirical Area-reduction method and Area-increment method.

CHAPTER-TWO

DESCRIPTION OF THE STUDY AREA

2.1 Brief history of the Kaptai Reservoir

Project reconnaissance of Kaptai reservoir was carried in the year 1906 and study was taken in 1923. Further study was taken in the year 1923 and third time study was conducted in 1946. First time site was selected by M.A Moore at Barkal 64.4 km up from Kaptai. Third time proposed site at Chitmaram 11.27 km down from Kaptai. Finally dam site was selected at Kaptai in 1951 by the Govt. Engr. under the guidance of Khawja Nazimuddin. Work started of Kaptai reservoir by the Govt.Engr. in 1951. Construction and erection of the reservoir was completed on January, 1962.

2.2 Major aspects of the project

The major aspects of the Karnafulli reservoir are as follows

- (i) Power (ii) Forestry (iii) Fish industry (iv) Navigation (v) Flood control
- (vi) Irrigation (vii) Tourism (viii) Training of engineer and technicians.

2.3 General Description of the Kaptai Reservoir :

The Karnafulli river watershed lies in the South-eastern portion of Bangladesh. The Karnafulli river originates from the Lushai Hills, India and creep forward for more than a hundred miles to meet the blue water of the Bay of Bengal near Chittagong Port. Innumerable streams have joined with the river which are carrying the rain water of the catchment area of 777 km². Due to construction of the dam at Kaptai on the river a vast pool of water with the low lying areas of the hills and streams falling on the river has become the reservoir of the Kaptai hydro-station project.

The water surface area of the reservoir at the elevation of 36m PWD is 588 sq.km. The width of the reservoir is only about 4 km but it extends along with many tributaries to the Karnafulli river. Its catchment area is 11003 sq.km. Upstream of the dam site is heavily vegetated and most of that part are very mountaneous with some ranges exceeding altitudes of 2438 m above mean sea level.

The topography of Karnafulli basin is different from the rest of the country. The young sedimentary formation of sandstone and shale have been subjected to lateral forces, resulting in a series of long high parallel ridges or folds running nearly in the north south direction.

The watershed of the Karnafulli reservoir lies within the tropics. Main water sheds are elongated in the north-south direction which lie within narrow valleys between parallel ridges of the hills, through which the main portion of the Karnafulli river has cut its channel. The topography of the lower part of the Karnafulli river watershed is fairly flat and low but the upstream portion is rugged.

During the construction of the project, upstream portion of the reservoir was full of forest. The jungles were dense and a very small portion of the area was cultivated. But at present deforestation is taking place rapidly and at the same time human activities in the region have increased. As a result, the rate of siltation in the reservoir is believed to be accelerated, affecting the storage capacity of the reservoir.

2.3.1 General statistics of the reservoir

Statistics of a reservoir like capacity, submerged area etc. play an important role in all phases of reservoir operation. The general statistics of Kaptai reservoir are shown in table 2.1.

Table 2.1 : General statistics of Kaptai reservoir

Name of parameters	Magnitude
Flood absorbing capacity	10180 Mm ³
Submerged area of the lake	777 sq.km
Full water level	33.22 m (M.S.L)
Maximum water level	33.53 m (M.S.L)
Minimum water level	20.12 m (M.S.L)
Dead storage	1818.39 Mm ³
Minimum rainfall	177.80 cm
Average rainfall	248.92 cm

2.3.2 Main Dam

The type of dam of Kaptai reservoir is earthen. The length of the dam is 671m and crest level is 36 m M.S.L above foundation. Maximum height of the dam is 46m above foundation. The amount of total excavation of the dam is 2973 cu.m and total rolled earth is 5.8 M.cu.m.

2.3.3 Spillway

Spillway is essentially a safety valve for a dam which is constructed at a dam site. It is designed to dispose of the entire surplus water from upstream to

downstream. The spillway length of the Kaptai reservoir is 227 m and maximum flood discharge capacity of the spillway is 15914 cu.m. Other dimensions and parameters of the existing reservoir spillway are shown in table2.2.

Table 2.2 : Dimensions and parameters of reservoir spillway

Name of spillway parameters	Magnitude
Crest level	2.17 m M.S.L
Number of gates	16 nos.
Size of each gate	12.19 m × 11.51 m
Length of tailrace channel	1219.00 m
Bed width of the tail race	122.00 m
Total excavation	5.80 Mm ³
Total concrete	0.11 Mm ³
Hoist motor capacity	34 H. P
Gate hoist capacity	75 ton each
Raising speed of the gate	0.46 m/min
Dropping speed of the gate	0.61 m/min

2.3.4 Reservoir statistics

Kaptai Hydropower Station has recorded maximum magnitude of different parameters of Kaptai reservoir from the year 1962 to 1989 based on yearly or daily basis. This is shown in table 2.3.

Table 2.3 : Statistics of 28 years (1962-1989) for the reservoir

Name of parameters	Magnitude	Year
Annual maximum spill way discharge	18017.96 Mm ³	1976
Annual maximum power house discharge	15798.72 Mm ³	1983
Daily maximum spillway discharge	8348.50 cume	1968
Annual maximum generation	998.172 mill.kwh	1988
Annual maximum inflow	27678.28 Mm ³	1976
Annual maximum outflow	27640.04 Mm ³	1976
Annual maximum rainfall	359.28 cm	1976

2.3.5 Hydrological Conditions

The climate of Bangladesh is mainly characterized by two seasons, the monsoon season which lasts from about mid-May to September and the generally dry season from October till May. During March to April there is occasional rain often occurring as thunderstorm and accompanied by strong winds coming out of the north-west. The monsoon winds blow from the south and carry moisture laden clouds from the Bay of Bengal towards the hills resulting in heavy precipitation. The climate of Karnafulli basin is tropical monsoon type. Heavy monsoon occurs in the summer specially in June, July and August. Rainfall begins to increase in April and taper off through September and October.

Excessive rainfall that may occur in one day or in consecutive days during the monsoon over the reservoir area is very important. It is essential to determine it by considering the rainfall of the existing rainfall stations situated within the reservoir surface area. Mean value can be determined for calculation of direct run off from rainfall over the reservoir surface area.

2.3.5.1 Rainfall

The network of existing rainfall stations within the reservoir area seems to be in satisfactory pattern and uniform for any rainfall analysis and run off relationship of the basin. However, there should be some more rainfall station in the north and north-eastern quadrant of the watershed. As the measurement of rainfall in the reservoir area is a vital element for the reservoir storage, it is very much essential to maintain sufficient number of representative rainfall stations through the reservoir area.

Table 2.4 : The normal rainfall of Rangamati and Kaptai stations

Months	Rainfall in mm for Rangamati station (10 years mean)		Rainfall in mm for Kaptai station (10 years mean)	
	1974 to 1983	1991 to 2000	1974 to 1983	1991 to 2000
January	21.34	5.33	5.84	8.38
February	27.18	20.10	22.35	33.02
March	34.04	103.12	44.20	129.03
April	111.76	82.30	170.43	80.26
May	402.84	380.24	315.47	389.38
June	570.74	504.95	593.34	502.16
July	270.00	610.11	513.59	536.19
August	539.50	418.08	477.77	448.31
September	296.67	262.89	328.93	264.67
October	184.66	132.33	153.93	154.69
November	96.52	38.86	58.67	41.15
December	1.02	11.18	7.34	18.29
Total	2556.27	2569.49	2691.89	2615.69

2.3.5.2 Water level

In the reservoir area, water levels are measured in seven stations. These station are Kaptai, Rangamati, Mahalchari, Longadu, Marisha, Barkal and Dighinala. Water levels of the following stations are observed in the reservoir area by the Power Development Board. The levels are recorded once in a day only at high water stage

except at Kaptai which is recorded hourly at all stages. Water level of the reservoir varies from 23.17 m to 33.22 m.

2.3.6 Operation of the reservoir

There are two major conflicting uses of Kaptai reservoir, viz., flood control and hydro-electricity generation. While the desirability for flood control is to maintain the reservoir pool level as high as possible. Up till now, the operation of the reservoir has been based on a rule curve formulated from historical data as a compromise between the two conflicting uses.

With the assistance of Japan International Co-operation Agency (JICA), Telemetric stations have been installed in the reservoir watershed area and these can be used to estimate reservoir inflows two to three days in advance. Also, with the expansion of the power station through commissioning of the 4th and 5th units, the potential for hydro-electricity generation has increased significantly but the station is operating below its capacity most of the time. Under the circumstances it is necessary that the efficiency of operation of the reservoir be increased by replacing existing operating rule with an optimal one which will incorporate inflow forecasts.

In 1970, H.G. Acres International Limited proposed a operation strategy for Kaptai reservoir both with and without flood warning. Their recommendation without warning system could not be implemented because of nonavailability of real-time data. Since real time data is now available from the telemetric network, it is possible to implement their reservoir operation strategy with the warning system. In order to do so, it will be necessary to forecast reservoir inflows from catchment rainfall and water level data available through the telemetric network. BUET(1990) made a preliminary assessment of the work involved for setting up a telemetric network for forecasting system. They opined that a reservoir operating policy incorporating the flood warning system may be beneficial for additional hydro-electricity generation. Such

benefits have been reported elsewhere in the world. However, the opinion of team recommends of H.G. Acres Ltd. should be reviewed before being implemented because the operating circumstances of the reservoir have changed considerably since the formulation of those recommendations. After careful examination of the problem, it was proposed that the study described sequel should be done to develop a feasible optimal operating rule with appropriate flood warning system for the reservoir. Since computers have become handy these days, the reservoir operating policy can conveniently be implemented within the frame-work of a computer model which can be installed and run in a micro-computer. The micro-computer should preferably be installed in the same location where the telemetric receivers are housed in Kaptai.

2.3.7 Reservoir operation models

Under most climatic condition and hydrologic conditions, efficient regulation of a reservoir can be carried out by abiding some present operating guidelines, stemming primarily from experience which usually involve maintaining the storage in the reservoir near some specified pool level and keeping the flow in downstream channel within certain ranges. When there is a heavy rainfall or high discharges from a source, adherence to present guidelines is not possible and some tactical measures are necessary in the regulation of the reservoir such that the expected damages are minimized. Until recently, the tactical problem was considered independent of the long-term operating rule. But, perhaps Tennessee Valley Authority (TVA) is the fore runner in showing through their scheduling model HYDROSIM, described by Gilbert and shane in 1982, that both long-term and short-term operating rules can be coupled for a more efficient operation. The scheduling model HYDROSIM developed by TVA is one of the several well developed available flexible optimization algorithm with many features that can be applied for different hydrologic and climatic conditions to obtain an optimal reservoir regulation policy. The model is interactive and can incorporate feed back information about changes climatic and hydrologic conditions. The model uses stochastic dynamic programming to determine long-term operating policy on a weekly basis. Descritization

of time into smaller time steps causes excessive demand on computer memory space and therefore, HYDROSIM uses linear programming (LP) algorithm when conditions demand that shorter time steps be used. Wasimi showed that when climatic and hydraulic variability necessitates that daily or hourly time steps be used in applying control measures, linear quadratic Gaussian (LQG) stochastic optimization technique is superior linear programming. In the present case under consideration, since a single reservoir is involved, computer memory space is unlikely to be a limiting factor in stochastic dynamic program can be used to determine daily operation schedule of Kaptai reservoir and in case of a storm on the watershed, hourly operation strategy may be followed. For the case of estimating inflows into the reservoir, a large number of routing models are available to day with various degrees of sophisticated models are undoubtedly hydrodynamic models. These models require an extensive data base and is generally not warranted for reservoir operation purposes because in the rugged terrain in which the reservoirs are commonly located channel topographies are not well-defined and meticulous accuracy in routing can not be achieved. By contrast, simple discharge storage relationship like the Muskingum method is widely used for reservoir inflow estimation.

CHAPTER-THREE

REVIEW OF LITERATURE

3.1 Introduction

Sediment deposition along streams or in reservoirs is a complex and troublesome process. It creates a variety of problems such as raising of stream beds and increasing flood heights, meandering and over flow along the banks, choking up of navigation and irrigation canals and depletion of capacity in storage reservoirs. Uncontrolled deforestation, forest fires, overgrazing, improper methods of tillage and unwise agricultural practices accelerates the soil erosion resulting in a large amount of sediment flow in the streams. The rate of reservoir sedimentation must be estimated accurately in order to ascertain the useful life of the reservoir and such determinations are the basic needs in evaluating the economic of the projects on silt laden streams. Reservoir sedimentation surveys determine the amount of material deposited in a reservoir and show where and how the deposition occurs. This informations will also be useful for :

- (i) Determining the prevailing and probable future sedimentation which damages to a particular reservoir.
- (ii) Periodically correcting the capacity curve to assure more efficient operation.
- (iii) For determining the most effective and economical control measures needed to reduce the rate of sedimentation.
- (iv) Such surveys may also be broadened to give valuable informations on the volume of deposited sediment, rate of sedimentation, unit weight of the deposited sediment, sediment distribution pattern, life of the reservoir and the quality of water etc.

3.2 Related Previous Research Works

Impact for a hydropower reservoir, the loss of storage volume and the possible equipment damage have the most potential for performance on degradation (Work Group of the Committee on sedimentation of reservoirs, 1989). The loss of storage in a hydropower reservoir causes the reduction of the effectiveness of the facility. The storage capacity of a hydropower reservoir has a direct effect upon a plant's ability to produce power. As seen in equation (2.1), the amount of power (P) produced is dependent upon the flow (Q) to the generators (Gulliver and Arnat, 1991). Thus the reservoir acts as a battery, storing the potential energy of the water.

$$P = e \gamma Q H / 737 \text{ -----(2.1)}$$

Where, P = Power production (Watt), e = Turbine efficiency (%), γ = Specific weight of water (N/m³), Q = Flow (m³/s) and H = Head difference (m)

This stored water will be used to produce power when the river flow is less than the needed flow (Q) to produce the desired amount of power. As storage capacity is reduced, the operation of the power plant becomes more dependent upon the river flow. This loss of storage capacity can significantly reduce a plant's ability to produce power during the low flow period, such as droughts or dry seasons.

Upstream of the dam, the reduction of the velocity of the water causes aggradation. The extent of this aggradation is greatly dependent upon the composition of the incoming sediment. If heavy aggradation occurs, there is the possibility of braided channel forming at the head waters of the reservoirs. The upstream river bed could possibly rise significantly, which would make the surrounding lands more prone to flooding and formation of marshes.

Downstream of the dam, lack of sediment and normally high discharge velocities produce a sediment hungry river. This results in downstream degradation. The degradation can cause a great deal of damage to the foundation of the dam unless

this possibility is included in the original design. If bank erosion is substantial, the degradation can also pose substantial problems to downstream structure near the river. The loss of silt downstream can reduce the productivity of fields that normally receive replenishment of silt from annual floods. An example on this, the construction of the Aswan high dam in Egypt which has turned the Nile delta in to the heaviest user of fertilizers in the world (Pearch, 1991). Lake McCillan in USA, Where the growth of tamarisk (variety of salt cedar) in the valley above the reservoir dramatically reduced the loss of storage due to sedimentation. The storage capacity was reduced approximately 50% of original capacity in first 20 years and to 3-5% of the original capacity in the 35 years following the growth of the trees (Bruk, 1995). Other benefits are that multiple channels are encouraged to form and this discourages channel scour that can cause sediment to be transported into the reservoir.

A primary impact of reservoir sedimentation is the upstream extension of the back water zone caused by sediments settling in the most upstream portions of the reservoir. This extension may be negligible or significant depending upon the incoming sediment load and reservoir operating rule. For example, the backwater zone of the Guanting reservoir on the yongding river in China has extended an additional 20 kilometers upstream on two tributaries as a result of sediment deposition in the reservoir area (Personal conservation, 1995) and on the Atbara river, a tributary to the Nile in Sudan, deposition upstream from the original khashm et Girba reservoir has extended into a pumping facility (Williams and Bradley, 1988). These primary impacts procedure may secondary and tertiary impacts.

Impacts on downstream from the dam are similar but act inversely. The primary impact is manifested in bed degradation and bank erosion (ASCE, 1975). While degradation is eventually arrested by channel armoring, secondary impacts are manifested and may be maintained much longer than the initial degradation.

Main channel aggradation upstream from a reservoir will raise water levels, which in turn results in increased flooding and lower navigational clearances. Due to degradation on downstream, lower water levels which will increase channel capacity but will lower surrounding groundwater levels (Hotchkiss, 1994).

In Tanzania, Lake Mabayani, a man-made water supply reservoir, was filling rapidly with silt, jeopardizing the population of Tanga, a city of about 150,000 residents. The silt is coming from severe erosion problems in the Usambara Mountains as a result of overgrazing, cropping on very steep terrain and over harvesting of wood for fuel supplies. If not stopped, this could lead to complete loss of the water source and a collapse of the socio-economic infrastructure of the region (Cooke et.al 1993).

Natural eutrophication or "aging" of a reservoir can take thousands of years but the process can be radically changed and shortened by human intervention. For example, Davy Crockett lake behind Nolichucky dam in Tennessee was completely filled with sediment from improper mining activities in its watershed within a few decades of dam construction. But this Lake was designed to provide beneficial uses for more than 100 years and hydropower generating capacity of the dam had been totally lost. The lake no longer serves as water source for nearby communities and fishing and other recreational activities had been vastly diminished (Tolba, 1984; Hecky, 1993).

Poor water management in terms of upstream diversions or changes in flow regimes downstream of reservoirs also degrades lake ecosystems, causing economic damage and human sufferings. Disruption of sediment flow to coastal zones by dam construction can cause coastal erosion and in West Africa entire coastal towns have been washed away (LeMarquand, 1993).

Larger reservoirs commonly have high trap efficiencies. This means that a large percentage of the volume of sediment that flows down the river is trapped in the reservoir. Although it is possible to modify the outlet works or the operation plan of a dam in order to decrease the amount of trapped sediment (Morris and Hu, 1992), there will be usually a decrease in the amount of bed material that is delivered to the channel downstream of the dam. This can result in both bed erosion and bank erosion of the outlet channel.

Reservoir provide 85% of the water supply to San Juan, Puerto Rico but the principal water supply impoundments face serious sedimentation problems due to high sediment yields and small hydrologic reservoir size. Puerto Rico has constructed and managed its reservoirs as if they had finite life times without implementing long-term

sediment management (Morris, 1994).

Construction of dams is accompanied by sedimentation in the upstream impoundment. Discounting the dead storage allowed for sediment deposition, there remain several detrimental impacts of reservoir sedimentation (Hotchkiss, 1995; Fan, 1985; ICOLD, 1989). Sedimentation rates are times under predicted, resulting in shorter-than-designed project lives. The problems of under prediction is often times exacerbated in developing countries due to 1) lack of historic information upon which estimate inflow of base sediment and 2) dramatic changes in upstream land use during the project life such as deforestation, intense agricultural cultivation and urbanization. These changes can drastically increase sediment production and result in accelerated storage loss in the reservoir. An inflow heavily laden with suspended sediment can also continue as a density current through the reservoir. The sediment laden stream entering the nearly static water in a reservoir has a higher density (Raudkivi, 1979). Lake Mangla in Pakistan is expected to loss $1.233 \times 10^9 \text{ m}^3$ of storage capacity every 20 years or 1/9 of its maximum capacity (Smith, 1971). Lake Nassar behind the Aswan high dam has a total capacity of $164 \times 10^9 \text{ m}^3$ of which $39 \times 10^9 \text{ m}^3$ was to store silt for the next 500 years. There are a number of examples of rapid siltation, e.g. Mohan et al. (1982) report that a reservoir behind a 60 m high concrete dam (Ichari, India) silted up to crest level of the spillway in two years. The Austin reservoir lost 41.5% of volume from 1893 to 1897 and it failed in 1900. The new lake Austin on the Colorado river in Texas lost 95.6% of capacity in 13 years and that of Habra reservoir in Algeria 58% in 22 years. The Indus river carries about 74 km^3 of water per annum and 200×10^6 tonnes of suspended sediment in to the Lake Tarba. In 6 years after its commissioning in 1974, it accumulated about $950 \times 10^6 \text{ m}^3$ of sediment in the upper 30 km of the delta.

The understanding of the sedimentation process gained from observed data and from the empirical methods for estimating the distribution of sediment deposits have been instrumental in the development of analytical and numerical models, e.g. those of Yucel and Graf (1973), Asade (1973), Chen et al. (1978). The resulting numerical simulation models are gradually replacing the empirical and earlier methods. They have the added advantages that the boundary conditions are easy to modify. One

model can actual operating procedure of the reservoir and even the possible periodic scouring (flushing) of the reservoir.

B.K Uppal (1977) mentioned that many reservoirs in India are losing 0.5 to 1.5 percent of their capacity annually while some of them are losing over 2 percent each year. In this connection, he would like to mention that the storage capacity being lost in Bhakra reservoir on an average for the last 17 years has come to 0.35 percent per year. The analysis of silting rates at Dakwan reservoir in India has shown the rate of silting to be as 0.0132 M.cu.m/sq.km of catchment area per 100 years.

Gandhisagar reservoir in India (1977) seems to have been provided with enough dead storage space for accumulation of sediment for 100 years, thinking that the entire load will get load to the bottom-most part of the lake. It has now been found that as much as 28 percent of sediment deposit during the first 15 years has come to live storage space.

Suspended sediment and sedimentation have many degrading effects on rivers and reservoirs. Marginal wetland can be completely covered by silt, eliminating their value as nutrient sinks, nursery areas and habitat. As silts settles in a spawning areas are covered and lake volume is also reduced. Then the fishery production can be completely changed. As a result of lost of storage capacity, both the volume and extent of flooding can increase. In the case of hydro-electric facilities, loss of generating capacity is possible. The increase of sedimentation can encourage increased macrophyte growth and can interfere with recreational activities such as boating and fishing. Soil loss and suspended silt also contributes to eutrophication and lake contamination since the silt generally includes attached nutrients, herbicides, pesticides and other chemicals. These increases water treatment costs and maintenance problems in water treatments plants (Dinar, 1995).

Soil erosion rates in Taiwan are very high due to monsoon climate and sandstone and soft shale geology. Yet almost all of the existing 44 reservoirs in Taiwan were built without any desilting facilities (Hwang, 1995). Consequently, storage capacity is decreasing year by year and the country faced expensive rehabilitation projects.

Density currents are found in large reservoirs with large sediment inflows whose channel energy slope greater than 0.0002. Density currents may be due to temperature differences but more commonly are those associated with the flow of the fine sediment particles. Studies of lake mead cited in ASCE manual 54 (1975) describe a $\frac{1}{2}$ of 0.1% more dense than surrounding water with an energy slope of 0.0009, width of 150 m, velocity of 9.6 km/day and sediment transport rate exceeding 5,400 mg/day.

To construct an upstream silt dam that captures coarse sediments but does not hold water long enough for suspended material to fall out. Pearce (1986) describes a situation where the Chinese have essentially taken that approach on the Yellow river with its annual sediment load exceeding 1.3 billion mg/year. The Sanmexia dam, closed in 1960, was built for flood control and hydropower. The reservoir filled so quickly with sediment that hydroelectric generators were removed to provide a flushing channel for the silty stream. The Sanmexia serves as a silt dam for the Xiolangdi (Peterson, 1986). Williams (1995) calculated sediment transfer over a ten-year span after removing the Washington water power dam on the clear water river to the Lower granite reservoir would exceed 777,000 cubic meters. Scour would also uncover buried toxic chemicals.

3.3 Maintenance aspects on reservoir sedimentation

The possibility of damage to a hydropower plant's equipment from sedimentation is an ever present threat. This damage to equipment comes primarily from ingestion of sediment. The main damage occurs as the sediment erodes the runners. The damage of the runners decreases generator's down time due to maintenance. This maintenance can be costly both in terms of cost of spare parts and lost productivity. So, sediment build-up in the reservoir can also cause damage to equipment. Damage consists of mainly blockage of intake and control structures (Work Group of the Committee on sedimentation of reservoirs, 1989). The low level intakes are the most susceptible to this type of blockage. The blockage of the intake could make massive reconstruction of the intakes necessary. Damage is also possible to the

structures of the dam itself. This is due to the added pressure at the base of the dam from sediment build-up chemicals or compounds which can possibly produce safety and maintenance problems.

Hitzhusen et al.(1995) address the sedimentation of lakes by agricultural soil erosion. Dredging and sediment handling in lakes is associated with high cost. They develop an institutional context for the dredging of sediments from Ohio's state lake parks in an attempt to rationalize economically by dredging activity.

Large reservoirs create a dependable supply of water and electricity for urban areas. Detention basin temporally store water and release it at a lower rate. Debris basins and sediment retention structures trap flowing sediment preventing it from damaging downstream structures (ASCE, 1995).

Sediment removal might be the only practical way to improve a lake or reservoir that has been badly silted. Dredging is one of the most frequently prescribed techniques to correct this problem. It has been successfully used in Lake Trumen, a small lake in southern Sweden and in Lake Vancouver in the United States. Dredging, however, is costly (for example, Hitzhusen et al.(1995) estimated the dredging cost in Lake Madison in Ohi to be \$1.65 per ton of sediments dredged) and works best if the sources of sediment delivery are fast controlled, eliminating the need for re-dredging. Because dredging requires the disturbance of the lake bottom, any entrained toxic materials in the bottom sediment can be re-suspended and made available to the biological community in the lake. Many areas of the Great lakes have highly contaminated with bottom sediments. This is true particularly in harbors and bay containing industrial sites and in river deltas where upstream industry has discharged wastes containing toxics.

Sediment from deforestation in Malawi, Tanzania and Mozambique inhibits fish production in Lake Malawi (LeMarquand, 1993). Removal of a nutrient-rich sediment layer by suction dredging can be effective, although dredging procedures are the high cost, especially if the lake is of great size, the problem of disposal of the dredge soils and the accompanying disruption of the bottom substrate which affects bottom dwelling animal.

Many options exist for removing sediment from reservoirs such as drawdown flushing, use a significant fraction of the water in storage to flush deposited sediments downstream (Fan and Morris, 1992a). Others such as venting density currents, rely on favourable hydraulic conditions to produce a density current of sediment laden water near the reservoir inlet. If low level outlets exist and are opened at the suitable time, the density current may be passed downstream without depositing in the reservoir.

Recent efforts have focused on very simple, low-cost methods of sediment removal that can be implemented at most any location. These methods use the energy head represented by the difference between upstream and downstream water levels to drive water and sediment into a diversion device such as an outlet or diversion tunnel. Hydrosuction dredging require no external power source to pump the sediment slurry through the pipe because the mixture is driven by the pressure head in the reservoir (Hotchkiss and Huang, 1995; Lysne et al.1995). Another sediment method is serpent uses a heavy-duty rubber tube which seals a slit between a settling basin and a flushing channel along the bottom of the basin when the tub is filled with water. This method showed promise, particularly in developing countries because it is relatively inexpensive, require no external source of energy (U.S Water News, 1993). The serpent method is now patented and marketed worldwide.

3.4 Siltation Survey of Kaptai reservoir

The recent siltation survey of Kaptai reservoir has been completed (BWDB, 2000). It was performed on the basis of field survey in the whole reservoir area. This is the second time survey of the whole reservoir after completion of the Karnafulli Hydro Electric Project (KHP). The survey work started from the Rangamati range and then completed up to KHP covering the whole area of the reservoir. It was very difficult and labourious to carry out the survey work due to steep bank, low water level and also as the triangulation pillars were covered by the earth deep forest.

In 1978 and 1980 a general survey on Kaptai-Rangamati portion was handed by BWDB limited way where it was not possible to get a comprehensive informations on the extent and the rate of sedimentation of the reservoir. In 1983 permanent triangulation pillars were set on the 67 selected cross-sections. Again in 1986 only 20 out of 67 cross-sections were surveyed and for some unavoidable reasons it was not possible to complete the survey in all 67 previously selected and surveyed cross-sections. Again in 1986 only 20 out of 67 cross-sections were surveyed and for some unavoidable reasons it was not possible to complete the survey in all cross-sections. Due to this, no comprehensive report was prepared. During the year 2000, field survey has been conducted in all 67 previously selected cross-sections and this time survey is of different survey from the previous survey in respect of quality and accuracy. Because of very up to date scientific equipments like Echo sounder (DESO-17) which is one of the latest machines are used during the survey work. Water samples were collected at 0.2m and 0.8m depth and 67 bed load samples were taken in each cross-section. These samples were sent to RRI, Faridpur for test and analysis and preparation of gradation curve of bed materials.

It is extremely difficult to identify the causes of siltation in a peculiar shaped vast pool of water as may be seen in the enclosed index-map whose bottom is also very complex. So, it is also difficult to make a good estimate of sedimentation but it is very important to know as far as possible the extent and the rate of sedimentation which might affect the storage capacity of the reservoir.

Out of several causes of sedimentation, following are seems to be worth mentioning for the reservoir.

1. Rain-wash or silt carried by rain water from catchment area of the basin.
2. Erosion from reservoir banks by wave action and current flow.
3. Landslide in the adjoining hills.

All the carried particles are setteled at the bottom of the reservoir, heavier at nearby the source and lighter or finer spreading over the downstream. This bed load is the main cause of siltation and it is likely to be deposited in the bottom where heavy flood flow enters with slack water, whereas suspended load tends to settle over a larger area. But unless density currents are present, the first deposit is likely to take place immediately downstream from the initial accumulation of bed load. Water containing aheavy load of suspended silt when flows into a clear pool, it tends to flow along the bed of the pool as density current. It generally does not mix with water but tends to carry the silt a long distance away without setting any great amount of it. In case, if it has to follow a Zigzag channel or if the clear water or push the enter ahead of it, depositing silt as its flow is checked.

The principle source of silt is said to be erosion from areas in the hills that are cleared and burned in the catchment areas for preparation of cultivation. When the catchment area was well forested and the vegetation on the watershed was dense the total silt from erosion of the cultivated areas was considered not to be high but at present the conditions is of different due to increase of human activity in the area. The silt is carried is evident from the apprearance of water flow specially at high water stage in rainy season.

From the testing report, it is found that the maximum suspended sediment concentration is 42,298.10 ppm by weight at 0.8th depth of cross-section no.12 which is abnormally high in respect of suspended sediment concentration found at the other section. This abnormal silt content at this location may be for increase rate of deposition of silt, as the flow constrains due to prevailing channel condition. It is found that somewhere (almost 50% of the total sections) sediment concentration is higher at

0.8 m depth and somewhere it is higher at 0.2 m depth. It may be due water depth of the channel, collection of samples at rainy period, velocity of flow etc.

During the survey of year 1983, the maximum silt content was found 55 ppm by weight at the surface. But this time survey, it was found that at about 88% of the total cross-sections sediment concentration is higher than that of 55 ppm by weight. As per test report of RRI bed materials in most of the sections were found clay to fine sand and the rests were clay to medium sand. Fine sand to coarse sand is available in one section. All the 67 cross-sections are superimposed with available data of year 1983, 1986 (Only 20 sections) and 2000. Silt-Range areas are given in table 3.1.

Table 3.1 : Silt range with cross-sections nos

Sl. No.	Silt-Range	Sl. No. of cross-section	No. of section
1	Dam-site	1 to 5	5
2	Rainkhong	6 to 10	5
3	Belaichari	11 to 15	5
4	Rangamati	16 to 20	5
5	Burighat	21 to 24	4
6	Nanyerchar	25 to 28	4
7	Mahalchari	29 to 32	4
8	Shubalang	33 to 37	6
9	Katali Bazar	38 to 42	5
10	Mainimukh	43 to 45	3
11	Bhangamora	46 to 48	3
12	Pabalakhali	49 to 52	4
13	Marisha	53 to 54C	5
14	Barkal	55 to 58	4
15	Harina	59 to 63	5

3.5 Factors of sedimentation

The rate of sedimentation depends on the following factors :

- (i) The relation of capacity inflow
- (ii) The content of sediment in the inflow
- (iii) Sediment yield transport from catchment
- (iv) Sediment characteristics
- (v) Land use
- (vi) Sediment control measurement in the catchment
- (vii) Reservoir geometry
- (viii) Mode of deposition
- (ix) Operating procedure for the reservoir
- (x) Rehabilitation procedures (removal of sediment from the reservoir)

3.6 Sources of Sediment

The sediment problem arises from man's disturbance of the prehistoric geological pattern. Cutting and burning of brush lands and forests, overgrazing of grass lands and cultivation of crops land have greatly reduced the primeval vegetal production. The causes of erosion is the soil mentle by the impact of rain drops, wind and surface run off etc. Practically all stream-borne sediment comes from one or more of the following sources :

Sheet erosion of the land surface

Sheet erosion is the removal of soil material, more or less uniformly from the surface of the land by the forces of rain drop impact and surface run off or wind action.

Gullying

Gullying are channels, generally more than 15.2 cm deep, eroded concentrated run off in soil, alluvium or decomposed and unconsolidated rock.

Stream channel erosion

This is defined as the erosion of the banks and the scouring of beds of geologically perennial or intermittent streams.

Mass movements

These includes landslides, slumps, avalanches and soil creep etc.

Flood erosion

Flood erosion results from the scouring action of flood water overflow on the surface of flood plains.

Construction erosion

This term issued to include all soil and earth movement produced directly by the construction of roads, rail roads, power lines, dams and building project etc.

Mining and industrial wastes

This includes all forms of waste damped into streams. Sheet, gully and stream-channel erosion are by far the most important sources of the sediment load of most streams. Sheet erosion generally produces a major part of the sediment load of stream over broad areas that are predominantly agricultural and have more than 50.8 cm of precipitation.

3.7 Mechanism of sediment deposition in reservoir

Every river carries certain amount of sediment load. The sediment particles try to settle down to the river bottom due to the gravitational force but may be kept in suspension due to the upward currents in the turbulent flow which may overcome the gravity force. Due to these reason, the river carries fine sediment in suspension as suspended load and larger solids along the river bed as bed load. When the silt laden water reaches a reservoir in the vicinity of a dam, the velocity and the turbulence are considerably reduced. The bigger suspended particles and most of the bed load, therefore, gets deposited in the head reaches of the reservoir. Fine particles may travel some more distance and may finally deposit farther down in the reservoir as shown in Fig. 3.1. Some very fine particles may remain in suspension for much longer period and may finally escape from the dam along with the water discharge through sluiceways, turbines and spillways etc. The deposition of sediment in the reservoir is known as reservoir sedimentation.

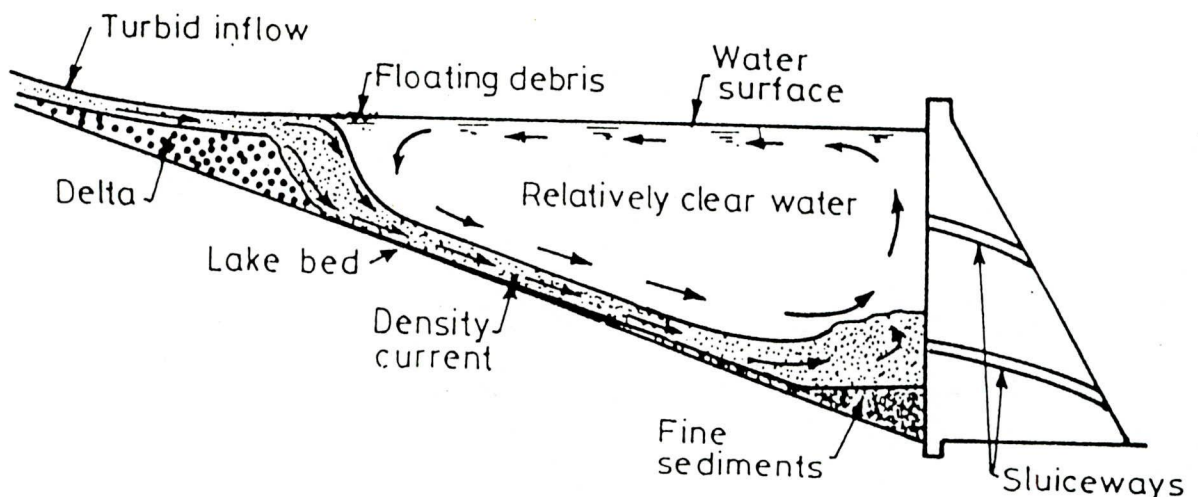


Fig 3.1 : Sediment accumulation in a reservoir

Deposited sediment will automatically reduce the water storing capacity of the reservoir and if this process of deposition continues longer, a stage is likely to reach when the whole reservoir may get silted up and become useless.

3.8 Delta formation in a reservoir

The delta formation in the upstream end of the reservoir is an aggradation process. The major effects of the delta are the reduction of reservoir capacity and a local rise of water level in the stream. Fig.3.2 represents a longitudinal cross-section through a reservoir formed by a dam on a stream. The different types of deposits that normally occur in the reservoir, viz., bottom set beds, fore-set beds, top-set beds, density current deposits and wave action deposits etc.

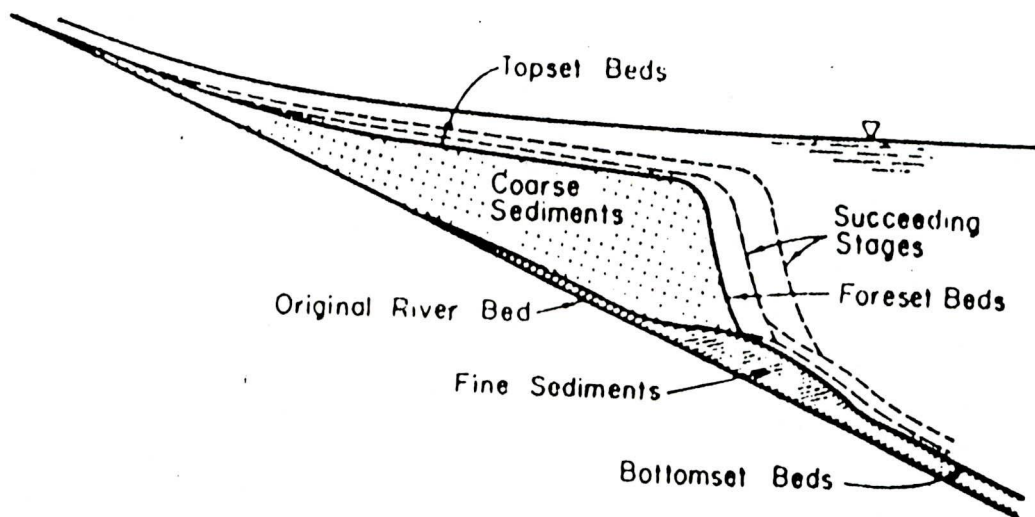


Fig. No 3.2 : Profile of a reservoir delta.

Fore-set beds : The fore-set beds are formed of the coarser sediment carried by the stream. This material is deposited where the current is retarded as it flows out into the lake. Fore-set beds are inclined downwards in the direction of the flow. The angle of inclination is generally greater with very coarse sediment but under favourable conditions with either, it may reach the angle of repose of that material. Fore-set beds

are usually more pronounced when formed of very coarse materials but with finer materials such as sand, they are usually not so prominent and may be entirely absent.

Bottom-set beds : The bottom-set beds are formed of the fine sediment brought in by the stream. The fine particles (silt and clay sizes) carried in the water settle slowly and may be moved over a long distance into the reservoir, usually depositing over most of the reservoir bottom in the layers. In small reservoir, bottom-set beds usually cover the entire bottom but are thicker at the upstream end but sometimes thicker in the deeper portion also. In larger reservoirs these beds cover only in the upstream end bottom initially but as the reservoir fills they deposit further and further downstream till they reach the dam.

Top-set beds : As the fore-set beds move out, the current in the river upstream from them is retarded because the length of the stream is increased at the expense of the reservoir and the slope is decreased. This causes a reduction in the velocity and some of the coarser materials traveling on or near the bottom are deposited on the bed of the stream. The deposition occurs not only above the fore-set beds previously formed but also on the stream bed farther upstream which lies above the water level in the reservoir. These deposits form slightly sloping layers and are called top-set beds. These beds are largely composed of coarser sediments and are usually sloped upstream at a low gradient from the edge of the fore-set beds.

Density-current Deposits : When water entering a reservoir carries large concentration of very fine particles, the action of the water is like that of dense fluid and such a mixture reaches the reservoir of relatively clear water because of its greater density it may flow along the bottom of the reservoir beneath the water surface level of fine clear water above it but without mixing with clear water until its flow is stopped by the dam. It then spreads out, fills up the lower parts of the reservoir and very gradually deposits sediment in nearly level beds. These deposits also take place due to the differences in temperature in the reservoir.

Wave-action deposits : If the reservoirs sides are steep and water remains at fairly constant levels for considerable time, deposits are formed in the reservoir due to wave-action. The coarser materials are deposited near the top and the finer material is

deposited in deeper water. These deposits occur in reservoir where the configuration of lake formed by the dam has a vast stretch over which wind blows unobstructedly and where the materials of the bank are such that it could be easily displaced by the waves.

3.9 Consolidations of soils

When a soil mass is subjected to a compressive force like all other materials, its volume decreases. The property of soil due to which a decreases in volume occurs under the compressive forces is known as the compressibility of soil.

This compression of soils can occur due to one or more of the following causes :

- (i) Compression of solids particles and water in the voids .
- (ii) Compression and expulsion of air in the voids .
- (iii) Expulsion of water in the voids.

When the soil is fully saturated, compression of soil occurs mainly due to third case, namely expulsion of water. The compression of a saturated soil under a steady static pressure is known as consolidation. It is extremely due to the expulsion of water from the voids and similar to the action of squeezing of water from a saturated sponge under pressure. The soil behaves as a saturated sponge. As the consolidation occurs, the water escapes. It is worth mentioning that the decrease in volume of soil occurs not due to the compression of solids or water but due to the shifting of position of the particles as the water escapes (Arora, 1987).

Murthy (1977) with the light of his experience for Bakra reservoir (India) stated that where actual densities had been observed at various levels indicated that consolidation of about 30% of total sedimentation rate had taken place in a period of 10 to 15 years. It is known as consolidation factor. Swamy (after Mutreza, 1995) has described for nine existing Indian reservoir and stated that sedimentation rate reduce if we compute it from the generated data of several years because of the decreasing capacity inflow ratio with time.

3.10 Related Terminology

Normal pool level or maximum water level : It is the maximum elevation to which the reservoir water surface will rise during normal operating conditions. It is equivalent to the elevation of the spillway crest or the top of the spillway gates for most of the cases.

Full water Level : During high floods, water is discharged over the spillway but will cause the water level to rise in the reservoir above the maximum water level. The maximum level to which the water rises during the worst design flood is known as the full water level.

Minimum pool level : The lowest water surface elevation which has to be kept under normal operating conditions in a reservoir is called the minimum pool level. This level may be fixed by the elevation of the lowest outlet in the dam or may be guided by the minimum head required for efficient functioning of turbines.

Live storage : The volume of water stored in a reservoir between the minimum pool level and normal pool level is called live storage. It is the storage capacity of the reservoir above dead storage level which constitutes usable portion of the total storage. Live storage assures the supply of water for specific period to meet the demand for irrigation, hydro power generation or public water supply.

Dead storage : Water stored in the reservoir below the minimum pool level is known as dead storage. Dead storage in a reservoir is provided to cater for sediment deposition by the impounded sediment-laden waters as very small portion of the sediment passes down through the dam outlets and for the minimum drawdown in the case of power projects. It is equivalent to the volume of sediment expected to be deposited in the reservoir during the designed life of the reservoir, usually taken as 100 years.

Retention time : It is defined as the time that the water requires to pass through a reservoir is called retention time.

Reservoir yield : The amount of water that can be drawn from a reservoir in any specified time interval called reservoir yield. It is naturally depends upon the inflow into the reservoir and the reservoir losses, consisting of reservoir leakage and reservoir operation.

Rate of sedimentation : The rate at which soil is deposited from a catchment area is called rate of sedimentation. This is normally expressed in volume per unit area and time.

Density current : In a reservoir, the coarser sediment settles down along the bottom of the reservoir, as the muddy flow approaches the reservoir while the finer sediment usually remains in suspension and moves in a separate layer than the clear reservoir water. This layer of water containing the fine sediment which moves below the upper clearer reservoir water is called density current.

Aggradation : The sediment deposition at the head of a reservoir may also alter the stream regimens to seriously affect the capacity of the stream to carry flows within the banks is called aggradation.

Capacity inflow ratio : The ratio of reservoir capacity to the total inflow of water is known as capacity-inflow ratio. It is a very important factor because the trap efficiency (η) has been found to be a function of capacity-inflow ratio i, e.

$$\eta = f(\text{capacity/inflow})$$

If capacity reduces with constant inflow, trap efficiency reduces and hence lesser sediment is trapped. Therefore, the silting rate in the reservoir shall be more in the beginning and as its capacity reduces due to silting. Hence, the complete reservoir-silting may take longer period. For small reservoirs (having small capacity) on large

rivers (having large inflow rates), the trap efficiency is extremely low because the capacity-inflow ratio is very small. Such reservoirs silt very little and most of their sediment is passed downstream. On the other hand, large reservoirs on smaller rivers shall silt tremendously and almost complete deposition of sediment may take place.

Time series : A time series may be defined as a set observations arranged chronically. In other words, it could be defined as a sequence of observations usually ordered in time but may order according to some other dimension. The daily hydrograph, the annual sequence of maximum or minimum flows or the mean discharge are examples of time series.

3.11 Distribution of sediments in a reservoir

The sediment accumulates at different elevations in a reservoir. Sediment distribution in a reservoir is very important and in planning conservation structures and this aspects requires careful consideration in the design. The designer is interested to know how high sediment will accumulate at the dam during a given period in order to fix up the sill elevation of the outlets and the penstocks gate elevation. For the purposes of allocation of different storages, the pattern of distribution needs consideration in order to allow necessary storage for silt accumulation as silt is distributed throughout the reservoir. Sediment distribution pattern is also necessary in order to estimate the region where delta would be forming and consequent increase in back water levels are important particularly if the reach happens to be in a developing area. Finally, it is necessary to locate spots for recreational facilities such as swimming and boating.

The distribution pattern in a reservoir depends on many factors such as slope of the valley, length of the reservoir, construction in the reservoir, particle size in the suspended sediment and capacity-inflow ratio etc., but reservoir operation has an important control over other factors. The sediment deposition is not necessarily confined to the lower storage increments of the reservoir. Sediment accumulation in a reservoir are usually distributed below the top of the conservation pool or normal water

surface (Murthy, 1980). However, if the reservoir has a flood-control pool and it is anticipated that the water surface will be held within this pool for significant periods of time, a portion of the sediment accumulation may be deposited within this pool (Mutreza, 1995).

3.11.1 Classification of reservoirs

Borland and Miller (After Mutreza, 1995) classified the reservoirs in four standard types. These are shown in the following table.

Table 3.2 : Classification of reservoir

Reservoir type	Standard Classification
Gorge	IV
Hill	III
Flood plain, foothill	II
Lake	I

Borland and Miller stated that the distribution pattern of sediment depends on many factors such as shape of the reservoir, Slope, characteristics of sediment and reservoir operation etc. They described that type I (Lake type) reservoir has a lower percentage of silt deposit than type IV (Gorge type). This is intuitively clear because a gorge type reservoir offers little opportunity for sediment grains to deposit at higher elevation than a lake type reservoir. If a type III (Hill) shaped reservoir is to be drawn down severely at frequent intervals or the sediment is frequently clay, it should be classified as a type IV due to greater portion of sediment deposition near the bottom.

3.12 Trap efficiency of reservoir

The trap efficiency of a reservoir is the percentage of total incoming sediment retained in the reservoir. It is commonly expressed as a ratio of the total sediment deposited in the reservoir to the total sediment flowing in the river. Therefore, trap efficiency

$$\eta = (S_r/S_f).$$

Here, η = Trap efficiency in percent

S_r = Total sediment deposited in the reservoir.

S_f = Total sediment flowing in the river.

The trap efficiency of a reservoir depends on the ratio of storage capacity to the inflow, watershed characteristics, age of the reservoir, the type and location of outlets, method of reservoir operation, sediment size and retention time. Trap efficiency increases with the increase of retention time. Thus for a storage reservoir which retains water for months will have a high trap efficiency, whereas a flood control reservoir will have a lower trap efficiency on account of smaller period for which silt laden water is retained. For a large reservoir, the trap efficiency is almost 100%, i. e., all sediment entering the reservoir will retain there. While allocating dead storage (Space provided in the reservoir for sediment deposition) space in a reservoir, Borland and Maddock (1995) recommended that the trap efficiency should be considered at least 95% and only in rare and special occasions it should fall below 90%.

3.12.1 Brune's Trap efficiency curves

Brune developed Brune's curves by analyzing data from 44 reservoirs : 40 being normal ponded reservoirs with the catchment area varying from 0.098 to 47,11215 sq.km and the capacity-inflow ratio ranging from 0.0016 to 2.05. Besides the information on the trap efficiency, data was also collected on the capacity, annual inflow, shape of the reservoir basin, method of operation, type of outlets, observations

on density current if any and other pertinent data. Based on this study of some data, Brune has developed a set of envelope curves as shown in Fig 3.3. This is a curvilinear relation between the trap efficiency and the capacity inflow ratio.

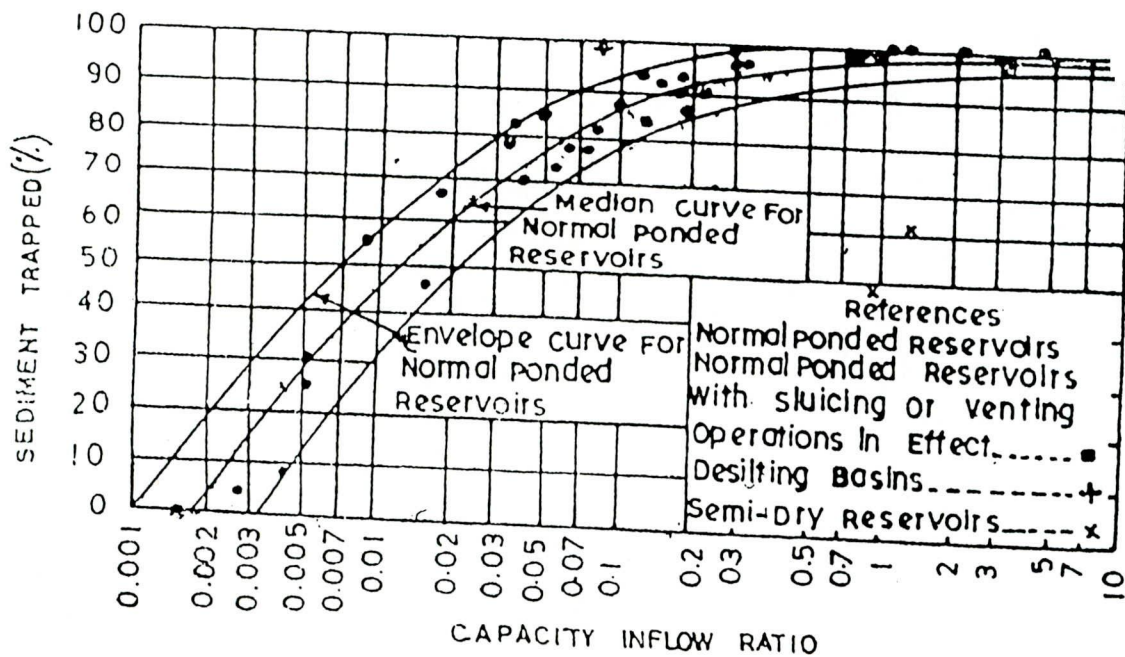


Fig No. 3.3 : Brune's trap efficiency curves

These curves serve a very useful purpose in estimating the trap efficiency for storage-type reservoirs. Their applicability for estimating the trap efficiency of reservoirs of greatly different reservoir shapes, operation and sediment characteristics etc.

3.13 Life of the reservoirs

Life of the reservoir means "the useful life of reservoir", only in terms of the length of life. This concept is probably based on the business practice where a particular given asset is assumed to become obsolete within a given definite period of time. In this case, it should not think so that the length of life of the reservoir but should have to think how

much and how long the reservoir has been useful to the community. Normally, it is interested to know when the capacity of a given reservoir would be fully depleted but from the operational considerations, should have to assess the useful life of the reservoir from putting up its guaranteed performance. The useful capacity varies from region to region depending upon the sediment content of the inflow, the size of the reservoir, operation schedule and the type and purpose for which it was built. In many cases, the useful capacity of the reservoir was found to vary from 50 to 80 percent of the original total capacity (Murthy, 1980). When the reservoir capacity is depleted by silting, the reservoir will no longer have the capacity to serve the primary purpose for which it was made and then have to think it replacement. Finally, a reservoir may be viewed as totally useless when the feasible methods of utilizing the reservoir economically inefficient.

In case of flood control reservoir, the picture would be different. Flood control is often provided gate control, detention storage being above the pool level maintained by power and irrigation water supply, etc. In such reservoirs flood control may not be greatly affected by silting. Some reservoirs which are mainly constructed for flood control provided with large outlets at the base of the dam, passes the flood water at normal stream discharge velocities, hence much of the sediment load may pass through and out of the basin. All this, leads to understanding the various concepts of the life of reservoirs. There are many definitions of reservoir life which was accepted and understood by the majority. These are defined in the following :

- (i) Useful life : It is usually taken as the period through which the capacity occupied by sediment does not prevent the reservoir from serving its intended primary purposes.
- (ii) Economic life : This is determined by the point of time at which the effect of various factors such as physical depreciation, obsolescences, changing requirements for project services and time discount and allowance for risks and uncertainly causes the costs of operating the reservoir to exceed the

additional benefits or during which period it can be operated with economic efficiency.

- (iii) Design life : This is either useful life or shorter of the expected economic life or fixed span of life 50/100 years (according to the practice of the agency owning the project) keeping in view various criteria which period is adopted for economic analysis.
- (iv) Usable Life : The reservoir can continue to serve some of the purposes though to limited extent even after expiry of its economic life, singly or in conjunction with additional facilities created for the purposes.
- (v) Full life : It is the number of years required for the reservoir capacity to be fully depleted by sedimentation.

3.13.1 Various practices in estimating the life of reservoir

Practice in USA : The practice in USA was to adopt a life of 50 to 100 years for reservoir but this is generally related to the repayment period. To prevent premature loss of storage and its services depending on it, an additional storage volume is usually provided in the reservoir for sediment accumulation. It is equivalent to the volume of sediment expected to deposit in the reservoir during the design life of the structures. This positive method of control is generally adopted for the design of most Government built reservoirs in the United States to-day (Hall, 1970).

USBR Practice : The present practice of USBR is to usually provide an additional storage capacity in the reservoir for sediment accumulation so as to prevent the premature loss of storage and the services depending on it. This volume of sediment is equivalent to the volume of sediment expected to deposit in the reservoir during the design life of the structure. In connection with the Colorado river storage project in the

Upper Colorado river basin, a basic concept adhered to was that a specified minimum active storage content should remain at the end of 200 years period (USBR, 1971).

TVA Practice : When the project is envisaged, the silt load is normally assessed by suspended-load observations on the stream and the life of the reservoir is estimated by assuming a certain density of the deposit. After impounding of the reservoir, capacity surveys by electronic equipment or by other methods actually indicate the silt load trapped in the reservoir and from this, the future expected sediment load and the life of the reservoir may be correctly estimated.

Practice in Pakistan : In the proposed reservoirs, the life has been estimated as the number of years when the total capacity of the reservoir would be depleted by sediment and this has been obtained by dividing capacity of reservoir by the annual suspended sediment load passing at the site. It has been further assumed that the dead storage would be depleted first and later encroachment will start into live storage.

Practice in India : Generally, the practice in India has been to adopt 100 years as the life of reservoirs and to provide a silt storage space (dead storage) equal to the estimated total volume of silt deposition during its entire life. This has followed in general elsewhere and the general idea being that such big structures should be capable of satisfactory functioning for at least a period of 100 years (Murthy, 1969).

Practice in Japan : Generally, the silt storage amount for 100 years is adopted, there is no need for dead storage over that amount. However, it is sometimes necessary to provide for dead storage exceeding the anticipated silt accumulation level in order to make the chance in head small or to prevent the eddying of water for power generation. This silt storage capacity can be utilized for a considerable length of time after the construction of the reservoir; accordingly, in some cases a water-discharging device is provided in order to the dead water below the silt accumulation level may be utilized in abnormally dry years (Japan Electric Generation and Transmission Co. Ltd. ,1950).

Practice in Bangladesh : Since the completion of the Kaptai project in 1962, the consultants and expert attached to the project stated in their report that the reservoir would have a life of 272 years to 300 years. The life of the reservoir was estimated by assuming a silt load of 1000 ppm with 50% addition for bed load and a dry unit of settled deposit of 60 pounds per cubic feet. They also suggested for comprehensive study to know the extent and the rate of siltation upon the effective storage capacity of the reservoir (BWDB, 2000).

CHAPTER- FOUR

METHODOLOGY

4.1 Introduction

The present study has been undertaken in order to predict the future trend of sediment deposition of Kaptai reservoir from field data by using the Prediction model. Others empirical equations have been used to calculate the annual sedimentation rate for the existing reservoir. These results have also been compared with Prediction model and actual measurements. Descrepancy has been shown between actual and predicted sediment in Chapter-5. Sediment distribution pattern at different elevations has been determined by using Empirical Area-reduction and Area-increment method. Results obtained by these two methods have been compared in Chapter-5. Finally, expected life of the Kaptai reservoir has also been predicted. The above tasks have been performed systematically with some limitations. They are described in details in the following sections.

4.2 Data collection

Annual inflow data for the last 12 years (1989-2000), storage data at different water levels and Bed reduced level data from Left bank distance have been collected. The earliest data on annual inflow data for the year 1989 to 2000, Water level-storage data and other required data have been collected from the KHS Library. Field survey data for the year of 1983 and 2000 at 67 cross-sections along the Kaptai reservoir and Index map of existing reservoir has been collected from the Surface Water Hydrology Division, BWDB, Comilla.

4.3 Data analysis

In the present study, efforts have been made for the assessment of different items of Kaptai reservoir by several methods. These are Prediction model analysis by sequential data generation, bed slope, width of the reservoir at full water level and stream bed level analysis, area-elevation analysis, comparison of different empirical equations with field measurements and Prediction model. The sediment distribution pattern obtained by empirical Area-reduction and Area-increment method have also been compared. Finally, prediction of expected life of Kaptai reservoir by analysing 'Step method' based on Brune's trap efficiency curve which is related to the capacity-inflow ratio, Garde and Swamee's equation and method provided by Khagawa University, Japan has been made. The above results are shown with tabular and graphical forms in Chapter-5.

4.4 Prediction model

The cumulative water inflow can be obtained by sequential data generation using time series analysis. The following equation was used for generating data as

$$Q_{i+1} = Q_i r + (1-r) \bar{Q} + s(1-r^2) \eta^+ \text{-----} (4.1)$$

Where Q_i = Mean annual water flow in the i th year (Mm^3).

Q_{i+1} = Mean annual water flow in the $i+1$ th year (Mm^3).

S = Standard deviation of the given data (Mm^3).

η^+ = Random normal deviate having zero mean and unit standard deviation.

r = First serial correlation coefficient of observed annual flow data.

$\bar{Q}$ = Mean annual flow (Mm^3)

Swamy (After Mutreza, 1995) related the sediment deposited in a reservoir to cumulative volume of water inflow per unit width of the reservoir at the full reservoir level and the average initial bed slope. The best fit equation is

$$V_s/B = v_p = 1.16 (v_w)^{0.94} S_0^{0.84} \text{-----} (4.2)$$

Where V_s = Volume of sediment deposited in the reservoir (Mm^3).

B = Average width of reservoir at the full water level (m).

v_w = Cumulative volume of water inflow per unit width of the reservoir at the full water level (m^3/m).

S_0 = Average initial bed slope.

4.4.1 Computation of Standard Deviation

The Standard deviation of a set of N numbers $x_1, x_2, \dots, x_N$ is denoted by s and is

$$\text{defined by, } s = \left(\frac{N}{N-1} \right) \sqrt{\frac{\sum x_i^2}{N} - \bar{x}^2} \text{-----} (4.3)$$

Where N = Total number of observations (Years).

x_i = Water inflow in the i th year (Mm^3).

$\sum x_i$ = Cumulative water inflow in the i th year (Mm^3).

$\bar{Q}$ = mean annual inflow in the i th year (Mm^3).

4.4.2 Serial correlation coefficient calculation

The serial correlation coefficients are therefore defined as correlation coefficient (Linear association) between the members of the series that are k units apart and is expressed as :

$$r_k = \frac{\frac{1}{N-K} \sum_{i=1}^{N-K} x_i \cdot x_{i+k} - \frac{1}{(N-K)^2} \left(\sum_{i=1}^{N-K} x_i \right) \left(\sum_{i=1}^{N-K} x_{i+k} \right)}{\left[\frac{1}{N-K} \sum_{i=1}^{N-K} x_i^2 - \frac{1}{(N-K)^2} \left(\sum_{i=1}^{N-K} x_i \right)^2 \right]^{\frac{1}{2}} \left[\frac{1}{N-K} \sum_{i=1}^{N-K} x_{i+k}^2 - \frac{1}{(N-K)^2} \left(\sum_{i=1}^{N-K} x_{i+k} \right)^2 \right]^{\frac{1}{2}}} \text{-----} (4.4)$$

Where, N is the length of data and is the number of product pairs (x_i, x_{i+k}) . If we put $k=1$ in equation (4.4), we get the serial correlation coefficient at lag one; that is, it will give the idea of dependence or association between consecutive values of the time series. So, the serial correlation coefficient at lag one, r_1 is given by equation (4.4) as

$$r_1 = \frac{\frac{1}{N-1} \sum_{i=1}^{N-1} x_i x_{i+1} - \frac{1}{(N-1)^2} \left(\sum_{i=1}^{N-1} x_i \right) \left(\sum_{i=1}^{N-1} x_{i+1} \right)}{\left[\frac{1}{N-1} \sum_{i=1}^{N-1} x_i^2 - \frac{1}{(N-1)^2} \left(\sum_{i=1}^{N-1} x_i \right)^2 \right]^{\frac{1}{2}} \left[\frac{1}{N-1} \sum_{i=1}^{N-1} x_{i+1}^2 - \frac{1}{(N-1)^2} \left(\sum_{i=1}^{N-1} x_{i+1} \right)^2 \right]^{\frac{1}{2}}} \quad (4.5)$$

4.4.3 Computation of Random normal standardize deviate

The variable that measures from the mean in units of the standardized variable is a dimensionless quantity (i, e., is dependent of the units used), and is given by

$$Z = \frac{x_i - \bar{x}}{s} \quad (4.6)$$

If the deviations from the mean are given in units of the standard deviation, it is said to be expressed in standard units, or standard scores. This standard units or standard scores are shown in table A6 which was read from this table.

4.4.4 Estimation of average width of the reservoir

The maximum width of the Kaptai reservoir is only 4 km, but it extends along with many tributaries to the Karnafulli river. But for the calibration of the prediction model, it is necessary to calculate the average width of the existing reservoir at full water level of 33.22 m. Width of each cross-section is not constant at full water level. It may vary

for all cross-sections. In order to find out the average width of the reservoir, it has been measured all 67 cross-sections for the whole reservoir area. The existing survey report (BWDB, 2000) prepared by distance versus elevation curve and width of the reservoir at full water level of 33.22 m was measured and then it was averaged. This width for all sections and average width are shown in tabular form in Appendices (Table A2).

4.4.5 Determination of average initial bed slope

The quantity of sediment delivered to a reservoir depends on many factors. Bed slope is one of them and it reflects on soil erosion. Eroded material accumulates at different cross-sections of the whole reservoir area which is the main causes of siltation. The effect of slope on run off and erosion as a result of mechanical disturbance. Slope was calculated by subtracting the lowest bed R.L of two consecutive sections and dividing it by the corresponding section length. Out of 67 cross-sections, only 31 sections were used by this procedure and then it was averaged. Only the data of 1983 was used to determine the average initial bed slope. This was shown in tabular form in appendices (Table A3).

4.4.6 Computation for sediment deposition :

The computation for sediment deposition (time-series analysis) are shown in tabular and graphical form (Chapter-5). The sedimentation rate per 100 sq.km/year was calculated by the following equation :

$$R = \frac{V_s * 100 * C_f}{A * y} \text{-----} (4.7)$$

Where, R = Sedimentation rate per 100 sq.km/year (Mm^3)

V_s = Volume of sediment deposited in the reservoir (Mm^3)

A = Catchment area of reservoir (Km^2)

y = Number of years

C_f = Consolidation factor in percent

4.4.6.1 Consolidation factor :

The factor which contributes to the reservoir sedimentation due to expulsion of water from the voids is called consolidation factor. With the advance of years, the rate of sedimentation in a reservoir decreases. The reason for this is the progressive reduction in the volume of deposits due to the settlement and shrinkage as a result of the superimposed load of additional sediment and weathering process. Consolidation factor varies from reservoir to reservoir which depends on many factors such as catchment characteristics, unit weight and time etc. It is normally assumed from 30% to 60% of the total sedimentation rate. For this study, it has been assumed to be 0.40.

4.5 Computation of annual silting rate (Q_s)

The annual silting rate of the reservoir was determined by using the following empirical equations.

4.5.1 Joglekar's Equation

Joglekar gave an equation to the observed data as

$$Q_s = \frac{0.597}{A^{0.24}} \text{-----} (4.8)$$

Where Q_s = the annual silting rate from 100 sq.km of watershed area ($Mm^3/100$ sq.km).

A = Catchment area of the reservoir (sq.km).

4.5.2 Garde and Swamee's Equation

An approximate empirical method for estimating the total volume of sediment in a reservoir is given by Swamee and Garde (Garde and Rangu Raju, 1985) as follows :

$$\frac{V_s}{V_r} = \frac{\left(\frac{T}{T^*}\right)^m}{\left[1 + \left(\frac{T}{T^*}\right)^{\frac{m}{n}}\right]^n} \quad \text{-----(4.9)}$$

Here, V_s = Total volume of sediment deposited in T years (Mm^3)

V_r = Original reservoir volume in Mm^3 .

T^* = Number of years in which the reservoir would be completely filled up and may be calculated by ,

$$T^* = 2.21 \times 10^{-8} \times \frac{A^{0.38} \bar{P}^{4.11}}{V_R^{0.019}} \quad \text{-----(4.10)}$$

Where A = Catchment area in sq.km.

$\bar{P}$ = average annual rainfall in cm.

m = Ranged between 0.47 and 1.0

n = ranged between 0.15 and 0.36 for the observed reservoir.

4.5.3 Khosla's Method

Khosla's analysed the data from various reservoirs and observed that the annual sediment deposited against the catchment area and suggested the following relationship

$$Q_s = \frac{0.323}{A^{0.28}} \text{-----(4.11)}$$

Where Q_s is the annual silting rate from 100 sq.km of watershed area ($Mm^3/100$) and A is the catchment area (sq.km) of the reservoir.

4.6 Actual measurement from field data

It has been stated that the whole Kaptai reservoir consists of 67 cross-sections. Field survey data of year 1983 and of 2000 have shown in appendices for all 67 cross-sections. The total R.L area was calculated by summing up the area of individual trapezoids.

$$\text{Area} = \frac{d_1}{2} (O_1 + O_2) + \frac{d_2}{2} (O_2 + O_3) + \frac{d_3}{2} (O_3 + O_4) + \text{-----(4.12)}$$

Here $O_1, O_2, O_3, O_4 \dots$ are the ordinates (R.L) at each point of division and d_1, d_2, d_3 are the distance between two ordinates.

By using above (4.12) equation, the R.L area was calculated by using data of year 1983 and 2000. If R.L area of year 1983 is lower than of year 2000, then siltation occur and if the R.L area of year 1983 is greater than that of year 2000, then it is Erosion. So, Erosion and silting area have been calculated by subtracting the R.L area of year 1983 and 2000 for all 67 cross-section. The length of each cross-section was measured by Rotometer from the Index map of the Kaptai reservoir. Siltation and erosion volume has been computed for all 67 cross-sections by the following formula

$$V = A_s * L \text{-----(4.13)}$$

Where, V = Siltation/erosion volume(m^3) for each cross-sections.

A_s = Siltation or erosion area (m^2) of individual cross-sections.

L = Length of each cross-sections (m).

Finally, actual sedimentation rate per 100 sq.km/year was determined by the following the equation (4.7).

4.7 Method for determining silt deposition in the dead storage zone

Murthy (After Mutreza, 1995) has suggested the following equation for the determination of silt deposit in the dead storage zone :

$$Q_s = KC^n \text{ ----- (4.14)}$$

Where Q_s = Percent of total silt in the dead storage space.

C = Percent of dead storage capacity to the total capacity.

n, k = Constants depending upon the type of reservoir and their values can be obtained from table 4.1

Table 4.1 Values of constants k and n – Murthy's Method.

Reservoir type		k	n
I	Lake	3.39	0.78
II	Flood plain	9.33	0.56
III	Hill	25.12	0.35
IV	Gorge	32.36	0.30

4.8 Methods for Predicting sediment Distribution

Borland and Millar (After Mutreja, 1995) have suggested two methods for predicting the sediment distribution pattern. The first method is a mathematical procedure based on the observations of sediment distribution in several reservoirs and is known as

Empirical Area-reduction method. The second is strictly mathematical and is called Area-increment method.

4.8.1 Assumption due to classification

Borland and Miller classified the sediment distribution pattern into four types of reservoirs as discussed in the Chapter-3 (table 3.2). Kaptai reservoir is also called Kaptai Lake. Another concern that reservoir is an artificial Lake. So, Kaptai reservoir has been considered as Lake type reservoir according to the Borland and Millar classification. Lake type reservoir have catagoried as standard classification I (table 3.2) whose sediment stage is near to the top as shown in table 4.2.

4.8.2 Empirical Area-reduction Method

Sediment will be deposited above the stream bed level. The height above the bed level at which sediment deposition is desired, by dividing it with the total height (the difference between the full water level and the stream bed level) is called relative depth. To workout the sediment area at relative depth firstly dimensionless relative area has been calculated by the following formula, $A_p = cp^m(1-p)^n$. Here p is the relative depth and the value of c , m , n were taken from the table 4.2 for lake type reservoir.

Table 4.2 : Characteristics for Four standard type reservoirs-Laras values given in Parentheses.

Type	c	m	n	sediment stage near
I	3.417	1.5	0.2	Top
II	2.324	0.5	0.4	Upper middle
III	15.882	1.1	2.3	Lower middle
IV	4.2324	0.1	2.5	Bottom

It has been assumed to be a probable sediment elevation at the dam after sedimentation. Area at and below this elevation will be equal to the original reservoir area. Then a constant K is to be determined. K is the ratio from the area at the assumed elevation (A_o) to the area of relative depth (A_p) called relative area i.e., $K = \frac{A_o}{A_p}$. After calculating

K, the sediment area above zero elevation at any relative depth is given by the expression KA_p , but below zero elevation it is equal to the original area of the reservoir. Finally, the increment sediment volume has been computed by the average end formula and it may be written as, $V_{inc} = \left(\frac{A_1 + A_2}{2} \right) \frac{H}{100} \text{ Mm}^3$ ----- (4.15)

Where A_1 and A_2 are sediment areas in hectares at two adjoining elevations and H is the difference between these adjoining elevation. Finally accumulation of sediment volume started from bottom to upward. The detail procedure and results are shown by tabular form in table 5.9.

4.8.2.1 Calculation of Mean Stream Bed level

Mean stream bed level was computed from the field survey data and by using super imposing curve. It has been stated earlier that the survey work was conducted at the whole reservoir area in all 67 cross-sections only two times (Year 1983 and 2000). To calculate the stream bed level, width at the reservoir at normal water surface and the elevation from the normal water surface to the datum were measured by scale and these two parameters were multiplied together. Then the total bed R.L area for each section was calculated from the LEW to REW by adding together the area of individual trapezoids by following the equation 4.12. Water surface area was calculated by using the following equation ,

$$A_{\text{water}} = A_{\text{earth}} - A_b \text{ ----- (4.16)}$$

$$A_{\text{water}} = \text{Water surface area in m}^2$$

$$A_{\text{earth}} = \text{Area from the Normal water surface to the datum in m}^2$$

$$A_b = \text{Bed Reduced level area in m}^2$$

After calculating the water surface area, water depth was calculated by

$$h_w = \frac{A_{water}}{W} \text{-----} (4.17)$$

Where, h_w is the water depth in m and W is the width of the reservoir at normal water surface in m. Finally, stream bed level was calculated by subtracting the water depth from the normal water surface elevation (Normal water surface elevation was measured from the datum). Each of the cross-sections has been individually calculated and then they were averaged. The stream bed level for all sections and average value is shown in appendecis (Table A5). The present situation of stream bed level for the existing reservoir was predicted by using the year 2000 data and curve.

4.8.3 Empirical Area-Increment Method

This procedure is based on the assumption that the curve after sedimentation, will parallel to the original curve. This means that the sediment area is constant at all elevations and the sediment volume is uniformly distributed above the new zero elevation. The equation can be written as :

$$V_s = A_o(H-H_o)+V_o \text{-----} (4.18)$$

Where V_s = sediment volume to be distributed (Mm^3)

V_o = Sediment volume below the new zero elevation (Mm^3)

H = Original reservoir depth from the stream bed level (m)

H_o = Height to which the reservoir is completely filled with sediment, i.e., height of the new zero elevation (m)

A_o = Surface area of the reservoir at the new zero elevation and is the area correction factor (ha)

Equation (4.18) mathematically states that the total incoming sediment volume to be distributed V_s gets deposited in two portions : the first is V_o which is below the new zero elevation and the second is uniformly distributed over the height $(H-H_o)$ with

constant sediment area A_0 . Thus the zero elevation is assumed and the surface area of the reservoir and the area correction factor A_0 was calculated by interpolating with respect to this zero elevation. After calculating A_0 , the reservoir capacity based on the reduced areas by applying the end-area method such that the capacity below the maximum normal level is the same as the predetermined capacity obtained by subtracting the sediment accumulation with time from the original capacity. Finally, the computations for sediment-distribution pattern are given in chapter-5 (Table 5.10) with their columnwise details.

4.9 Method for estimating the life of reservoir

1. Murthy (After Mutreza, 1995) described the TVA practice to estimate the life of a reservoir as the 'Step method' based on Brune's trap-efficiency as related to the capacity inflow-ratio (Fig 3.3). Initially, the computations are made for steps of 10, 20 and 30 year intervals as the trap efficiency changes with time because of a reduction in the reservoir due to silt deposition. If trap efficiencies change more rapidly, as in the case at the end of the period, the reservoir approaches to the point of being filled with sediment. The computations are given in table 5.8 (chapter-5), the columns of which are explained below :

- (1) = Time interval in steps of 10 years or so depending upon the change of the trap efficiency due to sediment deposition.
- (2) = Capacity of reservoir at the beginning of time period and is equal to original capacity less the silt. Therefore this is equal to (2)- (6) lagged by one time unit.
- (3) = Average annual inflow have taken from the existing average value.
- (4) = Capacity-inflow ratio (2)/(3).
- (5) = Trap efficiency was read from Fig 3.3 (Chapter -3) corresponding to the capacity- inflow ratio.

(6) = Sediment deposited during in the reservoir during the period of (1) = (annual sediment rate) × (number of years) × (trap efficiency during the period).

2. Swamee and Garde (Garde and Rangu Raju, 1985) has estimated the life of the reservoir by the following equation

$$T_s = 2.21 \times 10^{-8} \frac{A^{0.38} \bar{P}^{4.11}}{V_R^{0.019}} \text{-----(4.19)}$$

Where A = Catchment area of the reservoir in sq.km.

$\bar{P}$ = average annual rainfall in cm.

m = ranged between 0.47 and 1.0

n = ranged between 0.15 and 0.36 for the observed reservoir.

3. Hachiro Kira of Khagawa University (1950), Japan has analysed observed sedimentation data of a number of reservoirs collected all over Japan, U.S.A and Taiwan and found out the number of years when the reservoir will be fully silted up. The following relationship has been developed

$$Y_s = 467 (c/i)^{0.473} \text{-----(4.20)}$$

Where Y_s = average number of years during which the silt will filled up in the reservoir

c = Original storage capacity of the reservoir in cubic meter

i = Annual mean inflow into the reservoir in cubic meter.

CHAPTER – FIVE

RESULTS AND DISCUSSION

5.1 Introduction

This chapter deals with the analysis and discussion of various results which were obtained by using the Prediction model i.e Swamy's equation, other's empirical equations and actual measurement of sediment volume and sedimentation rate in the reservoir. As stated earlier, the inflow data was collected for the year 1989-2000 to predict the future trend of sediment deposition volume and the sedimentation rate by using the Prediction model. Field data of actual survey was collected for the year of 1983 and 2000. In this study, a comparative performance was evaluated between Prediction model with other's empirical equations. Field measurement of sediment yield has been determined for all sections of the whole reservoir area and sedimentation rate was also calculated. This sedimentation rate was also compared between Prediction model and other's empirical equations. The sediment distribution pattern at various elevations from field data by using two empirical methods have been predicted and the results of this two methods were also compared. Finally, life of the reservoir was also computed by the method provided by Khagawa University, step method, Garde and Swamee's equation. The results obtained are presented and discussed in the following sections.

5.2 Measured and Predicted sediment deposition and sedimentation rate

Computation for sediment deposition for Prediction model are shown in table 5.1, 5.2 and 5.3. From the table 5.3 and Fig. 5.1, it is found that the future trend of sediment deposition is increasing in every year. Sedimentation rate per 100 sq.km/year by using Prediction model and other's empirical equation's were found to be 4.09, 2.25, 2.39 and 6.4 ha-m respectively. Sediment deposition and erosion volume for all sections from

actual measurement in the field are shown in table 5.4 and Fig. 5.2. Sedimentation rate per 100 sq.km/year was also computed and which was found to be 3.33 ha-m. From the field measurement, it is observed that most of the sections of reservoir produce siltation and few of them produce erosion. From the field measurement, it is seen that maximum amount of siltation has occurred at the section 16 due to landslide in the adjoining hills and maximum amount of erosion has occurred at the section 43 due to erosion from reservoir banks by wave action and current flow. These are presented in graphical and tabular form. It can be noted that sediment volume are considered as positive and erosion volume are considered as negative to making the curves.

Table 5.1 : Computation for Standard Deviation and Serial Correlation Coefficient of observed run off data.

Year	Inflow, x_i (Given) (Mm ³)	x_{i+1} (2) Lagged by one time unit (Mm ³)	x_i^2 (2)*(2)	x_{i+1}^2 (3)*(3)	$x_i * x_{i+1}$ (2)*(3)
1	2	3	4	5	6
1989	13473.30	13188.36	181529812.90	173932839.50	177690730.80
1990	13188.36	18546.55	173932839.50	343974516.90	244598578.20
1991	18546.55	7687.83	343974516.90	59102730.11	142582723.50
1992	7687.83	20525.70	59102730.11	421304360.50	157798092.20
1993	20525.70	5554.50	421304360.50	30852470.25	114010000.70
1994	5554.50	11308.14	30852470.25	127874030.30	62811063.63
1995	11308.14	12123.64	127874030.30	146982646.90	137095818.40
1996	12123.64	17371.93	146982646.90	301783951.90	210611025.40
1997	17371.93	17022.94	301783951.90	289780486.20	295721322.10
1998	17022.94	17577.05	289780486.20	308952686.20	299213067.50
1999	17577.05	19875.83	308952686.20	395048618.20	343958457.70
2000	19875.83	—	395048618.20	—	—
Total	174255.77		2781119150.00	2599589337.00	2791490880.00

Table 5.2 : Generation of Annual Run off Data for the period 2001-2015

Year	Q_i (Mm^3)	$Q_i * r$ $-0.27788*(3)$	$(1-r) \bar{Q}$ $=1.27788*14521.31$	η^+	$s(1-r^2)\eta^+$ $= 4601.20\eta^+$	$v_w=(3)+(4)$ $+ (6)$
1	2	3	4	5	6	7
2000	-	-	-	-	-	19875.83
2001	19875.83	-5523.09	18556.49	0.2251	1035.73	14069.13
2002	14069.13	-3909.53	18556.49	-0.3973	-1828.05	12818.91
2003	12818.91	-3562.12	18556.49	-0.3765	-1732.35	13262.02
2004	13262.02	-3685.25	18556.49	-0.3867	-1779.28	13091.96
2005	13091.96	-3637.99	18556.49	-0.3825	-1759.96	13158.54
2006	13158.54	-3656.49	18556.49	-0.3847	-1770.08	13129.91
2007	13129.91	-3648.54	18556.49	-0.3836	-1765.02	13142.93
2008	13142.93	-3652.16	18556.49	-0.3847	-1770.08	13134.25
2009	13134.25	-3649.75	18556.49	-0.3836	-1765.02	13141.73
2010	13141.72	-3651.82	18556.49	-0.3845	-1769.16	13135.71
2011	13135.51	-3650.09	18556.49	-0.3842	-1767.78	13138.62
2012	13138.62	-3650.95	18556.49	-0.3836	-1765.02	13140.51
2013	13140.52	-3651.50	18556.49	-0.3835	-1764.56	13140.44
2014	13140.43	-3651.46	18556.49	-0.3834	-1764.10	13140.93
2015	13140.92	-3651.59	18556.49	-0.3836	-1765.02	13139.88

Table 5.3 : Computation of Sediment Deposition

Year	Annual run off from table No.5.2	Cumulative Annual run off $\Sigma(2)$ (Mm ³)	Cumulative dis- charge per unit width, V_w $= (4)/664.13$ (Mm ²)	$(v_w)^{0.94}$	$V_s = 0.7985 * (6)$ (Mm ³)
1	2	3	4	5	6
2001	14069.13	14069.13	21.18	17.63	14.08
2002	12818.91	26888.04	40.49	32.43	26.05
2003	13262.02	40150.06	60.45	47.26	37.74
2004	13091.96	53242.02	80.17	61.63	49.21
2005	13158.54	66400.56	99.98	75.84	60.56
2006	13129.91	79530.47	119.75	89.86	71.35
2007	13142.93	92673.40	139.54	103.76	82.85
2008	13134.25	10807.65	159.32	117.53	93.85
2009	13141.72	118949.37	179.10	131.19	104.76
2010	13135.51	132084.88	198.88	144.77	115.60
2011	13138.62	145223.50	218.67	158.27	126.38
2012	13140.52	158364.02	238.45	171.69	137.09
2013	13140.43	171504.45	258.24	185.06	147.77
2014	13140.92	184645.37	278.03	198.35	158.38
2015	13139.88	197785.25	297.81	211.59	168.95

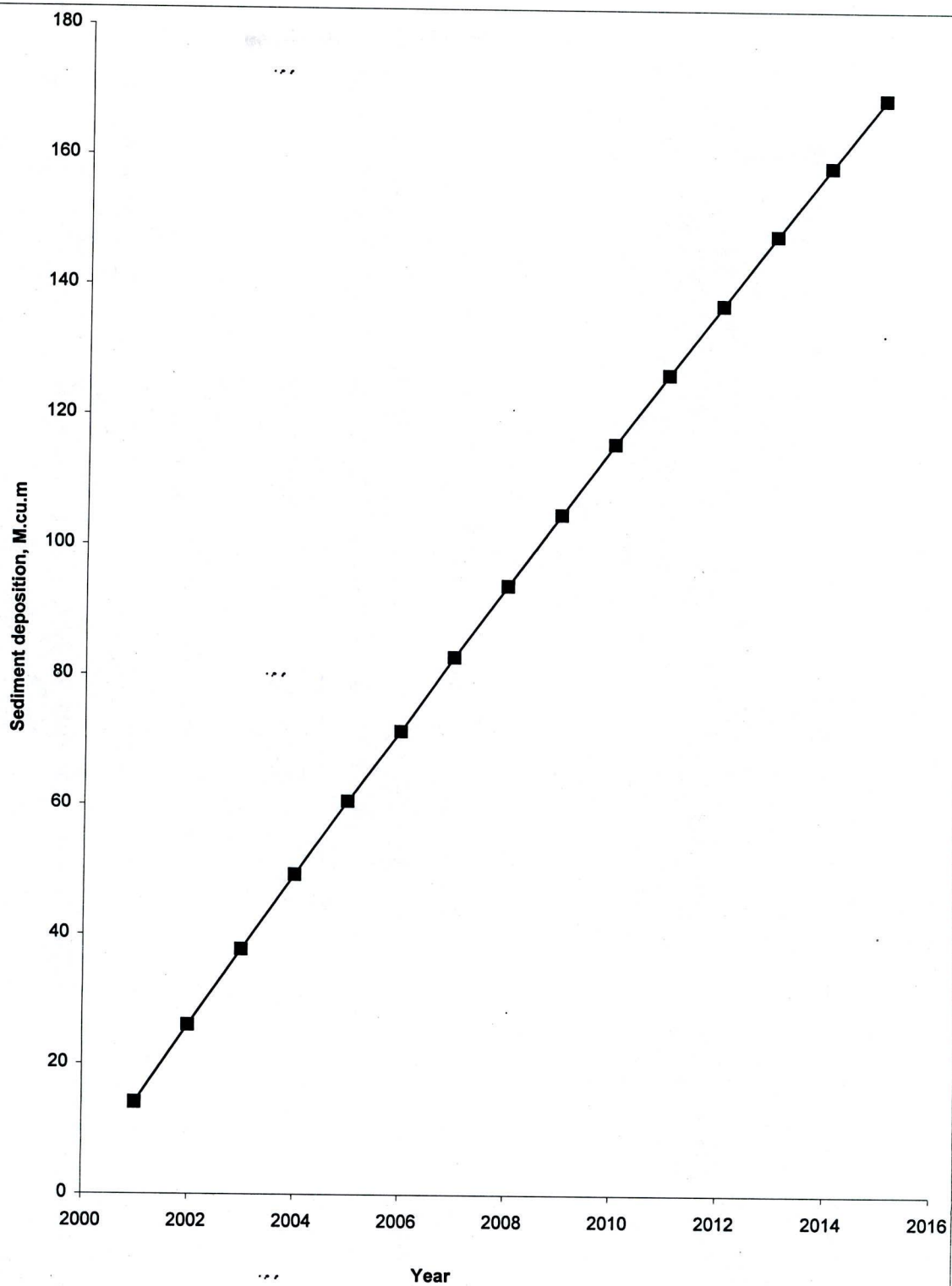


Fig 5.1 : Time-series analysis curve

Table 5.4 : Measured amount of sediment and erosion volume of Kaptai reservoir (1983-2000)

Section No.	Bed R.L Area (m ²)		Siltation Area(m ²)	Erosion Area(m ²)	Length of each Cross-sections, m	Sediment Vol.(Mm ³)	Erosion Vol.(Mm ³)
	Year 1983	Year 2000					
1	10949.08	10985.89	36.81	-	6459.26	0.24	-
2	8066.67	7945.43	-	121.24	2161.85	-	0.26
3	10211.50	10321.74	110.24	-	2193.52	0.24	-
4	6771.36	7130.91	359.55	-	1908.47	0.67	-
5	6048.23	7380.59	-	-	5075.79	6.76	-
6	17411.02	17314.82	-	96.2	3800.79	-	0.37
7	8708.33	7759.96	-	948.37	2415.24	-	-
8	22507.42	21303.94	-	1203.48	2288.54	-	1.82
9	16374.07	15522.24	-	851.83	2288.54	-	1.29
10	16419.99	16505.32	85.33	-	3555.47	0.30	-
11	6855.71	6612.73	-	242.98	1425.30	-	0.35
12	16362.80	18451.99	2089.19	-	2351.89	4.91	-
13	35186.49	38236.83	3050.34	-	2288.54	6.98	-
14	13388.81	14286.80	897.99	-	2288.54	2.06	-
15	8484.72	8994.87	510.15	-	2415.24	1.23	-
16	63819.38	63968.00	148.62	-	152003.16	22.59	-
17	50393.79	47792.96	-	2600.83	1640.24	-	4.27
18	28247.44	27383.78	-	863.66	1640.24	-	1.41
19	67907.18	77210.00	9302.82	-	2415.25	22.46	-
20	29154.63	29707.61	552.98	-	3175.40	1.76	-
21	30276.88	27467.83	-	2809.05	3033.86	-	8.52
22	12351.99	12391.63	39.64	-	3555.47	0.14	-
23	21778.51	21365.34	-	413.17	3800.79	-	1.57

Table 5.4 : Contd. (1983-2000)

Section No.	Bed R.L Area (m ²)		Siltation Area (m ²)	Erosion Area (m ²)	Length of each Section(m)	Siltation Volume (Mm ³)	Erosion Volume (Mm ³)
	Year 1983	Year 2000					
24	38693.49	40390.15	1696.66	-	3682.17	6.25	-
25	22806.61	22603.73	-	202.88	2933.86	-	0.59
26	12553.06	12465.39	-	87.67	1693.63	-	0.15
27	11392.59	11590.97	198.38	-	3808.86	0.76	-
28	3894.88	4090.28	195.40	-	2545.95	0.50	-
29	6571.20	6774.73	203.53	-	3808.86	0.78	-
30	14760.33	14975.56	215.23	-	3808.86	0.82	-
31	9511.70	9724.40	212.70	-	3872.21	0.83	-
32	4301.86	4489.13	187.27	-	2161.85	0.41	-
33	16031.13	16334.98	303.85	-	2541.93	0.77	-
34	10696.03	11283.14	587.93	-	5075.79	2.98	-
35	7916.28	8177.45	261.17	-	5075.79	1.33	-
36	17642.78	22936.51	5293.73	-	2262.14	11.98	-
36A	21004.50	23740.70	2736.20	-	3175.36	8.69	-
37	13358.54	15093.57	1735.03	-	2541.93	4.41	-
38	14005.83	16249.73	2243.90	-	2351.89	5.28	-
39	20363.51	22616.14	2252.63	-	4442.33	7.13	-
40	12832.74	12912.37	79.63	-	4695.71	0.38	-
41	51851.04	50712.39	-	1138.65	4200.80	-	4.78
42	19163.89	19567.48	403.59	-	10776.95	4.35	-
43	8818.71	6111.62	-	2707.09	5467.72	-	14.80
44	8230.80	8435.42	204.62	-	4949.10	1.01	-
45	8101.22	8487.76	386.54	-	2541.93	0.98	-

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Table 5.4 : Contd. (1983-2000)

Section No.	Bed R.L Area (m ²)		Siltation Area (m ²)	Erosion Area (m ²)	Length of each section (m)	Sediment Volume (Mm ³)	Erosion Volume (Mm ³)
	Year 1983	Year 2000					
46	6491.06	6675.60	184.54	-	3808.86	0.70	-
47	2459.10	2538.93	79.83	-	2541.93	0.20	-
48	2722.12	2865.70	143.58	-	2415.24	0.35	-
49	14873.55	15138.82	265.27	-	5075.79	1.35	-
50	2577.35	2690.69	113.34	-	2541.93	0.29	-
51	2237.56	2346.08	108.52	-	2161.85	0.24	-
52	2679.36	2790.61	111.25	-	1908.47	0.21	-
53	2576.54	2716.78	140.24	-	3555.47	0.50	-
54	3944.95	4576.73	631.78	-	2541.93	1.61	-
54A	2824.56	2977.31	152.75	-	3808.86	0.58	-
54B	2951.35	3097.03	145.68	-	1591.73	0.23	-
54C	3054.81	3041.96	-	12.85	1983.66	-	0.025
55	6107.14	5713.00	-	394.14	2580.47	-	1.02
56	4036.32	5829.91	1793.59	-	2668.62	4.79	-
57	8750.32	9567.27	816.95	-	5075.79	4.15	-
58	5437.57	7040.86	1603.29	-	3682.17	5.93	-
59	7186.14	7354.81	168.67	-	2541.93	0.43	-
60	4328.10	4753.58	425.48	-	2541.93	1.08	-
61	5520.05	5772.91	252.86	-	5202.48	1.32	-
62	6179.10	6797.24	618.14	-	10776.98	6.66	-
63	4543.19	5447.91	904.72	-	4991.39	4.52	-

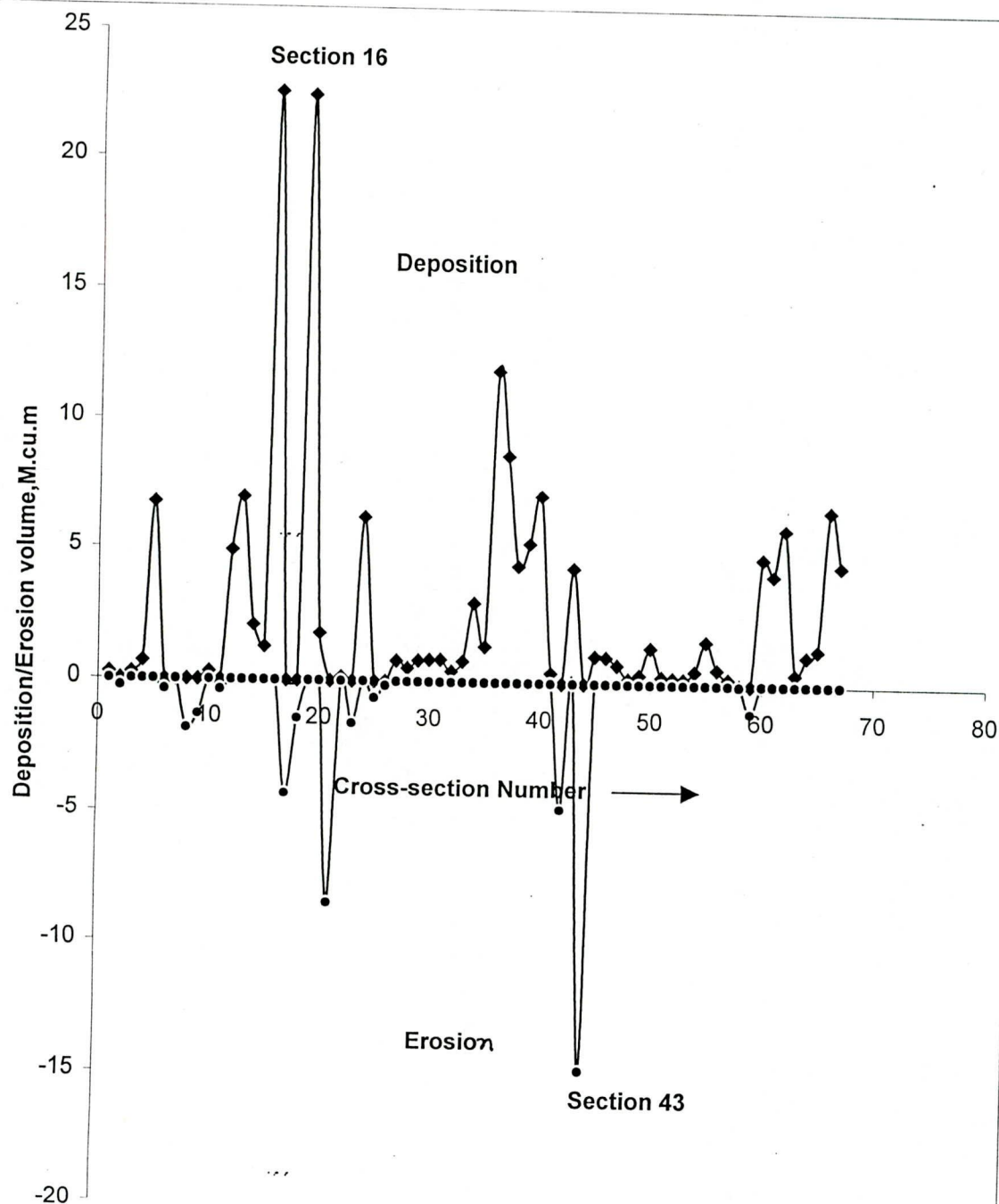


Fig 5.2 : Measured amount of sediment and erosion volume

5.3 Comparison between Predicted and Measured Sedimentation rate

A comparison has been made between measured and predicted sedimentation rate for the reservoir. This comparison is shown in tabular form. From the table 5.6, it is observed that the percentages of variation between measured and predicted sedimentation rate by using Prediction model is smaller than any other empirical equations. Therefore it can be said that the Prediction model can be applied with reasonable accuracy. Comparison of other's empirical equations with field measurement are shown in the table 5.5. Discrepancy among actual measurement, Prediction model and other's empirical equations are also shown in Fig. 5.3 and Fig.5.4. However, from table 5.5 and table 5.6, it is found that the variation of Prediction model is less than other's empirical equations from the actual measurement. So, it is commented that the Prediction model can be easily applicable from the water inflow data than any other empirical equations.

Table 5.5 Comparison of sedimentation rate between Prediction model and other's empirical equations

Name of Empirical equations	Sedimentation rate per 100 sq.km/year in ha-m by three empirical equations, S	Sedimentation rate per 100 sq.km/year in ha-m by using Prediction Model, P	Percentage Discrepancy Ratio $=\{(P-S)/P\} \times 100$	Remarks
Joglekar's equation	6.40	4.09	- 56.48	Khosla's equation is nearly close to Predicon model.
Garde and Swamee's eqns.	2.25		44.99	
Khosla's eqns.	2.39		41.56	

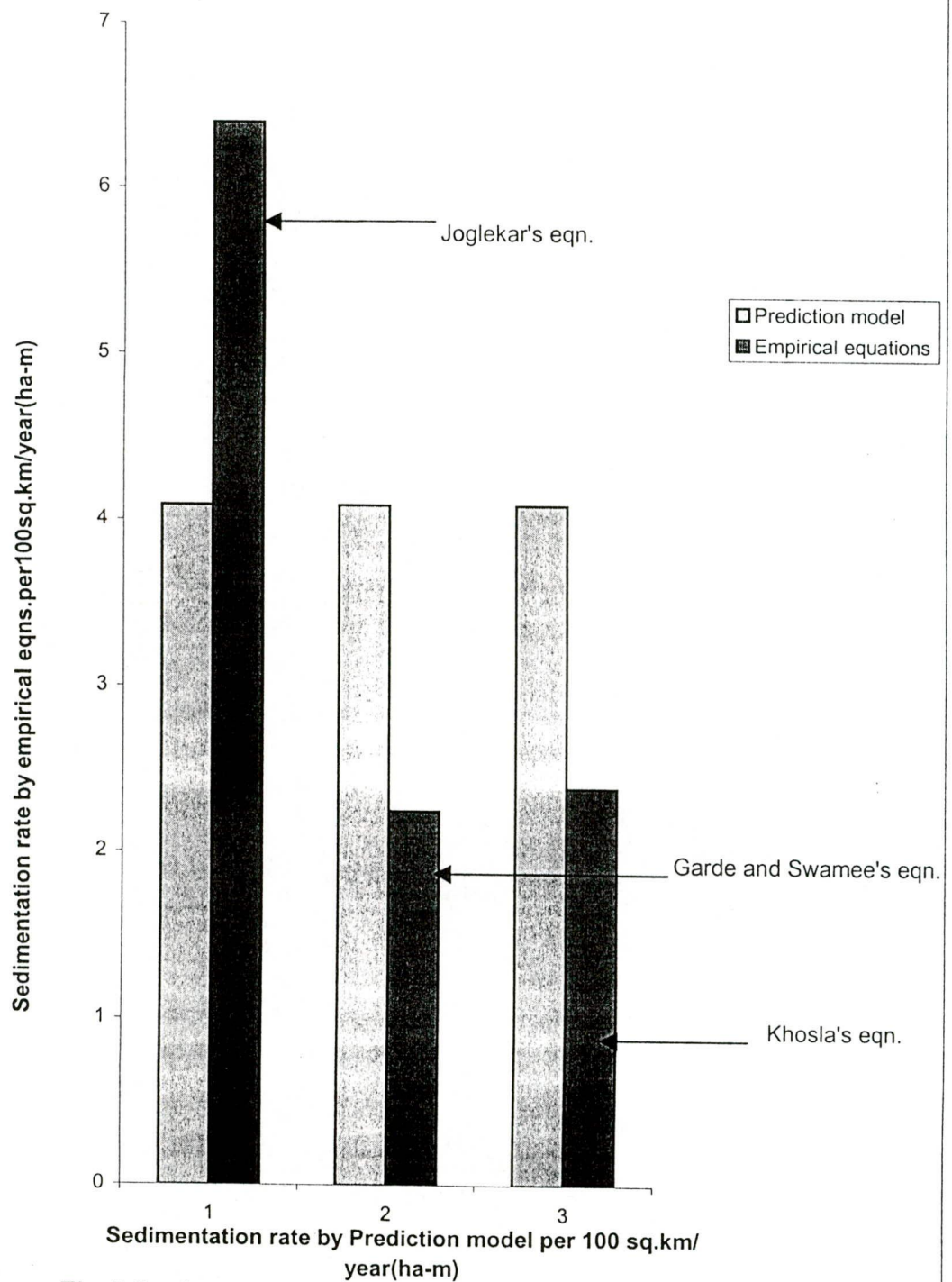


Fig 5.3 : Comparison of sedimentation rate between Prediction model and empirical equations

Table 5.6: Comparison of sedimentation rate among Prediction Model, Empirical equations and observed values

Name of Modules	Predicted sedimentation rate per 100 sq.km/year in ha-m, R	Actual sedimentation rate per 100 sq.km/year in ha-m by field measurement, A	Percentage Discrepancy Ratio $=\{(A-R)/A\} \times 100$	Remarks
Prediction Model	4.09	3.33	-22.82	Prediction model is nearly close to Actual measurements.
Joglekar's Equation	6.40		-92.19	
Garde and Swamee's equation	2.25		32.43	
Khosla's Equation	2.39		28.22	

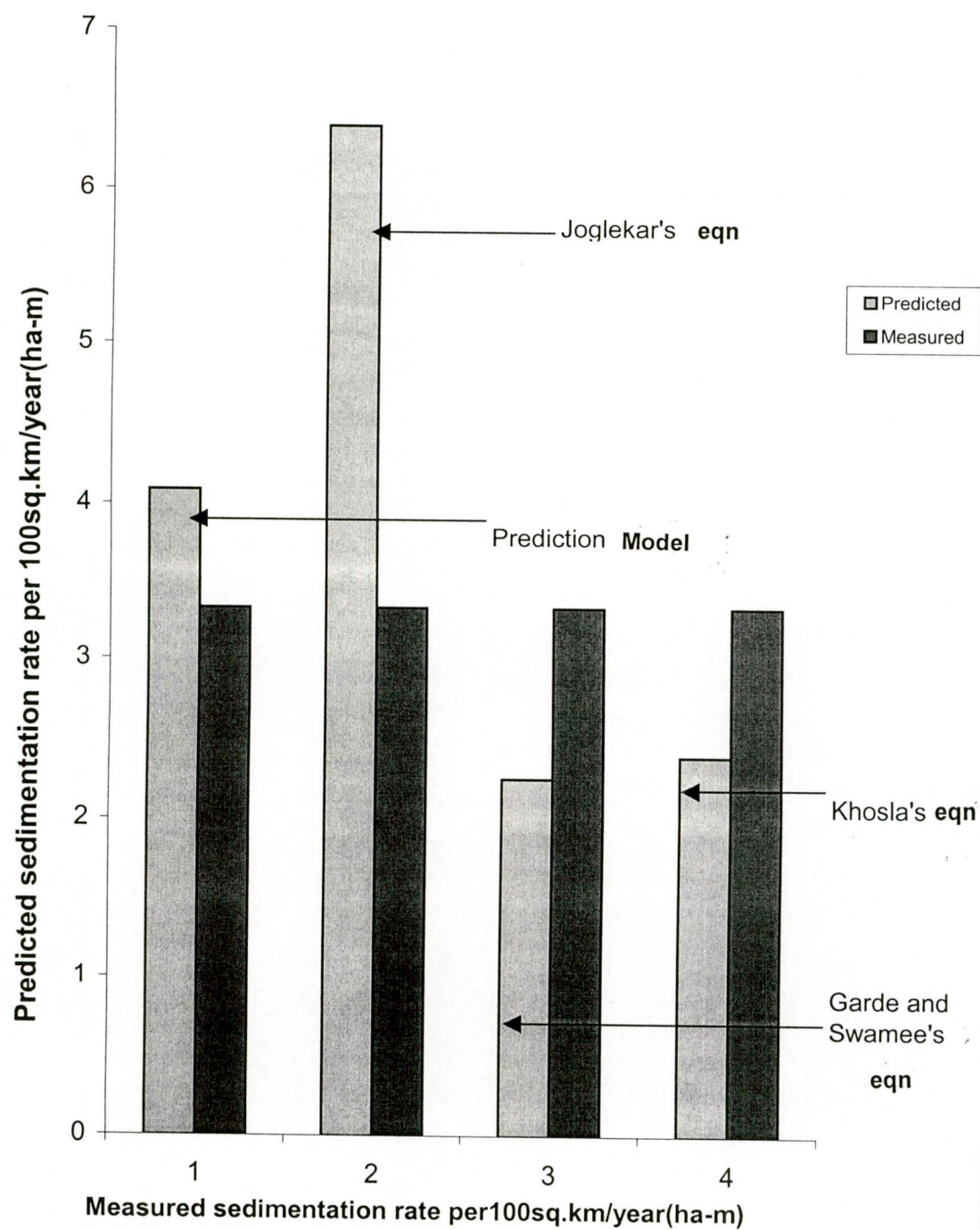


Fig 5.4: Comparison of sedimentation rate among Prediction model, Empirical equations and observed values

5.4 Calculation of Dead Storage Space

Lowest water surface elevation that means water stored in the reservoir below the minimum pool level is said to be the dead storage zone. From the equation 4.14 (chapter- 4), it has been calculated that 47.35 % of the whole reservoir is dead storage space and the remaining 52.65 % is live storage space. Percent Discrepancy Ratio has been determined by predicted and actual measurement which is shown in table 5.7. From this table, it is found that the percentage of variation among predicted and actual measurement is not so large. So, the equation 4.14 can be applied to estimate the dead storage zone of the reservoir.

Table 5.7 : Comparison of Live and Dead storage zone between predicted and field value

Name of module	Predicted, P (%)	Field value, F (%)	Percentage Discrepancy Ratio = $\{(F-P)/F\} * 100$
Live storage	52.65	70.61	25.44
Dead storage	47.35	29.39	- 61.11

5.5 Prediction of Life of the Kaptai Reservoir

The estimated life of the Kaptai reservoir has been predicted using the method provided by Khagawa University is 312 years, Step method is 1110 years and Swamee and Garde method is 4527 years. Therefore, method provided by Khagawa University has been chosen to estimate the expected life of the Kaptai reservoir for safety factor. Finally, it may be observed that the Kaptai reservoir will be completely filled up by sediment within 312 years. The life of the Kaptai reservoir by using different methods are shown in table 5.8 and the life obtained by Step method are shown in table 5.9, Fig 5.5 and 5.6.

Table 5.9 : Life of the Kaptai reservoir obtained by different methods

Name of the methods	Life of the reservoir
Method provided by Khagawa University	312 years
Step method	1110 years
Garde and Swamee's equation	4527 years

Table 5.9 : Estimated life of Kaptai reservoir (Brune's trap efficiency relationship)

Time (Year)	Capacity (ha-m)	Average annual inflow (ha-m)	Capacity inflow ratio=(2)/(3)	Trap efficiency in% (From Fig 3.3)	Sediment deposited (ha-m)	Cu. Sediment deposited (ha-m)
1	2	3	4	5	6	7
0	617000.00	1452131.42	0.42489	95	—	—
10	610864.14	1452131.42	0.42067	95	6135.86	6135.86
20	604728.28	1452131.42	0.41644	95	6135.86	12271.72
50	586320.70	1452131.42	0.40377	95	18407.58	30679.3
100	555641.40	1452131.42	0.38264	95	30679.30	61358.6
200	494282.80	1452131.42	0.34038	94	61358.60	122717.2
300	433570.08	1452131.42	0.29857	94	60712.72	183429.92
400	372857.36	1452131.42	0.25677	93	60712.72	244142.64
500	312790.52	1452131.42	0.21540	92	60066.84	304209.48
600	253369.56	1452131.42	0.17448	91	59420.96	363630.44
700	194594.48	1452131.42	0.13401	88	58775.08	422405.52
800	137757.04	1452131.42	0.09487	85	56837.44	479242.96
900	82857.24	1452131.42	0.05706	79	54899.80	534142.76
1000	31832.72	1452131.42	0.02192	63	51024.52	585167.28
1030	19625.59	1452131.42	0.01352	54	12207.13	597374.41
1050	12650.09	1452131.42	0.00871	43	6975.50	604349.91
1070	7095.52	1452131.42	0.00489	27	5554.57	609904.48
1080	5351.64	1452131.42	0.00369	25	1743.88	611648.36
1090	3736.94	1452131.42	0.00257	11	1614.70	613263.06
1100	3026.47	1452131.42	0.00208	5	710.47	613973.53
1110	2703.53	1452131.42	0.00186	0	322.94	614296.47

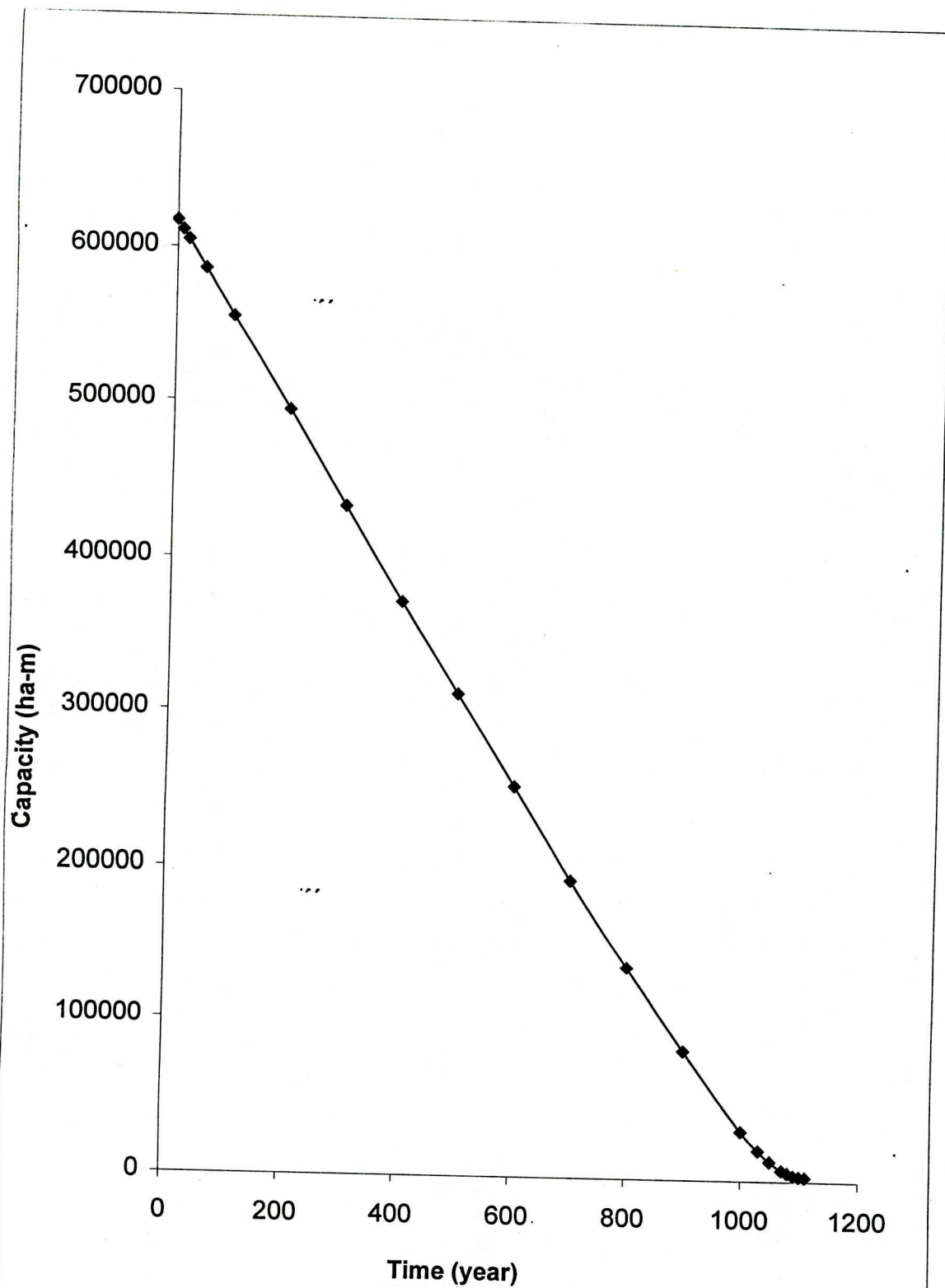


Fig 5.5 : Estimated life of the Kaptai reservoir

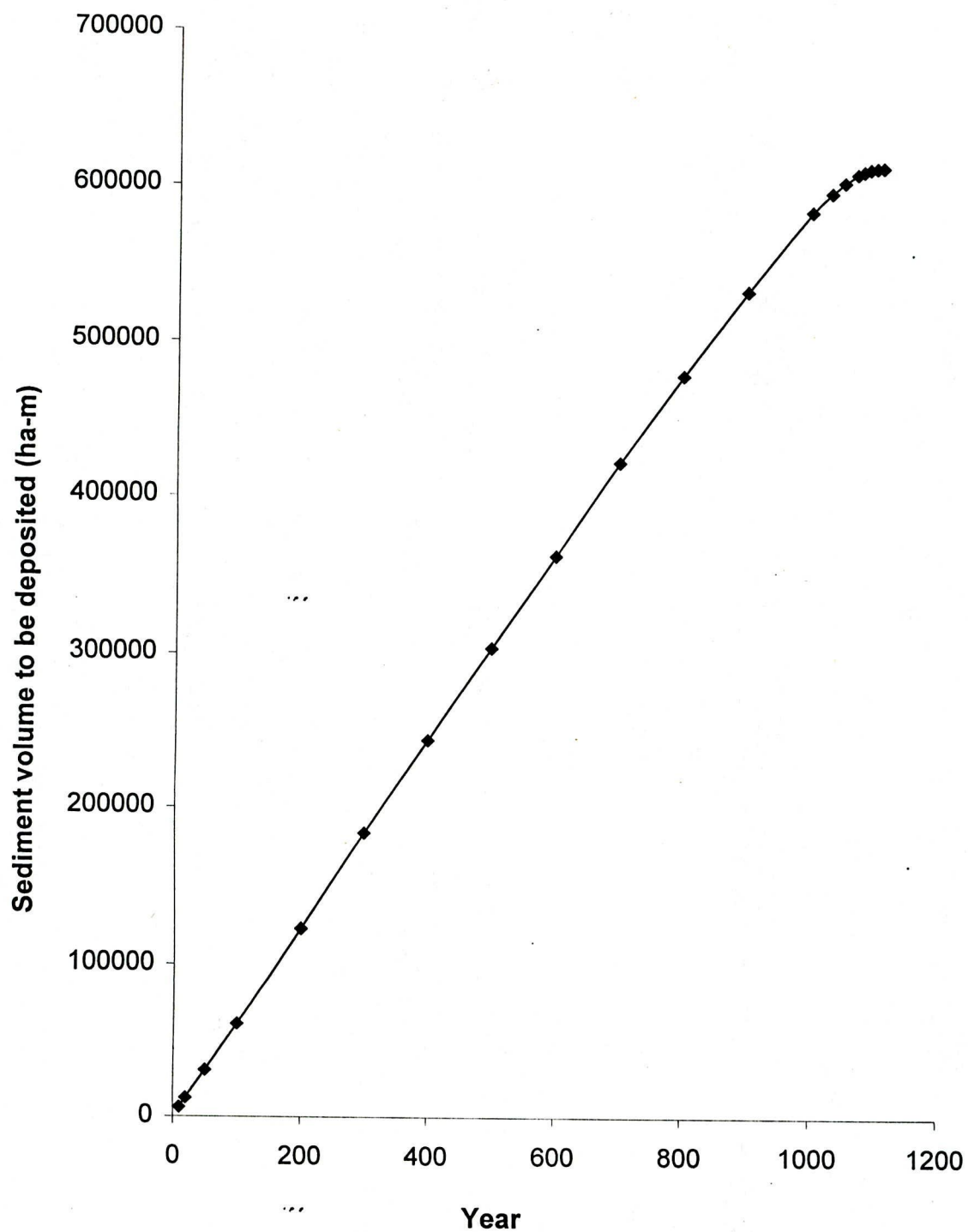


Fig 5.6 : Predicted sediment volume for Kaptai reservoir

5.6 Determination of sediment distribution pattern of the reservoir

The methodology of sediment distribution pattern of two empirical methods have been detailed discussed in Chapter-4. Computation procedures of area-reduction and area-increment methods are columnwise foundout at different elevation which are shown in table 5.9 and table 5.10. Original and revised area-capacity curves of both the methods are shown in Fig 5.7, 5.8 and 5.9 respectively. It is observed that the revised area-capacity curves obtained by empirical area-reduction is not such parallel to the original area-capacity curves but the revised area-capacity curves obtained by empirical area-increment method is approximately parallel to the original area-capacity curves of the reservoir. So, area-increment method can be applicable to determine the sediment distribution pattern of the reservoir.

Table 5.10 : Computation for sediment Distribution pattern of Kaptai reservoir-Empirical area-reduction method

Sl. No.	Elv.(m) MSL	Original Capacity (Mm3)	Original Area(ha)	Depth (2)-17.53 (m)	Relative depth (5)/15.69	Relative Area (ha) $cp^m(1-p)^n$	Sediment Area, KAp ha	Sediment Volume (M.cu.m) $\{(A1+A2)/2\} \cdot H/100$	Acu. Sediment Vol.(Mm3)	Modi. accu Sediment Vol.(Mm3)	Revised Area(ha) (4)-(8)	Modi. revised Capacity(Mm3) (3)-(11)
1	2	3	4	5	6	7	8	9	10	11	12	13
1	33.22	6503.54	79226.67	15.69	1.00	0.00	0.00	72.38	5277.81	5277.81	79226.67	1225.73
2	32.92	6265.86	74038.71	15.39	0.98	1.50	48251.65	158.39	5205.44	5205.44	25787.1	1060.42
3	32.61	6036.34	72016.67	15.08	0.96	1.68	53938.39	165.95	5047.04	5047.04	18078.3	989.30
4	32.31	5820.29	67703.23	14.78	0.94	1.77	56695.68	178.15	4881.09	4881.09	11007.6	939.20
5	32.00	5610.41	68980.00	14.47	0.92	1.82	58237.78	175.82	4702.94	4702.94	10742.2	907.47
6	31.70	5403.47	70003.33	14.17	0.90	1.84	58973.04	177.27	4527.13	4527.13	11030.3	876.34
7	31.40	5193.46	64864.52	13.87	0.88	1.85	59205.08	183.31	4349.86	4349.86	5659.43	843.60
8	31.09	4992.38	63270.97	13.56	0.86	1.84	59060.28	182.40	4166.55	4166.55	4210.69	825.83
9	30.78	4796.24	63326.67	13.25	0.84	1.83	58618.11	174.88	3984.15	3984.15	4708.56	812.09
10	30.48	4606.26	61680.00	12.95	0.83	1.81	57967.53	172.66	3809.27	3809.27	3712.47	796.99
11	30.18	4421.22	58496.77	12.65	0.81	1.78	57140.04	175.57	3636.61	3636.61	1356.74	784.61
12	29.87	4239.88	57976.67	12.34	0.79	1.75	56132.16	166.75	3461.04	3461.04	1844.51	778.84
13	29.57	4065.95	55033.65	12.04	0.77	1.72	54916.13	168.68	3294.29	3294.29	117.52	771.66
14	29.26	3895.71	53813.33	11.73	0.75	1.68	53791.8	159.44	3125.61	3125.61	121.53	770.10
15	28.96	3734.27	52580.65	11.43	0.73	1.64	52502.66	160.57	2966.17	2966.17	177.99	768.10
16	28.65	3571.27	51400.00	11.12	0.71	1.59	51094.06	151.14	2805.59	2805.59	305.94	765.68
17	28.35	3417.07	49668.00	10.82	0.69	1.55	49548.38	151.56	2654.45	2654.45	119.62	762.62
18	28.04	3266.57	48110.00	10.51	0.67	1.50	48110.00	140.21	2502.89	2502.89	0.00	0.00
19	27.74	3122.24	45364.52	10.21	0.65	1.45	45364.52	140.42	2362.68	2362.68	0.00	0.00
20	27.43	2981.61	45230.00	9.90	0.63	1.40	45230.00	131.12	2222.26	2222.26	0.00	0.00
21	27.13	2845.92	42183.87	9.60	0.61	1.35	42183.87	131.03	2091.14	2091.14	0.00	0.00
22	26.82	2715.15	42350.00	9.29	0.59	1.30	42350.00	122.62	1960.11	1960.11	0.00	0.00
23	26.52	2588.10	39396.77	8.99	0.57	1.25	39396.77	121.62	1837.49	1837.49	0.00	0.00
24	26.21	2465.97	39066.67	8.68	0.55	1.20	39066.67	114.11	1715.87	1715.87	0.00	0.00
25	25.91	2348.77	37006.45	8.38	0.53	1.14	37006.45	114.08	1601.76	1601.76	0.00	0.00
26	25.60	2234.05	36596.67	8.07	0.51	1.09	36596.67	106.23	1487.68	1487.68	0.00	0.00
27	25.30	2124.26	34222.58	7.77	0.50	1.04	34222.58	105.31	1381.45	1381.45	0.00	0.00
28	24.99	2018.17	33720.00	7.46	0.48	0.98	33720.00	98.33	1276.14	1276.14	0.00	0.00
29	24.69	1917.01	31832.26	7.16	0.46	0.93	31832.26	98.42	1177.81	1177.81	0.00	0.00
30	24.38	1818.33	31663.33	6.85	0.44	0.88	31663.33	91.67	1079.39	1079.39	0.00	0.00
31	24.08	1723.34	29448.39	6.55	0.42	0.83	29448.39	90.89	987.72	987.72	0.00	0.00
32	23.77	1632.05	29193.33	6.24	0.40	0.77	29193.33	84.38	896.83	896.83	0.00	0.00
33	23.47	1544.47	27061.29	5.94	0.38	0.72	27061.29	82.16	812.45	812.45	0.00	0.00
34	23.16	1460.58	25942.81	5.63	0.36	0.67	25942.81	730.28	730.29	730.29	0.00	0.00
35	17.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

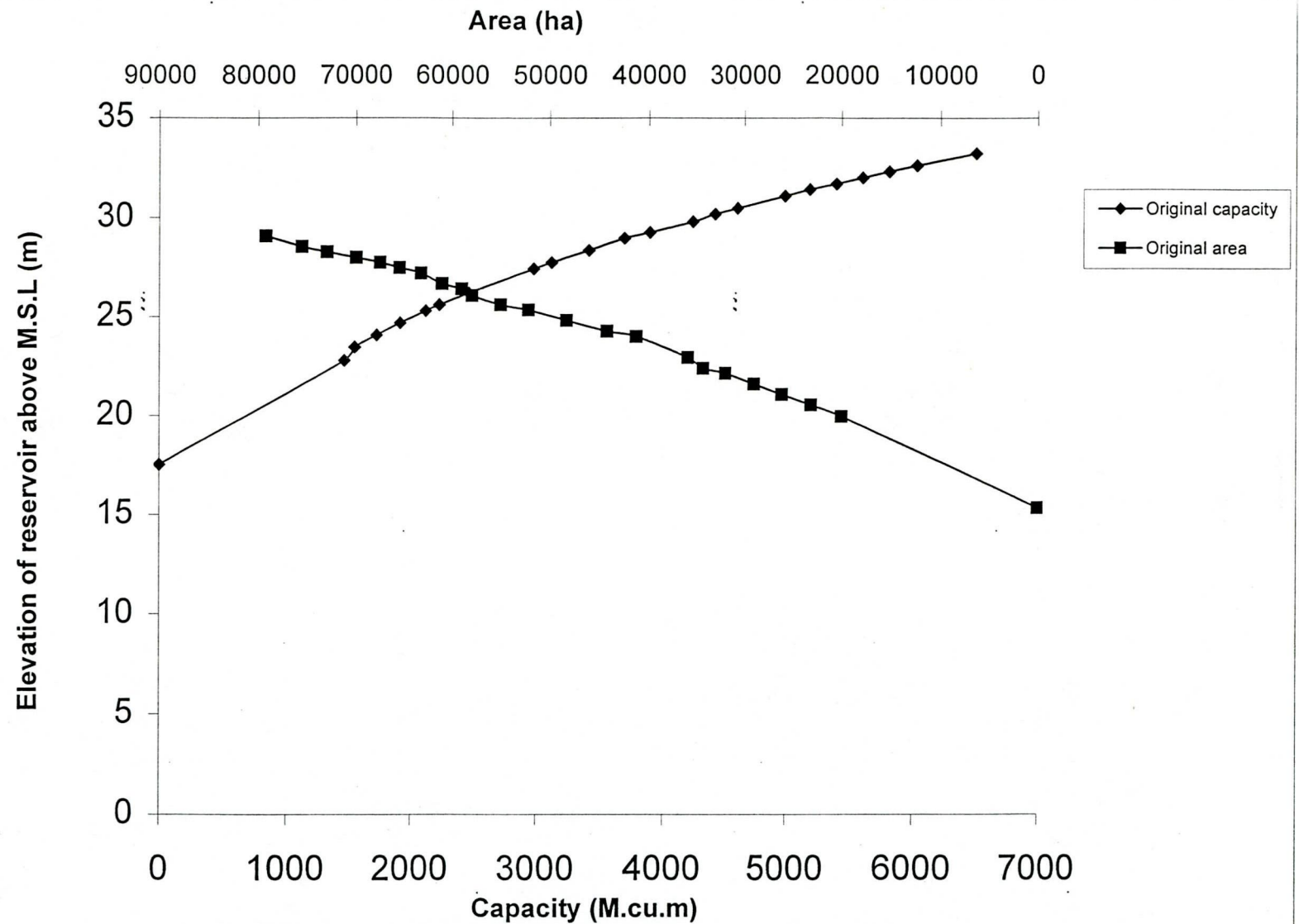


Fig 5.7 : Original area-capacity curves of Kaptai reservoir

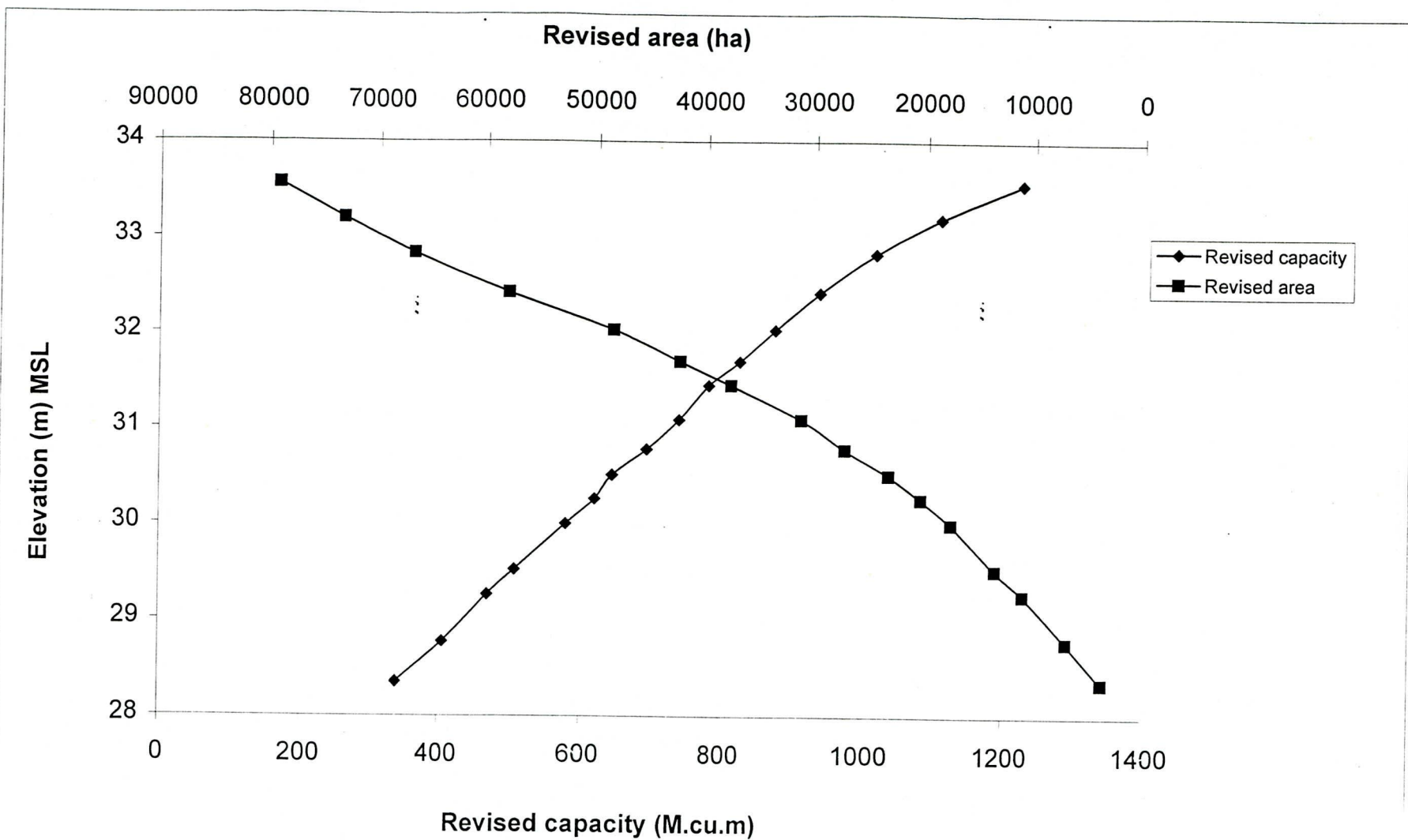


Fig 5.8 : Revised area-capacity curves obtained by empirical area-reduction method

Table 5.11: Computation for Sediment Distribution Pattern of Kaptai Reservoir-Empirical Area-increment Method:

Sl. No.	Elv. (m)	Original Area(ha)	Original Capacity(Mm ³)	Depth,m (2)-17.53	A ₀ (ha)	Sediment Volume(Mm ³)	Rev. Area(ha) (3)-(6)	Rev. Capacity(Mm ³) (4)-(7)
1	2	3	4	5	6	7	8	9
1	33.22	79226.67	6503.54	15.69	40078.86	5274.98	39147.81	1228.56
2	32.92	74038.71	6265.86	15.39	40078.86	5154.74	33959.85	1111.12
3	32.61	72016.67	6036.34	15.08	40078.86	5030.50	31937.81	1005.84
4	32.31	67703.23	5820.29	14.78	40078.86	4910.26	27624.37	910.03
5	32.00	68980.12	5610.41	14.47	40078.86	4786.02	28901.26	824.39
6	31.70	67745.16	5403.47	14.17	40078.86	4665.78	27666.30	737.69
7	31.39	67026.67	5193.46	13.86	40078.86	4541.54	26947.81	651.92
8	31.09	63270.97	4992.38	13.56	40078.86	4421.30	23192.11	571.08
9	30.78	63326.67	4796.24	13.25	40078.86	4297.05	23247.81	499.19
10	30.48	61680.01	4606.26	12.95	40078.86	4176.82	21601.15	429.44
11	30.18	58496.78	4421.22	12.65	40078.86	4056.58	18417.92	364.64
12	29.87	57976.67	4239.88	12.34	40078.86	3932.34	17897.81	307.54
13	29.57	54916.13	4065.95	12.04	40078.86	3812.10	14837.27	253.85
14	29.26	53813.33	3895.71	11.73	40078.86	3687.86	13734.47	207.85
15	28.96	52580.65	3734.27	11.43	40078.86	3567.62	12501.79	166.65
16	28.65	51400.02	3571.27	11.12	40078.86	3443.37	11321.16	127.90
17	28.35	48548.39	3417.07	10.82	40078.86	3323.14	8469.53	93.93
18	28.04	48110.00	3266.57	10.51	40078.86	3198.89	8031.14	67.68
19	27.74	45364.52	3122.24	10.21	40078.86	3078.66	5285.66	43.58
20	27.43	45230.00	2981.61	9.90	40078.86	2954.41	5151.14	27.20
21	27.13	42183.87	2845.92	9.60	40078.86	2834.18	2105.01	11.74
22	26.82	42350.00	2715.15	9.29	40078.86	2709.93	2271.14	5.22
23	26.59	40078.86	2617.75	9.06	40078.86	2617.75	0.00	0.00
24	26.52	39396.77	2588.1	8.99	39396.77	2588.10	0.00	0.00
25	26.21	39066.67	2465.97	8.68	39066.67	2465.97	0.00	0.00
26	25.91	37006.45	2348.77	8.38	37006.45	2348.77	0.00	0.00
27	25.60	36596.67	2234.05	8.07	36596.67	2234.05	0.00	0.00
28	25.30	34222.58	2124.26	7.77	34222.58	2124.26	0.00	0.00
29	24.99	33720.00	2018.17	7.46	33720.00	2018.17	0.00	0.00
30	24.69	31832.26	1917.01	7.16	31832.26	1917.01	0.00	0.00
31	24.38	31663.33	1818.33	6.85	31663.33	1818.33	0.00	0.00
32	24.08	29448.39	1723.34	6.55	29448.39	1723.34	0.00	0.00
33	23.77	29193.33	1632.05	6.24	29193.33	1632.05	0.00	0.00
34	23.47	27963.33	1544.47	5.94	27963.33	1544.47	0.00	0.00
35	23.17	25896.81	1460.58	5.64	25896.81	1460.58	0.00	0.00
36	17.53	0.00	0	0.00	0.00	0.00	0.00	0.00

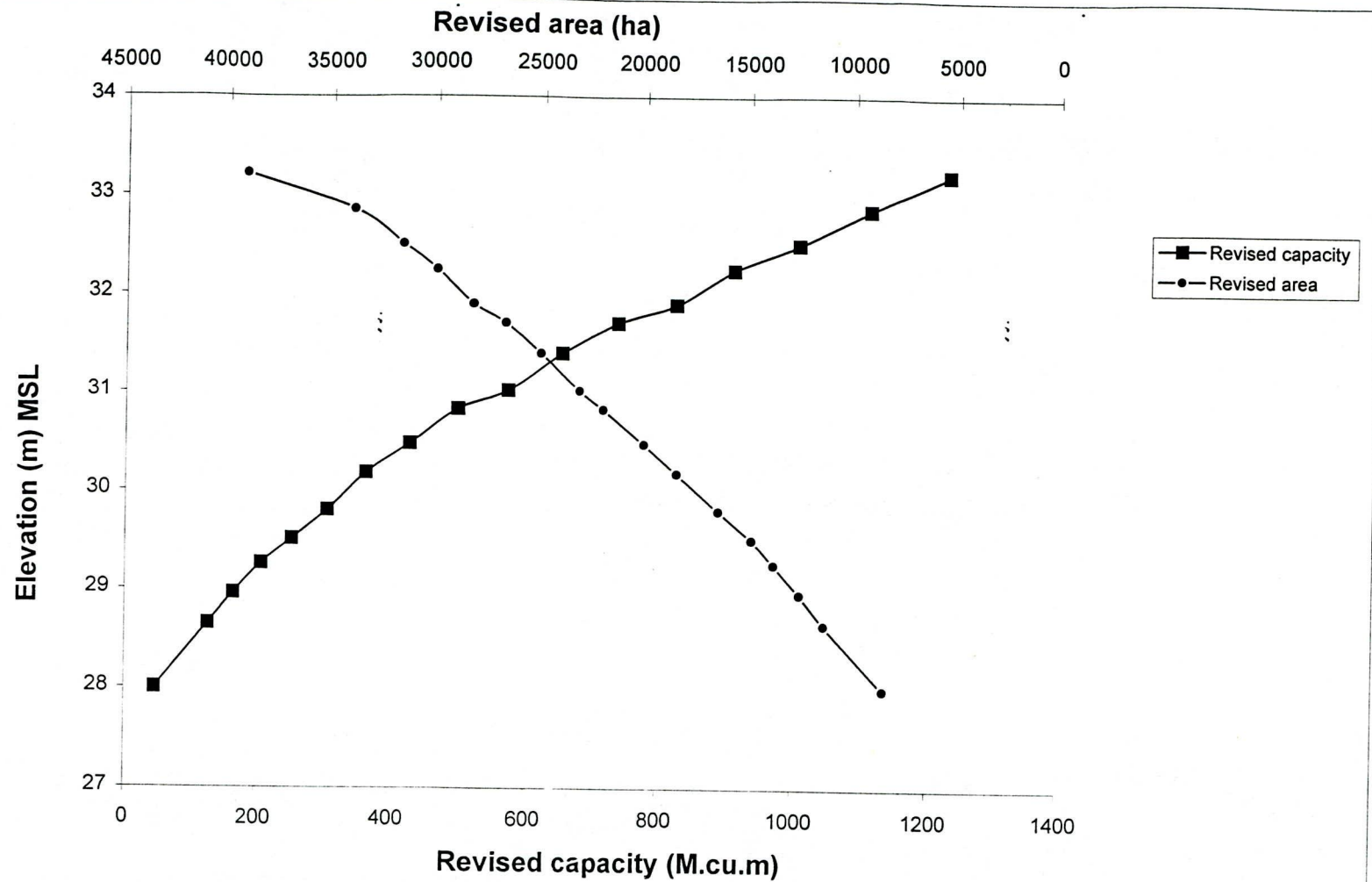


Fig 5.9 : Revised area-capacity curve obtained by empirical area-increment method

5.7 Comparison of distribution patterns obtained by using two empirical methods

A comparison has been made between empirical area-reduction and empirical area-increment methods are shown in table 5.11. Discrepancy ratio of sediment volume at different elevation among these two methods have been determined which are shown in table 5.11. The variation of sediment distribution at different elevation between empirical area-reduction method and empirical area-increment method is small. The results obtained by using two methods are plotted in Fig.5.10 to understand the discrepancy between this two empirical methods.

Table 5.12 : : Comparison of Distribution Pattern obtained by Empirical Area-reduction Method and Area-Increment Method:

SI. NO.	Elv. (m)	Empirical area-reduction method		Empirical area-increment method		Percent Discrepancy Ratio={((3)-(5))/(3)}*100
		Sediment Volume (Mm ³)	Remaining Capacity (Mm ³)	Sediment Volume (Mm ³)	Remaining Capacity (Mm ³)	
1	33.22	5277.81	1225.73	5274.98	1228.56	0.05
2	32.92	5205.44	1060.42	5154.74	1111.12	0.97
3	32.61	5047.04	989.30	5030.50	1005.84	0.33
4	32.31	4881.09	939.20	4910.26	910.03	-0.60
5	32.00	4702.94	907.47	4786.02	824.39	-1.77
6	31.70	4527.13	876.34	4665.78	737.69	-3.06
7	31.39	4349.86	843.60	4541.54	651.92	-4.41
8	31.09	4166.55	825.83	4421.30	571.08	-6.11
9	30.78	3984.15	812.09	4297.05	499.19	-7.85
10	30.48	3809.27	796.99	4176.82	429.44	-9.65
11	30.18	3636.61	784.61	4056.58	364.64	-11.55
12	29.87	3461.04	778.84	3932.34	307.54	-13.62
13	29.57	3294.29	771.66	3812.10	253.85	-15.72
14	29.26	3125.61	770.10	3687.86	207.85	-17.99
15	28.96	2966.17	768.10	3567.62	166.65	-20.28
16	28.65	2805.59	765.68	3443.37	127.90	-22.73
17	28.35	2654.45	762.62	3323.14	93.93	-25.19
18	28.04	3266.57	0.00	3198.89	67.68	2.07
19	27.74	3122.24	0.00	3078.66	43.58	1.40
20	27.43	2981.61	0.00	2954.41	27.20	0.91
21	27.13	2845.92	0.00	2834.18	11.74	0.41
22	26.82	2715.15	0.00	2709.93	5.22	0.19
23	26.59	2617.75	0.00	2617.75	0.00	0.00
24	26.52	2588.10	0.00	2589.69	0.00	-0.06
25	26.21	2465.97	0.00	2465.45	0.00	0.02
26	25.91	2348.77	0.00	2345.21	0.00	0.15
27	25.60	2234.05	0.00	2220.97	0.00	0.59
28	25.30	2124.26	0.00	2100.73	0.00	1.11
29	24.99	2018.17	0.00	1976.49	0.00	2.07
30	24.69	1917.01	0.00	1856.25	0.00	3.17
31	24.38	1818.33	0.00	1732.01	0.00	4.75
32	24.08	1723.34	0.00	1611.77	0.00	6.47
33	23.77	1632.05	0.00	1487.53	0.00	8.86
34	23.47	1544.47	0.00	1367.29	0.00	11.47
35	23.17	1460.58	0.00	1247.05	0.00	14.62
36	17.53	0.00	0.00	0.00	0.00	0.00

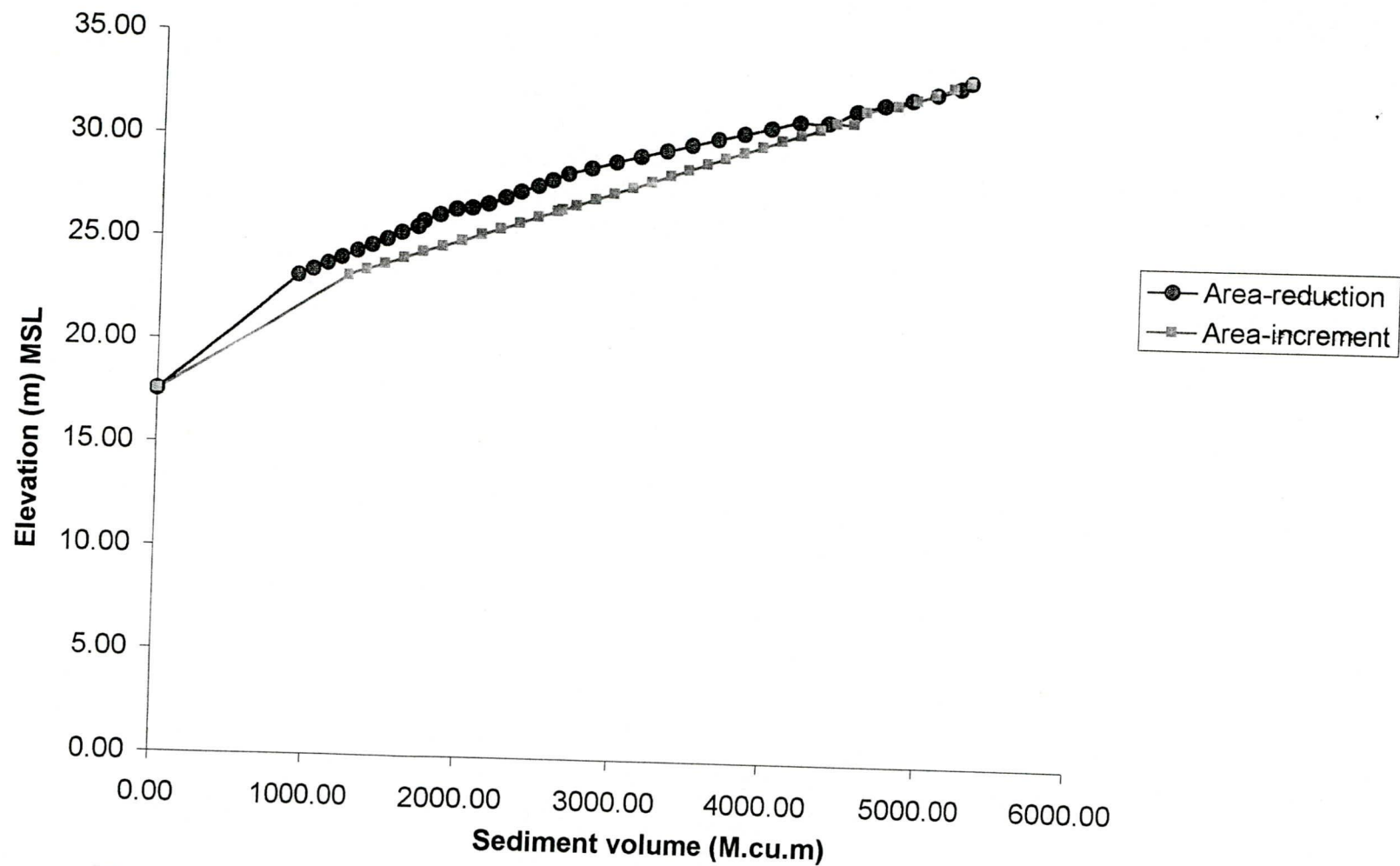


Fig 5.10 : Comparison of sediment volume at different elevation obtained by empirical area-reduction and area-increment methods

CHAPTER-SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The following conclusions may be drawn from the present study

- i) The Swamee's Prediction model (Eqn.4.1) has been applied to calculate the rate of sediment deposition of the Kaptai reservoir. Result obtained from this model has been compared with measured data and found good agreement. Percentage of discrepancy ratio of sedimentation rate obtained between the model and field measurement is found to be 22.82.
- ii) Available empirical equations such as Joglekar's, Khosla's, Garde and Swamee's equations have also been used to compare the results obtained from this study. Percentage of discrepancy ratio among Joglekar's, Khosla's, Garde and Swamee's equations with Prediction model are -56.48, 41.56 and 44.99 respectively. It is seen that Khosla's equation is nearly close to Prediction model results. In addition, a comparative study was also made among all the available methods against the field measurement. Percentage of discrepancy ratio among Prediction model, Joglekar's, Khosla's, Garde and Swamee's equation with field measurement are -22.82, 32.43, -92.19 and 28.22 respectively. From this comparison, it is seen that the results obtained for Prediction model relatively close to the field measurement.
- iii) Sediment deposition and erosion volume have been calculated for all 67 cross-sections of the Kaptai reservoir. It is found that the maximum amount of sediment deposition 22.59 Mm^3 in the section 16 at Rangamati due to landslide in the adjoining hills and minimum amount of sediment deposition 0.14 Mm^3 in the section 22 at Burighat. It is also seen that the maximum amount of erosion 14.80 Mm^3 in the section

43 at Mainimukh due to erosion from reservoir banks by wave action and current flow and minimum amount of erosion 0.025 Mm^3 in the section 54 C at Marisha.

iv) Life of the Kaptai reservoir has been estimated using various available methods. The methods used are Step method, method provided by Khagawa University, Swamee and Garde method. The estimated life of the reservoir by using these methods are 1110, 312, 4527 years respectively. The maximum trap efficiency have been found by using Brune's Trap efficiency curves upto 100 years is 95%.

v) Sediment distribution pattern at different elevations has been obtained by using Empirical area-reduction and area-increment method. The percentage of discrepancy ratio varies from 0.05 to 14.62. This discrepancy range seems to be not significant as far as the sediment distribution pattern in the reservoir is concerned.

vi) The prediction model used in this study has been found to be reasonable and suitable its present form. Therefore the model may be suggested to predict the sedimentation rate for the Kaptai reservoir.

6.2 Recommendations for Future Study

i) To evaluate the actual life of the reservoir, correct assessment of unit weight of the deposited sediment should be necessary and it would be based on experimental basis.

ii) Index map used in this study was collected for the year 1983. Detail information such as precise Index map, cross-sectional survey data need to be used for similar type study in future.

iii) Based on the measured sedimentation rate an attempt can be made to obtain an empirical relationship between the sedimentation rate and the catchment area.

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Table A1: Inflow of Kaptai reservoir for the year 1989-2000

Year	Inflow (Mm ³)
1989	13473.30
1990	13188.36
1991	18546.55
1992	7687.83
1993	20525.70
1994	5554.50
1995	11308.14
1996	12123.64
1997	17371.93
1998	17022.94
1999	17577.05
2000	19875.83
Average,, =	14521.31

Table A2: Width at each sections of the reservoir at full water level of 33.22 m
(Measured by scale by using the curves of year 2000 for all sections)

Section No.	Width (m)	Section No.	Width (m)	Section No.	Width (m)
1	625.93	33	745.83	61	168.21
2	533.33	34	531.25	62	165.63
3	701.17	35	381.59	63	144.10
4	501.82	36	876.00	Average 664.13	
5	563.13	36A	1097.10		
6	990.00	37	563.00		
7	511.11	38	561.54		
8	1398.00	39	1117.07		
9	898.00	40	523.87		
10	1005.00	41	2467.95		
11	215.33	42	708.20		
12	620.69	43	190.00		
13	1277.42	44	260.07		
14	401.25	45	227.27		
15	231.00	46	202.98		
16	3690.00	47	61.89		
17	2715.00	48	66.60		
18	1496.00	49	473.61		
19	4355.00	50	84.61		
20	1440.00	51	57.16		
21	1339.93	52	60.65		
22	602.98	53	58.76		
23	847.54	54	112.45		
24	1521.26	54A	55.13		
25	836.77	54B	45.55		
26	416.25	54C	53.59		
27	362.50	55	347.22		
28	123.00	56	191.77		
29	175.82	57	273.00		
30	412.79	58	200.00		
31	252.73	59	177.52		
32	62.00	60	121.40		

Table A3: Slope of the reservoir for 31 sections (Calculated from given data and Index map)

Section No.	Slope	Section No.	Slope
1	0.000038	40	0.00033
3	0.000159	41	0.000202
5	0.000358	42	0.00063
7	0.000157	44	0.000042
9	0.000065	45	0.000196
14	0.000034	47	0.000314
18	0.000351	48	0.000207
24	0.000103	49	0.000158
25	0.000551	50	0.000424
27	0.000009	53	0.00035
29	0.000275	54	0.00118
30	0.000611	54C	0.000433
31	0.000204	56	0.000112
34	0.000238	58	0.000586
35	0.00009	62	0.000037
36A	0.000138		
		Average	0.00028

Table A4: Storage at different water level of the reservoir

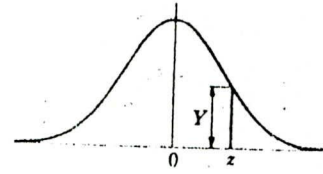
Water level (m)	Storage (Mm ³)	Water level (m)	Storage (Mm ³)
33.22	6503.54	27.74	3122.24
32.92	6265.86	27.43	2981.61
32.61	6036.34	27.13	2845.92
32.31	5820.29	26.82	2715.15
32.00	5610.41	26.52	2588.10
31.70	5403.47	26.21	2465.97
31.40	5193.46	25.91	2348.77
31.09	4992.38	25.60	2234.05
30.78	4796.24	25.30	2124.26
30.48	4606.26	24.99	2018.17
30.18	4421.22	24.69	1917.01
29.87	4239.88	24.38	1818.33
29.57	4065.95	24.08	1723.34
29.26	3895.71	23.77	1632.05
28.96	3734.27	23.47	1544.47
28.65	3571.27	23.16	1460.58
28.35	3417.07	17.53	0.00
28.04	3266.57		

Table A5 : Stream bed level (Measured from given data)

Section No.	S.B.L(m)
1	12.67
2	11.68
3	11.94
4	10.66
5	9.46
6	11.00
7	10.15
8	11.14
9	11.84
10	11.77
11	15.75
12	20.65
13	13.39
14	19.12
15	18.11
16	13.25
17	13.18
18	13.17
19	13.51
20	13.50
21	11.97
22	12.33
23	17.38
24	18.69
25	18.86
26	20.41
27	22.13
28	22.06
29	23.61
30	24.30
31	25.05
32	23.88
33	23.69
34	12.64
35	12.14
36	19.23
36A	14.50
37	19.55
38	22.05
39	13.17
40	12.47

Section No.	S.B.L(m)
41	13.40
42	19.17
43	19.76
44	20.80
45	19.08
46	20.99
47	22.16
48	21.68
49	22.63
50	21.48
51	20.41
52	21.83
53	22.22
54	22.37
54A	24.94
54B	25.50
54C	25.02
55	12.08
56	16.36
57	18.87
58	16.52
59	18.10
60	16.71
61	19.03
62	19.21
63	16.95
Average	17.53

Table A6 : Ordinates (Y)
of the
Standard
Normal Curve
at z



z	0	1	2	3	4	5	6	7	8	9
0.0	.3989	.3989	.3989	.3988	.3986	.3984	.3982	.3980	.3977	.3973
0.1	.3970	.3965	.3961	.3956	.3951	.3945	.3939	.3932	.3925	.3918
0.2	.3910	.3902	.3894	.3885	.3876	.3867	.3857	.3847	.3836	.3825
0.3	.3814	.3802	.3790	.3778	.3765	.3752	.3739	.3725	.3712	.3697
0.4	.3683	.3668	.3653	.3637	.3621	.3605	.3589	.3572	.3555	.3538
0.5	.3521	.3503	.3485	.3467	.3448	.3429	.3410	.3391	.3372	.3352
0.6	.3332	.3312	.3292	.3271	.3251	.3230	.3209	.3187	.3166	.3144
0.7	.3123	.3101	.3079	.3056	.3034	.3011	.2989	.2966	.2943	.2920
0.8	.2897	.2874	.2850	.2827	.2803	.2780	.2756	.2732	.2709	.2685
0.9	.2661	.2637	.2613	.2589	.2565	.2541	.2516	.2492	.2468	.2444
1.0	.2420	.2396	.2371	.2347	.2323	.2299	.2275	.2251	.2227	.2203
1.1	.2179	.2155	.2131	.2107	.2083	.2059	.2036	.2012	.1989	.1965
1.2	.1942	.1919	.1895	.1872	.1849	.1826	.1804	.1781	.1758	.1736
1.3	.1714	.1691	.1669	.1647	.1626	.1604	.1582	.1561	.1539	.1518
1.4	.1497	.1476	.1456	.1435	.1415	.1394	.1374	.1354	.1334	.1315
1.5	.1295	.1276	.1257	.1238	.1219	.1200	.1182	.1163	.1145	.1127
1.6	.1109	.1092	.1074	.1057	.1040	.1023	.1006	.0989	.0973	.0957
1.7	.0940	.0925	.0909	.0893	.0878	.0863	.0848	.0833	.0818	.0804
1.8	.0790	.0775	.0761	.0748	.0734	.0721	.0707	.0694	.0681	.0669
1.9	.0656	.0644	.0632	.0620	.0608	.0596	.0584	.0573	.0562	.0551
2.0	.0540	.0529	.0519	.0508	.0498	.0488	.0478	.0468	.0459	.0449
2.1	.0440	.0431	.0422	.0413	.0404	.0396	.0387	.0379	.0371	.0363
2.2	.0355	.0347	.0339	.0332	.0325	.0317	.0310	.0303	.0297	.0290
2.3	.0283	.0277	.0270	.0264	.0258	.0252	.0246	.0241	.0235	.0229
2.4	.0224	.0219	.0213	.0208	.0203	.0198	.0194	.0189	.0184	.0180
2.5	.0175	.0171	.0167	.0163	.0158	.0154	.0151	.0147	.0143	.0139
2.6	.0136	.0132	.0129	.0126	.0122	.0119	.0116	.0113	.0110	.0107
2.7	.0104	.0101	.0099	.0096	.0093	.0091	.0088	.0086	.0084	.0081
2.8	.0079	.0077	.0075	.0073	.0071	.0069	.0067	.0065	.0063	.0061
2.9	.0060	.0058	.0056	.0055	.0053	.0051	.0050	.0048	.0047	.0046
3.0	.0044	.0043	.0042	.0040	.0039	.0038	.0037	.0036	.0035	.0034
3.1	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026	.0025	.0025
3.2	.0024	.0023	.0022	.0022	.0021	.0020	.0020	.0019	.0018	.0018
3.3	.0017	.0017	.0016	.0016	.0015	.0015	.0014	.0014	.0013	.0013
3.4	.0012	.0012	.0012	.0011	.0011	.0010	.0010	.0010	.0009	.0009
3.5	.0009	.0008	.0008	.0008	.0008	.0007	.0007	.0007	.0007	.0006
3.6	.0006	.0006	.0006	.0005	.0005	.0005	.0005	.0005	.0005	.0004
3.7	.0004	.0004	.0004	.0004	.0004	.0004	.0003	.0003	.0003	.0003
3.8	.0003	.0003	.0003	.0003	.0003	.0002	.0002	.0002	.0002	.0002
3.9	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0001	.0001

Table A7 Records of different parameters of reservoir sedimentation

Section-1							
L/B Dist.	Year 1983 Bed R.L.	Area m ²	m	L/B Dist.	Year 2000 Bed R.L.	Area m ²	m
0.00	50.25	0.00	0.00	0.00	50.25	0.00	0.00
4.00	48.63	197.77	0.00	4.00	49.85	0.00	486.69
26.00	36.03	931.30	10.00	10.00	43.49	403.98	403.98
33.00	34.76	247.78	20.00	20.00	37.31	542.50	542.50
47.00	27.26	434.17	35.00	35.00	35.03	506.10	506.10
57.00	21.76	245.12	50.00	50.00	32.46	278.67	278.67
101.00	15.26	814.53	59.00	59.00	29.47	116.46	116.46
118.00	16.06	266.25	63.00	63.00	28.76	150.31	150.31
141.00	13.96	345.28	69.00	69.00	21.35	168.17	168.17
184.00	12.96	578.87	78.00	78.00	16.03	364.09	364.09
207.00	12.76	295.83	101.00	101.00	15.64	46.82	46.82
235.00	12.26	350.34	104.00	104.00	15.65	96.42	96.42
257.00	12.11	268.11	110.00	110.00	14.53	248.16	248.16
280.00	11.96	276.85	126.00	126.00	13.92	341.28	341.28
321.00	11.76	486.34	150.00	150.00	12.57	463.40	463.40
350.00	11.31	334.57	185.00	185.00	12.32	422.96	422.96
363.00	11.46	148.03	219.00	219.00	11.71	492.41	492.41
390.00	12.06	317.57	260.00	260.00	9.43	306.39	306.39
412.00	11.61	260.41	289.00	289.00	3.87	152.84	152.84
433.00	11.21	239.65	312.00	312.00	5.69	57.30	57.30
478.00	15.26	595.67	324.00	324.00	8.65	114.64	114.64
498.00	14.26	295.24	340.00	340.00	12.50	137.41	137.41
523.00	13.76	350.30	353.00	353.00	12.82	240.45	240.45
552.00	13.46	394.75	372.00	372.00	12.83	397.42	397.42
575.00	7.76	244.08	403.00	403.00	12.05	373.05	373.05
597.00	4.36	133.36	433.00	433.00	11.93	179.78	179.78
618.00	7.56	125.20	448.00	448.00	14.73	79.95	79.95
644.00	22.06	385.11	454.00	454.00	15.91	214.41	214.41
666.00	30.46	577.76	468.00	468.00	14.66	198.64	198.64
676.00	34.76	326.12	508.00	508.00	14.21	389.61	389.61
680.00	37.05	143.63	547.00	547.00	13.93	554.00	554.00
689.00	38.30	339.09	557.00	557.00	7.13	140.65	140.65
Total Area	=	10949.08		566.00	6.27	94.73	94.73
				577.00	6.43	107.87	107.87
				594.00	16.55	298.61	298.61
				620.00	20.85	598.24	598.24
				659.00	28.78	173.67	173.67
				662.00	29.39	87.25	87.25
				669.00	32.46	216.48	216.48
				681.00	35.39	407.13	407.13
				689.00	35.43	283.30	283.30
				689.00	38.30	0.00	0.00
Total Area	=	10985.89					

Table A7 Contd. : Section No. 2

Year 1983			Year 2000		
L/B Dist. (m)	Bed R.L m	Area m ²	L/B Dist. (m)	Bed R.L m	Area m ²
0.00	39.88	0.00	0.00	39.88	0.00
4.00	37.51	154.78	0.00	39.50	0.00
8.00	34.73	144.48	4.00	37.08	153.15
30.00	24.83	655.20	8.00	33.97	142.09
39.00	20.43	203.69	12.00	31.87	131.68
63.00	15.98	436.97	13.00	31.15	131.51
84.00	12.13	295.20	17.00	22.25	106.80
105.00	12.03	253.72	33.00	19.49	333.94
136.00	11.43	363.69	45.00	17.18	220.03
150.00	9.33	145.35	56.00	16.25	183.88
165.00	4.11	100.83	65.00	15.61	143.38
179.00	4.18	58.06	74.00	15.12	138.29
200.00	4.48	90.97	82.00	13.02	112.57
226.00	4.38	115.23	92.00	12.25	126.36
254.00	4.38	122.70	104.00	12.15	146.41
284.00	4.23	129.21	123.00	11.71	226.69
309.00	4.23	105.80	133.00	11.26	114.86
315.00	4.30	25.60	145.00	8.73	119.95
331.00	7.33	93.07	177.00	3.90	202.11
367.00	12.98	365.65	192.00	3.76	57.47
406.00	17.38	592.10	213.00	3.62	77.51
431.00	17.88	440.80	229.00	3.95	60.58
459.00	22.08	559.50	253.00	3.74	92.30
479.00	24.03	461.14	276.00	3.76	86.27
483.00	24.82	97.71	312.00	4.03	140.26
496.00	19.43	287.65	344.00	11.18	243.39
511.00	26.28	342.86	368.00	17.39	342.86
520.00	31.03	257.91	397.00	17.98	512.89
533.00	34.73	427.47	407.00	17.78	178.81
543.00	39.23	369.79	425.00	18.13	323.21
552.00	42.90	369.54	447.00	20.09	420.44
Total area	=	8066.67	465.00	25.19	407.54
			488.00	24.79	574.79
			496.00	19.48	177.09
			524.00	25.05	623.45
			530.00	31.15	188.61
			536.00	34.42	196.71
			537.00	36.41	35.41
			544.00	39.30	264.96
			548.00	40.89	160.37
			552.00	42.51	166.81
			552.00	42.90	0.00
			Total Area	=	7945.43

Contd. : Section No. 3

Year 1983			Year 2000		
L/B Dist.	Bed R.L(m)	Area(m ²)	L/B Dist.(m)	Bed R.L(m)	Area(m ²)
0.00	39.50	0.00	0.00	39.50	0.00
0.00	38.96	0.00	0.00	39.23	0.00
6.00	37.05	228.03	6.00	37.76	230.96
13.00	34.71	251.16	10.00	36.50	148.52
25.00	29.31	384.12	12.00	34.52	71.03
41.00	28.86	465.36	18.00	32.16	200.04
54.00	29.66	380.38	26.00	30.48	250.55
85.00	33.91	985.34	29.00	29.98	90.68
112.00	21.96	754.25	32.00	29.48	89.18
163.00	13.31	899.39	35.00	29.18	87.98
187.00	18.01	375.84	38.00	29.13	87.46
200.00	15.51	217.88	41.00	27.98	85.66
227.00	7.31	308.07	45.00	28.28	112.51

Section A3 Contd.

Year 1983			Year 2000		
L/B Dist.	Bed R. L.(m)	Area(m ²)	L/B Dist. (m)	Bed R. L.(m)	Area(m ²)
260.00	6.51	228.03	49.00	28.98	114.51
290.00	7.91	216.30	54.00	29.18	145.39
299.00	14.45	100.62	59.00	30.48	149.14
310.00	12.91	150.48	64.00	31.25	154.33
346.00	12.71	461.16	75.00	33.88	358.21
380.00	12.31	425.34	80.00	34.06	169.83
424.00	12.36	542.74	88.00	32.45	266.01
456.00	11.61	383.52	93.00	30.70	157.87
499.00	4.81	353.03	96.00	30.48	91.77
536.00	4.46	171.50	101.00	27.62	145.24
588.00	4.51	233.22	121.00	22.12	497.36
628.00	4.96	189.40	135.00	19.17	289.00
653.00	5.06	125.25	149.00	17.34	255.54
674.00	11.96	178.71	159.00	13.59	154.63
689.00	16.21	211.28	162.00	13.34	40.39
716.00	27.21	586.17	169.00	15.70	101.63
723.00	34.71	216.72	185.00	17.91	268.85
725.00	38.10	72.81	194.00	17.06	157.35
728.00	38.84	115.40	204.00	15.91	164.83
728.00	38.84	0.00	214.00	12.66	142.83
Total Area	=	10211.50	225.00	8.20	114.71
			238.00	6.35	94.55
			264.00	6.16	162.58
			285.00	7.01	138.24
			299.00	12.91	139.41
			318.00	12.58	242.12
			345.00	12.59	339.74
			372.00	12.43	337.72
			395.00	12.11	282.16
			412.00	12.16	206.26
			434.00	12.44	270.56
			450.00	11.55	191.89
			455.00	11.09	56.59
			476.00	9.34	214.47
			495.00	5.58	141.70
			501.00	4.77	31.04
			512.00	3.76	46.89
			522.00	3.72	37.38
			540.00	3.79	67.55
			551.00	3.59	40.57
			565.00	3.98	52.96
			577.00	3.91	47.32
			590.00	3.96	51.13
			601.00	4.08	44.20
			612.00	4.40	46.62
			622.00	4.41	44.03
			632.00	4.90	46.53
			643.00	4.38	51.02
			655.00	4.96	56.02
			659.00	8.21	26.33
			667.00	11.91	80.46
			678.00	15.97	153.32
			689.00	17.93	186.43
			706.00	23.32	350.59
			714.00	24.33	190.58
			718.00	30.48	109.61
			719.00	31.56	31.02
			721.00	34.74	66.30
			724.00	35.09	104.74
			728.00	38.47	147.12
			728.00	38.84	0.00
			Total Area	=	10321.74

Table A7 Contd : : Section No.4

Year 1983			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.71	0.00	0.00	36.71	0.00
0.00	35.63	0.00	0.00	35.66	0.00
10.00	35.61	356.20	8.00	36.03	286.76
17.00	34.71	246.12	16.00	34.79	283.28
40.00	25.81	695.98	20.00	33.46	136.50
40.77	20.46	17.81	22.00	32.42	65.88
62.28	14.46	375.56	25.00	31.28	95.55
102.84	13.71	571.29	30.00	27.86	147.85
141.26	13.41	520.98	44.00	26.09	377.65
171.08	15.91	437.16	59.00	23.96	375.38
193.89	17.26	378.30	69.00	22.00	229.80
216.20	17.91	392.32	75.00	22.35	133.05
248.37	11.21	468.40	89.00	21.02	303.59
256.00	17.71	110.33	105.00	15.79	294.48
270.93	5.21	171.10	123.00	15.14	278.37
299.43	5.01	145.64	135.00	16.55	190.14
321.63	5.51	116.77	151.00	13.06	236.88
346.53	4.51	124.75	162.00	13.23	144.60
368.08	4.06	92.34	179.00	13.00	222.96
385.72	3.61	67.65	191.00	14.42	164.52
410.02	3.21	82.86	221.00	17.52	479.10
435.82	2.86	78.30	246.00	17.82	441.75
454.36	2.61	50.71	267.00	16.55	360.89
478.83	2.71	65.09	282.00	10.71	204.45
511.40	26.11	469.33	292.00	12.05	113.80
522.00	34.79	322.77	320.00	4.62	233.38
527.00	37.77	181.40	347.00	4.52	123.39
533.00	39.63	232.20	369.00	4.11	94.93
533.00	40.11	0.00	408.00	3.09	140.40
Total Area=		6770.32	424.00	2.56	45.20
			451.00	1.73	57.92
			480.00	1.15	41.76
			492.00	5.02	37.02
			503.00	1.45	35.59
			515.00	22.92	146.22
			520.00	31.28	135.50
			522.00	32.80	64.08
			525.00	35.61	102.62
			529.00	38.75	148.72
			533.00	39.74	156.98
			533.00	40.11	0.00
			Total Area=		7129.91

Table A7. Contd : Section No.5

Year 1983			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²
0.00	39.17	0.00	0.00	39.17	0.00
0.00	38.66	0.00	0.00	38.77	0.00
5.00	36.58	188.10	4.00	35.32	148.18
7.00	35.19	71.77	8.00	33.34	137.32
20.00	32.84	442.20	16.00	30.03	253.48
38.00	32.79	590.67	24.00	28.65	234.72
45.00	23.79	198.03	31.00	26.95	194.60
52.70	-8.31	59.60	36.00	-2.32	61.58
74.20	-8.21	-177.59	51.00	-3.08	-40.50
97.40	-8.21	-190.47	76.00	-3.92	-87.50
124.30	-7.31	-208.74	83.00	-4.01	-27.76
141.60	-5.91	-114.35	116.00	-2.99	-115.50
171.90	-1.00	-104.69	154.00	-2.92	-112.29
196.50	3.85	35.06	184.00	-1.57	-67.35
227.40	5.89		210.00	4.46	37.57

Section 5 Contd.

Year 1983			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²
265.00	8.19	264.70	247.00	6.29	198.88
286.60	10.09	197.42	282.00	8.40	257.08
308.40	11.79	238.49	325.00	11.27	422.91
327.40	16.99	273.41	330.00	16.59	69.65
349.50	16.94	374.93	350.00	16.53	331.20
371.70	17.09	377.73	379.00	16.53	479.37
388.00	17.04	276.16	409.00	16.77	499.50
401.90	17.14	237.55	449.00	16.58	667.00
423.40	17.09	367.97	478.00	17.23	490.25
439.10	17.49	271.45	499.00	18.10	370.97
458.20	17.09	330.24	515.00	20.26	306.88
476.60	17.34	316.76	535.00	23.90	441.60
496.40	17.79	347.79	542.00	24.05	167.83
515.40	18.79	347.51	547.00	26.95	127.50
537.30	23.29	460.78	559.00	29.66	339.66
554.20	27.99	433.32	569.00	32.26	309.60
568.90	32.19	442.32	579.00	34.24	332.50
579.00	34.6	337.29	579.00	34.60	0.00
Total Area =		6048.23	Total Area =		7380.59

Table A7 Contd. :

Section NO.6

Year 1983			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²
0.00	39.13	0.00	0.00	39.13	0.00
0.00	37.77	0.00	0.00	37.74	0.00
8.00	36.01	298.72	4.00	36.83	149.14
11.00	35.22	108.20	8.00	35.43	144.52
25.00	30.22	458.08	16.00	32.48	271.64
45.00	19.62	408.40	20.00	31.02	127.00
54.00	20.42	220.68	27.00	29.12	210.49
61.00	27.62	199.64	35.00	36.82	263.76
78.00	21.72	410.39	45.00	20.18	285.00
110.00	27.92	794.24	54.00	24.73	202.10
146.00	17.92	825.12	62.00	26.82	206.20
154.00	18.62	146.16	66.00	27.96	109.56
164.00	19.72	191.70	70.00	29.06	114.04
187.00	17.32	425.06	74.00	29.66	117.44
220.00	14.72	528.66	78.00	29.78	118.88
234.00	13.77	109.43	101.00	26.82	650.90
266.00	13.87	442.24	106.00	15.52	105.85
296.00	13.72	413.85	111.00	13.86	73.45
331.00	14.72	497.70	117.00	22.02	107.64
361.00	17.17	479.35	121.00	23.07	90.18
391.00	22.72	508.35	125.00	23.84	93.82
415.00	25.42	577.68	130.00	24.52	120.90
439.00	21.32	560.88	133.00	26.82	77.01
456.00	20.47	355.22	137.00	27.74	109.12
471.00	22.87	325.05	141.00	29.08	111.64
477.00	23.52	139.17	145.00	28.07	112.30
498.00	19.12	447.72	150.00	26.82	137.23
507.00	15.57	156.11	161.00	18.53	249.43
525.00	15.62	280.71	187.00	15.27	439.40
551.00	16.32	415.22	215.00	19.39	485.24
580.00	17.62	492.13	243.00	19.72	547.54
607.00	18.12	482.49	260.00	15.73	460.85
635.00	18.22	508.76	282.00	13.40	189.35
654.00	17.62	340.48	296.00	13.13	185.71

Section No.6 Contd.

Year 1983			Year 2000		
L/B Dist. m	Bed R.L m	Area m ²	L/B Dist. m	Bed R.L m	Area m ²
678.00	18.17	429.48	316.00	14.49	276.2
707.00	19.52		343.00	21.39	484.38
731.00	8.22	332.88	380.00	22.13	805.12
769.00	5.07	252.51	411.00	16.96	605.895
788.00	4.67	92.53	438.00	21.48	518.94
810.00	3.62	91.19	469.00	22.55	682.465
841.00	2.27	91.30	484.00	21.26	328.575
869.00	1.57	53.76	502.00	16.37	338.67
892.00	0.97	29.21	516.00	14.50	216.09
897.00	0.82	4.48	546.00	15.89	455.85
909.00	5.62	38.64	572.00	16.40	419.77
944.00	20.77	461.83	601.00	17.16	486.62
968.00	26.52	567.48	631.00	17.76	523.8
992.00	31.12	691.68	655.00	17.18	419.28
1011.00	33.87	617.41	697.00	18.96	758.94
1013.00	35.22	69.09	708.00	19.11	209.385
1016.00	35.82	106.56	717.00	13.74	147.825
1019.00	36.20	108.03	743.00	5.28	247.26
1019.00	36.56	0.00	777.00	4.66	168.98
Total area	=	16864.52	816.00	3.30	155.22
			855.00	1.30	89.7
			890.00	2.26	62.3
			920.00	12.82	226.2
			943.00	19.32	369.61
			959.00	19.25	308.56
			988.00	16.82	523.015
			997.00	18.37	158.355
			1006.00	30.90	221.715
			1013.00	34.16	227.71
			1019.00	36.20	211.08
			1019.00	36.56	0.00
			Total area	=	17314.82

Table A7 Contd. : Section No. 7

Year 1983			Year 2000		
L/B Dist. m	Bed R.L m	Area m ²	L/B Dist. m	Bed R.L m	Area m ²
0.00	42.25	0.00	0.00	42.25	0.00
0.00	41.77	0.00	0.00	41.82	0.00
9.00	38.50	361.22	4.00	38.87	161.38
14.00	36.00	186.25	7.00	36.18	112.58
105.00	27.60	2893.80	10.00	35.02	106.80
110.00	24.30	129.75	15.00	31.33	165.88
118.00	17.90	168.80	20.00	28.30	149.08
125.00	15.60	117.25	24.00	27.10	110.80
147.00	4.50	221.10	29.00	24.24	128.35
190.00	4.80	199.95	38.00	23.67	215.60
205.00	4.00	66.00	55.00	22.81	395.08
249.00	4.40	184.80	64.00	21.10	197.60
293.00	1.20	123.20	78.00	17.67	271.39
309.00	9.10	82.40	101.00	17.59	405.49
345.00	15.80	448.20	117.00	17.39	279.84
383.00	18.50	651.70	128.00	21.53	214.06
415.00	17.20	571.20	144.00	4.24	206.16
441.00	15.60	426.40	160.00	4.24	67.84
466.00	13.00	357.50	179.00	4.36	81.70
500.00	23.00	612.00	196.00	4.13	72.17
517.00	29.80	448.80	206.00	3.79	39.60
531.00	35.63	458.01	218.00	3.96	46.50
531.00	36.01	0.00	231.00	4.08	52.26
Total Area =		8708.32	245.00	4.13	57.47
			257.00	5.30	56.58
			266.00	1.53	30.74
			284.00	16.24	159.93
			299.00	11.67	209.33
			308.00	9.30	94.37
			316.00	11.67	83.88
			346.00	16.24	418.65
			358.00	18.24	206.88
			374.00	17.67	287.28
			402.00	16.04	471.94
			429.00	14.53	412.70
			452.00	12.53	311.19
			461.00	13.39	116.64
			510.00	16.81	739.90
			514.00	27.10	87.82
			519.00	28.90	140.00
			523.00	31.58	120.96
			525.00	33.77	65.35
			527.00	34.41	68.18
			531.00	35.62	140.06
			531.00	36.01	0.00
			Total Area =		7759.97

Table A7 Contd. : Section No. 8

Year 1983			Year 2000			Year 2000		
L/B Dist. m	Bed R.L m	Area m ²	L/B Dist. m	Bed R.L m	Area m ²	L/B Dist. m	Bed R.L m	Area m ²
0.00	36.08	0.00	0.00	36.08	0.00	1307.00	19.40	527.66
0.00	35.70	0.00	0.00	35.41	0.00	1316.00	17.48	165.96
0.00	35.91	0.00	0.00	33.96	346.85	1328.00	14.08	189.36
40.00	16.51	1048.40	10.00	32.40	99.54	1351.00	14.26	325.91
188.00	13.31	2206.68	13.00	30.59	125.98	1361.00	14.97	146.15
275.00	12.71	1131.87	17.00	28.75	148.35	1383.00	20.48	389.95
340.00	20.71	1086.15	22.00	27.11	139.65	1389.00	27.11	142.77
425.00	18.11	1649.85	27.00	14.91	147.07	1399.00	29.43	282.70
541.00	14.11	1868.76	34.00	12.83	1442.48	1407.00	31.39	243.28
559.00	14.31	255.78	138.00	15.49	623.04	1411.00	33.43	129.64
585.00	15.71	390.26	182.00	16.25	222.18	1415.00	34.22	135.30
617.00	21.11	589.12	196.00	12.25	570.00	1423.00	36.16	281.52
732.00	17.31	2209.15	236.00	11.91	434.88	1423.00	36.50	0.00
760.00	19.71	518.28	272.00	12.25	120.80	Total Area = 21209.99		
770.00	19.71	197.10	282.00	18.21	776.73			
797.00	20.91	548.37	333.00	16.54	434.38			
819.00	21.11	462.22	358.00	19.26	608.60			
859.00	16.51	752.40	392.00	19.68	292.05			
926.00	6.71	777.87	407.00	13.49	464.38			
969.00	5.11	254.13	435.00	13.22	534.20			
1003.00	3.91	153.34	475.00	13.41	452.71			
1037.00	3.71	129.54	509.00	13.26	506.73			
1085.00	15.31	456.48	547.00	17.57	755.34			
1111.00	11.31	346.06	596.00	20.26	416.13			
1134.00	15.71	310.73	618.00	18.16	1459.96			
1168.00	11.91	469.54	694.00	15.69	626.23			
1202.00	15.91	472.94	731.00	16.06	79.38			
1250.00	15.31	749.28	736.00	21.40	112.38			
1267.00	15.51	261.97	742.00	16.99	95.98			
1310.00	18.71	735.73	747.00	16.54	134.12			
1353.00	15.11	727.13	755.00	17.25	50.69			
1392.00	25.31	788.19	758.00	19.09	181.70			
1421.00	35.91	887.69	768.00	19.02	266.77			
1423.00	36.50	72.41	782.00	19.98	273.00			
Total Area =		22507.42	796.00	20.19	140.60			
			803.00	30.32	378.83			
			818.00	20.54	101.72			
			822.00	15.96	511.00			
			850.00	11.39	382.90			
			878.00	7.68	95.35			
			888.00	7.48	45.48			
			894.00	6.59	112.56			
			910.00	6.27	77.16			
			922.00	5.85	72.72			
			934.00	5.15	121.00			
			956.00	4.31	118.25			
			981.00	3.71	88.22			
			1003.00	3.46	103.97			
			1032.00	3.40	78.89			
			1055.00	7.06	78.45			
			1070.00	15.11	155.19			
			1084.00	13.88	188.44			
			1097.00	9.68	94.24			
			1105.00	16.34	221.17			
			1122.00	12.02	482.12			
			1156.00	9.97	98.96			
			1165.00	11.92	131.34			
			1177.00	14.68	159.60			
			1189.00	15.30	314.79			
			1210.00	14.72	525.35			
			1245.00	16.99	523.22			
			1278.00					

Table A7 Contd. :

Section No. 9

Year 1983		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	37.32	0.00
0.00	36.91	0.00
20.00	35.05	719.60
33.00	33.96	448.57
47.00	29.96	447.44
63.00	25.21	441.36
82.00	23.26	460.47
96.00	6.46	208.04
120.00	3.86	123.84
145.00	3.86	96.50
174.00	3.96	113.39
198.00	4.16	97.44
224.00	11.96	209.56
258.00	18.96	525.64
285.00	19.61	520.70
311.00	17.96	488.41
335.00	16.86	417.84
362.00	17.06	457.92
383.00	18.96	378.21
401.00	16.36	317.88
437.00	17.26	605.16
466.00	16.06	483.14
491.00	15.56	395.25
517.00	16.96	422.76
546.00	17.16	494.74
570.00	16.46	403.44
593.00	16.26	376.28
613.00	16.26	325.20
638.00	15.96	402.75
714.00	14.86	1171.16
743.00	15.06	433.84
762.00	15.16	287.09
789.00	15.96	420.12
811.00	20.36	399.52
832.00	15.76	379.26
852.00	22.56	383.20
865.00	24.21	304.01
885.00	18.46	426.70
911.00	28.46	609.96
941.00	33.96	936.30
948.00	35.01	241.40
948.00	35.39	0.00
Total Area	=	16371.30

Year 2000		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	37.32	0.00
0.00	36.91	0.00
20.00	35.00	719.10
34.00	33.73	481.11
43.00	30.35	288.36
52.00	28.75	265.95
67.00	21.61	377.70
89.00	9.61	343.42
102.00	4.75	93.34
115.00	4.18	58.05
140.00	4.04	102.75
172.00	4.17	131.36
209.00	4.24	155.59
236.00	13.61	240.98
265.00	17.89	456.75
283.00	19.64	337.77
297.00	18.70	268.38
331.00	16.75	602.65
353.00	16.18	362.23
380.00	18.39	466.70
409.00	16.41	504.60
423.00	15.85	225.82
435.00	16.69	195.24
449.00	17.87	241.92
474.00	15.28	414.38
498.00	15.29	366.84
508.00	16.78	160.35
524.00	16.98	270.08
558.00	16.47	568.65
591.00	15.89	533.94
623.00	15.75	506.24
660.00	15.32	574.80
697.00	14.64	554.26
734.00	14.61	541.13
788.00	15.92	824.31
809.00	9.61	268.07
830.00	15.33	261.87
855.00	22.18	468.88
864.00	23.09	203.72
884.00	19.84	429.30
890.00	17.52	112.08
896.00	19.18	110.10
909.00	23.61	278.14
917.00	24.47	192.32
924.00	28.75	186.27
928.00	30.13	117.76
934.00	31.90	186.09
940.00	33.88	197.34
948.00	35.02	275.60
948.00	35.39	0.00
Total Area	=	15519.43

Table A7 Contd. : Section No. 10

Year 1983			Year 2000			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²	m	m	m ²
0.00	36.15	0.00	0.00	36.15	0.00	793.00	-0.34	-10.56
0.00	35.79	0.00	0.00	35.83	0.00	817.00	-0.93	-15.24
25.00	30.35	826.75	10.00	34.04	349.35	846.00	-1.16	-30.31
40.00	25.75	420.75	15.00	32.96	167.50	871.00	4.78	45.25
67.00	22.75	654.75	20.00	31.51	161.18	898.00	6.21	148.37
93.00	19.25	546.00	26.00	29.73	183.72	920.00	14.21	224.62
141.00	15.20	826.80	30.00	28.78	117.02	932.00	18.81	198.12
170.00	14.75	434.28	42.00	25.35	324.78	941.00	16.21	157.59
193.00	15.75	350.75	58.00	23.12	387.76	951.00	19.92	180.65
223.00	24.85	609.00	88.00	22.50	684.30	967.00	22.21	337.04
232.00	26.40	230.63	119.00	18.84	640.77	980.00	24.07	300.82
252.00	23.75	501.50	145.00	17.64	474.24	998.00	24.50	437.13
289.00	18.45	780.70	171.00	17.35	454.87	1006.00	28.78	213.12
304.00	20.65	293.25	184.00	18.21	231.14	1010.00	29.95	117.46
353.00	13.50	836.68	220.00	22.21	727.56	1018.00	32.43	249.52
376.00	14.60	323.15	230.00	18.64	204.25	1026.00	34.12	266.20
405.00	15.10	430.65	243.00	14.55	215.74	1034.00	34.97	276.36
432.00	15.25	409.73	251.00	13.64	112.76	1042.00	35.63	282.40
461.00	15.40	444.43	260.00	13.27	121.10	1042.00	35.92	0.00
490.00	19.55	506.78	269.00	13.12	118.76	Total Area =		16632.02
513.00	20.20	457.13	282.00	13.07	170.24			
538.00	20.85	513.13	297.00	13.64	200.33			
569.00	21.40	654.88	312.00	13.92	206.70			
602.00	20.85	697.13	329.00	14.21	239.11			
624.00	20.25	452.10	339.00	16.24	152.25			
653.00	13.50	489.38	342.00	17.07	49.97			
676.00	6.90	234.60	349.00	17.92	122.47			
701.00	5.05	149.38	362.00	14.50	210.73			
723.00	4.35	103.40	407.00	18.21	735.98			
749.00	2.70	91.65	456.00	19.35	920.22			
779.00	1.05	56.25	515.00	20.21	1167.02			
802.00	-0.35	8.05	535.00	20.78	409.90			
822.00	-0.95	-13.00	558.00	20.64	476.33			
847.00	-1.80	-34.38	581.00	20.27	470.47			
868.00	-0.75	-26.78	605.00	28.78	588.60			
895.00	6.25	74.25	628.00	16.50	520.72			
912.00	14.25	174.25	661.00	7.07	388.91			
924.00	9.35	141.60	673.00	5.64	76.26			
931.00	15.65	87.50	691.00	5.07	96.39			
948.00	18.50	290.28	700.00	4.50	43.07			
1010.00	26.60	1398.10	718.00	3.50	72.00			
1042.00	35.56	994.56	735.00	2.21	48.54			
1042.00	35.92	0.00	753.00	1.64	34.65			
Total Area	=	16594.01	768.00	1.07	20.33			

Table A5 Contd. : Section No. 11

Year 1983			Year 2000			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²	m	m	m ²
0.00	42.06	0.00	0.00	42.07	0.00	164.00	19.05	114.42
0.00	41.68	0.00	0.00	41.67	0.00	170.00	19.00	114.15
8.00	39.74	325.68	8.00	38.63	321.20	175.00	18.96	94.90
20.00	35.26	450.00	12.00	35.05	147.36	181.00	18.95	113.73
24.00	33.26	137.04	18.00	31.47	199.56	189.00	18.94	151.56
34.00	31.36	323.10	26.00	29.15	242.48	195.00	19.69	115.89
39.00	27.76	147.80	31.00	28.25	143.50	200.00	22.05	104.35
53.00	25.61	373.59	38.00	26.06	190.09	206.00	24.45	139.50
70.00	23.66	418.80	46.00	26.05	208.44	213.00	25.89	176.19
88.00	22.56	415.98	55.00	26.05	234.45	219.00	28.25	162.42
102.00	21.01	304.99	64.00	25.99	234.18	225.00	29.68	173.79
118.00	19.36	322.96	72.00	25.44	205.72	230.00	33.30	157.45
131.00	16.76	234.78	89.00	24.05	420.67	235.00	37.18	176.20

Section No.11 Contd.

Section No.11 Contd.

Year 1983			Year 2000			Year 2000		
L/B Dist. m	Bed R.L. m	Area m^2	L/B Dist. m	m	Area m^2	L/B Dist. m	Bed R.L. m	Area m^2
146.00	16.61	250.28	97.00	23.24	189.16	240.00	40.13	193.28
154.00	16.56	132.68	105.00	21.75	179.96	247.00	43.78	293.69
170.00	16.51	264.56	110.00	21.28		255.00	47.29	364.28
191.00	23.06	415.49	117.00	20.49	146.20	255.00	47.32	0.00
207.00	27.86	407.36	124.00	19.72	140.74	Total Area		= 6612.14
213.00	35.26	189.36	130.00	19.42	117.42			
229.00	40.84	608.80	136.00	19.32	116.22			
240.00	43.84	465.74	141.00	19.24	96.40			
247.00	43.41	305.38	146.00	19.20	96.10			
255.00	46.93	361.36	152.00	19.11	114.93			
255.00	47.32	0.00	158.00	19.09	114.60			
Total Area		= 6854.69						

Table A7 Contd : Section 12

Year 1983			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Area m ²	L/B Dist. m
0.00	39.18	0.00	0.00	39.18	0.00
0.00	38.77	0.00	0.00	38.81	0.00
8.00	37.14	303.64	8.00	37.39	304.80
13.00	35.27	181.03	14.00	34.88	216.81
34.56	33.47	741.02	22.00	31.89	267.08
52.91	31.52	596.28	26.00	29.61	123.00
69.03	38.12	561.30	61.00	29.49	1034.25
77.89	38.42	339.07	91.00	29.43	883.80
97.41	29.02	658.21	122.00	29.51	913.57
120.61	27.62	657.02	157.00	28.31	1011.85
144.54	23.67	613.68	186.00	27.55	809.97
168.87	26.67	612.39	201.00	28.04	416.93
192.26	20.57	552.47	212.00	27.26	304.15
208.59	24.47	367.75	253.00	26.86	1109.46
223.80	29.47	410.21	278.00	26.67	669.13
240.51	22.17	431.45	318.00	26.87	1070.80
260.44	18.47	404.98	346.00	27.55	761.88
281.57	18.37	389.21	372.00	27.55	716.30
308.83	18.47	502.13	395.00	26.30	619.28
320.15	18.57	209.65	421.00	26.32	684.06
339.72	20.87	385.92	454.00	25.92	861.96
358.15	24.47	417.81	475.00	26.62	551.67
378.70	24.47	502.86	491.00	26.75	426.96
395.80	23.92	413.73	527.00	26.55	959.40
415.44	23.57	466.35	563.00	26.39	952.92
432.01	23.37	388.90	583.00	26.27	526.60
453.64	23.07	502.25	598.00	25.78	390.38
467.42	22.37	313.08	611.00	25.70	334.62
494.78	22.17	609.31	625.00	26.18	363.16
515.66	21.87	459.78	634.00	27.09	239.72
522.12	21.37	139.67	638.00	31.89	117.96
545.19	18.07	454.94	641.00	33.35	97.86
562.55	20.17	331.92	645.00	35.23	137.16
578.98	21.37	341.25	652.00	38.13	256.76
600.10	20.37	440.77	656.00	39.73	155.72
617.95	21.67	375.21	660.00	41.29	162.04
630.89	23.77	294.00	660.00	41.72	0.00
645.00	35.27	416.53	Total area		= 18453.23
652.00	38.44	257.99			
660.00	41.32	319.04			
660.00	41.72	0.00			
Total Area		= 16364.61			

Table A7 Contd. : Section No. 13

Year 1983			Year 2000			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²	m	m	m ²
0.00	42.78	0.00	0.00	42.78	0.00	915.00	25.17	126.70
0.00	42.50	0.00	0.00	42.40	0.00	920.00	25.17	125.85
5.00	40.01	206.28	10.00	40.81	416.05	925.00	25.49	126.65
9.00	38.67	157.36	15.00	37.66	196.18	935.00	25.29	253.90
15.00	35.30	221.91	19.00	33.94	143.20	945.00	25.01	251.50
20.00	34.00	173.25	23.00	31.16	130.20	955.00	24.94	249.75
44.00	26.50	726.00	30.00	28.06	207.27	965.00	24.64	247.90
78.00	25.30	880.60	40.00	26.97	275.15	975.00	25.49	250.65
102.00	24.60	598.80	60.00	26.52	534.90	985.00	27.39	264.40
137.00	24.60	861.00	80.00	26.25	527.70	990.00	28.06	138.63
163.00	23.80	629.20	100.00	26.35	526.00	1009.00	30.18	553.28
206.00	25.40	1057.80	110.00	26.01	261.80	1019.00	30.47	303.25
244.00	26.10	978.50	130.00	26.30	523.10	1039.00	30.43	609.00
276.00	25.60	827.20	150.00	26.54	528.40	1069.00	30.25	910.20
310.00	27.40	901.00	170.00	26.80	533.40	1099.00	30.07	904.80
340.00	27.60	825.00	190.00	26.52	533.20	1129.00	30.07	902.10
384.00	25.80	1174.80	210.00	26.98	535.00	1159.00	29.92	899.85
428.00	26.70	1155.00	230.00	27.02	540.00	1189.00	30.15	901.05
468.00	27.30	1080.00	250.00	26.98	540.00	1219.00	29.64	896.85
498.00	27.50	822.00	270.00	27.26	542.40	1249.00	29.37	885.15
539.00	25.80	1092.65	278.00	28.06	221.28	1264.00	29.36	440.48
578.00	27.70	1043.25	298.00	28.46	565.20	1279.00	29.73	443.18
618.00	25.40	1062.00	325.00	28.63	770.72	1296.00	31.24	518.25
678.00	25.70	1533.00	346.00	28.93	604.38	1305.00	33.95	293.36
733.00	25.80	1416.25	376.00	28.73	864.90	1309.00	34.49	136.88
768.00	28.30	946.75	406.00	28.73	861.90	1313.00	36.78	142.54
809.00	27.20	1137.75	436.00	29.08	867.15	1320.00	37.68	260.61
860.00	26.40	1366.80	466.00	29.48	878.40	1320.00	38.06	0.00
905.00	26.20	1183.50	496.00	29.40	883.20	Total Area = 38235.93		
940.00	23.70	873.25	526.00	29.23	879.45			
964.00	23.55	567.00	556.00	29.37	879.00			
984.00	23.50	470.50	586.00	29.65	885.30			
1014.00	27.20	760.50	616.00	29.55	888.00			
1049.00	28.35	972.13	646.00	29.54	886.35			
1072.00	28.35	652.05	676.00	29.60	887.10			
1111.00	28.60	1071.53	706.00	29.69	889.35			
1136.00	26.30	661.25	736.00	29.83	892.80			
1155.00	25.65	493.53	766.00	29.77	894.00			
1199.00	25.40	1123.10	796.00	29.51	889.20			
1228.00	25.40	736.60	826.00	29.42	883.95			
1243.00	25.40	381.00	856.00	29.55	884.55			
1266.00	28.40	618.70	886.00	29.36	883.65			
1280.00	30.00	408.80	891.00	29.37	146.83			
1312.00	35.30	1044.80	895.00	28.71	116.16			
1316.00	37.02	144.64	899.00	28.06	113.54			
1320.00	37.72	149.48	905.00	25.79	161.55			
1320.00	38.06	0.00	910.00	25.51	128.25			
Total Area = 35189.06								

Table A7: Contd. : Section No. 14

Year 1983		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	38.35	0.00
0.00	37.95	0.00
8.00	36.53	297.92
11.00	35.33	107.79
26.53	30.73	512.96
36.28	30.38	297.91
46.96	30.43	324.73
64.71	29.88	535.25

Year 2000		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	38.35	0.00
0.00	37.97	0.00
6.00	36.85	224.46
10.00	35.65	145.00
15.00	33.62	173.18
20.00	33.13	166.88
26.00	30.88	192.03
41.00	30.86	463.05

Year 1983			Section14 Contd.	Year 2000		
L/B Dist. m	Bed R.L m	Area m ²		L/B Dist. m	Bed R.L m	Area m ²
75.85	28.88	327.29		56.00	30.87	462.98
88.63	28.48	366.53		71.00	31.19	465.45
106.95	28.23	519.46		86.00	31.22	468.08
127.04	26.88	553.58		101.00	31.32	469.05
143.99	24.98	439.51		116.00	31.48	471.00
157.38	24.63	332.14		120.00	30.55	124.06
170.78	24.48	329.04		124.00	29.01	119.12
185.85	24.28	367.41		130.00	27.82	170.49
204.04	27.08	467.12		135.00	27.44	138.15
220.48	29.63	466.16		140.00	26.98	136.05
231.06	30.18	316.39		145.00	26.55	133.83
263.49	30.53	984.41		150.00	26.33	132.20
285.81	28.78	661.90		155.00	25.99	130.80
311.74	25.83	708.02		160.00	25.64	129.08
337.11	25.83	655.31		165.00	25.35	127.48
378.34	25.58	1059.82		170.00	25.23	126.45
389.64	25.88	290.75		175.00	25.28	126.28
399.60	25.68	256.77		180.00	25.14	126.05
419.23	27.48	521.77		185.00	25.51	126.63
438.23	35.33	596.70		189.00	27.82	106.66
456.23	36.97	650.70		198.00	33.27	274.91
468.00	38.05	441.49		208.00	31.35	323.10
468.00	38.40	0.00		225.00	31.48	534.06
Total Area	=	13386.94		253.00	31.29	878.78
				273.00	30.58	618.70
				288.00	29.23	448.58
				308.00	29.18	584.10
				327.00	28.14	544.54
				348.00	29.11	601.13
				368.00	29.19	583.00
				388.00	29.26	584.50
				406.00	29.47	528.57
				418.00	31.82	367.74
				423.00	32.81	161.58
				438.00	34.43	504.30
				448.00	36.32	353.75
				456.00	36.74	292.24
				468.00	38.06	448.80
				468.00	38.40	0.00
				Total Area	=	14286.55

Table A7 Contd. : Section No.15

Year 1983			Year 2000			Year 2000		
L/B Dist. m	Bed R.L m	Area m ²	L/B Dist. m	Bed R.L m	Area m ²	L/B Dist. m	Bed R.L m	Area m ²
0.00	35.84	0.00	0.00	35.84	0.00	147.00	26.20	128.20
0.00	35.53	0.00	0.00	35.53	0.00	152.00	26.50	131.75
2.00	35.34	70.87	15.00	33.02	514.13	157.00	27.10	134.00
10.44	34.54	294.89	30.00	32.73	493.13	162.00	27.50	136.50
18.22	32.24	259.77	45.00	32.81	491.55	167.00	27.90	138.50
29.96	31.64	374.98	60.00	33.13	494.55	175.00	31.02	235.68
45.80	31.44	499.59	70.00	33.57	333.50	185.00	32.97	319.95
60.44	31.64	461.75	78.00	33.48	268.20	195.00	33.51	332.40
82.55	31.24	695.14	84.00	31.92	196.20	205.00	33.46	334.85
97.29	26.34	424.36	87.00	30.81	94.10	215.00	33.70	335.80
112.86	25.04	399.99	97.00	28.95	298.80	225.00	32.78	332.40
134.27	21.24	495.43	102.00	28.35	143.25	235.00	32.28	325.30
147.89	24.44	311.08	112.00	27.90	281.25	247.00	33.02	391.80
179.15	28.34	824.95	117.00	27.60	138.75	255.00	33.84	267.44
206.20	31.74	812.58	122.00	27.20	137.00	265.00	34.28	340.60
234.00	30.54	865.69	127.00	26.60	134.50	275.00	35.12	347.00
280.00	35.34	1515.24	132.00	25.90	131.25	285.00	36.00	355.60
285.00	36.02	178.40	137.00	25.90	129.50	285.00	36.40	0.00
285.00	36.40	0.00	142.00	25.08	127.45	Total Area	=	8994.70
Total Area	=	8484.17						

Table A7 Contd. : Section No. 16

Year 1983			Year 2000		
L/B Dist.	Bed R.L.	Area	L/B Dist.	Bed R.L.	Area
m	m	m ²	m	m	m ²
0.00	35.29	0.00	0.00		0.00
0.00	34.90	0.00	0.00	34.90	0.00
10.00	34.00	344.50	6.00	34.81	209.13
40.00	24.60	879.00	10.00	33.48	136.58
111.00	16.90	1473.25	14.00	28.62	124.20
171.00	16.40	999.00	62.00	22.80	1234.08
201.00	16.30	490.50	87.00	18.42	515.25
221.00	16.10	324.00	121.00	16.22	588.88
256.00	16.20	565.25	158.00	15.80	592.37
281.00	16.20	405.00	193.00	15.56	548.80
311.00	16.20	486.00	228.00	15.62	545.65
337.00	16.20	421.20	263.00	15.65	547.23
363.00	18.40	449.80	301.00	17.55	630.80
383.00	17.10	355.00	334.00	16.12	555.56
411.00	21.60	541.80	352.00	21.06	334.62
435.00	19.20	489.60	368.00	20.15	329.68
465.00	21.80	615.00	379.00	15.77	197.56
498.00	16.40	630.30	395.00	21.62	299.12
531.00	16.50	542.85	405.00	17.77	196.95
558.00	24.40	552.15	411.00	16.05	101.46
583.00	27.00	642.50	438.00	15.91	431.46
609.00	26.20	691.60	447.00	16.62	146.39
638.00	21.30	688.75	468.00	23.77	424.10
667.00	26.00	685.85	476.00	25.77	198.16
697.00	26.50	787.50	484.00	26.48	209.00
723.00	26.60	690.30	514.00	21.20	715.20
744.00	26.10	553.35	519.00	23.05	110.63
778.00	25.30	873.80	542.00	26.01	564.19
811.00	17.50	706.20	582.00	25.16	1023.40
846.00	19.80	652.75	605.00	25.91	587.31
890.00	24.60	976.80	618.00	25.33	333.06
937.00	27.60	1226.70	653.00	19.02	776.13
954.00	27.70	470.05	659.00	17.08	108.30
993.00	27.35	1073.48	674.00	22.91	299.93
1017.00	24.50	622.20	692.00	22.23	406.26
1047.00	23.80	724.50	726.00	25.97	819.40
1079.00	26.30	801.60	733.00	26.73	184.45
1109.00	24.90	768.00	748.00	27.36	405.68
1140.00	18.30	669.60	793.00	27.14	1226.25
1179.00	19.30	733.20	805.00	23.05	301.14
1215.00	20.00	707.40	832.00	26.22	665.15
1253.00	21.30	784.70	867.00	24.92	894.95
1291.00	22.70	836.00	881.00	18.48	303.80
1325.00	23.30	782.00	901.00	17.47	359.50
1365.00	23.70	940.00	937.00	16.92	619.02
1412.00	24.40	1130.35	955.00	16.91	304.47
1458.00	13.75	877.45	971.00	19.19	288.80
1502.00	22.90	806.30	986.00	24.91	330.75
1552.00	16.50	985.00	1011.00	17.84	534.38
1496.00	15.10	-884.80	1043.00	24.45	676.64
1646.00	15.30	2280.00	1059.00	25.87	402.56
1692.00	17.60	756.70	1079.00	25.55	514.20
1736.00	12.50	662.20	1114.00	22.03	832.65
1793.00	4.80	493.05	1137.00	12.25	394.22
1852.00	9.00	407.10	1151.00	15.61	195.02
1900.00	13.20	532.80	1175.00	12.62	338.76
2015.00	15.30	1638.75	1185.00	11.81	122.15
2094.00	13.55	1139.58	1220.00	15.12	471.28
2137.00	13.55	582.65	1256.00	16.61	571.14
2184.00	13.60	638.03	1290.00	17.88	586.33
2233.00	14.00	676.20	1309.00	12.05	284.34
2290.00	14.15	802.28	1325.00	11.10	185.20

Section 16 Contd.

Year 1983			Year 2000			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²
2337.00	14.15	665.05	1350.00	15.77	335.88	2378.00	3.65	58.50
2375.00	14.00	534.85	1361.00	14.11	164.34	2385.00	3.39	24.64
2417.00	13.60	579.60	1399.00	18.91	627.38	2404.00	3.42	64.70
2581.00	13.65	2234.50	1433.00	16.26	597.89	2419.00	3.63	52.88
2629.00	13.70	656.40	1468.00	16.65	575.93	2456.00	5.25	164.28
2664.00	13.80	481.25	1474.00	16.62	99.81	2492.00	7.25	225.00
2701.00	14.10	516.15	1500.00	12.83	382.85	2526.00	11.97	326.74
2739.00	14.50	543.40	1520.00	12.60	254.30	2559.00	18.23	498.30
2772.00	14.80	483.45	1572.00	12.79	660.14	2605.00	17.98	832.83
2807.00	15.20	525.00	1611.00	12.88	500.57	2632.00	17.80	483.03
2842.00	15.50	537.25	1642.00	12.78	397.73	2648.00	25.68	347.84
2883.00	16.20	649.85	1679.00	13.02	477.30	2660.00	28.38	324.36
2910.00	16.65	443.48	1700.00	13.33	276.68	2666.00	28.61	170.97
2946.00	17.30	611.10	1712.00	10.88	145.26	2707.00	19.16	979.29
2988.00	18.10	743.40	1726.00	13.63	171.57	2725.00	17.20	327.24
3021.00	18.60	605.55	1747.00	13.59	285.81	2743.00	19.00	325.80
3050.00	19.00	545.20	1782.00	12.88	463.23	2784.00	22.98	860.59
3101.00	19.90	991.95	1822.00	12.96	516.80	2810.00	17.11	521.17
3154.00	20.30	1065.30	1853.00	13.27	406.57	2842.00	15.51	521.92
3201.00	19.40	932.95	1890.00	13.39	493.21	2877.00	14.69	528.50
3283.00	8.00	1123.40	1926.00	13.40	482.22	2899.00	14.34	319.33
3348.00	3.70	380.25	1961.00	14.01	479.68	2913.00	20.44	243.46
3379.00	4.35	124.78	1995.00	14.17	479.06	2934.00	22.34	449.19
3440.00	6.90	343.13	2030.00	14.60	503.48	2941.00	20.78	150.92
3482.00	10.20	359.10	2068.00	16.28	586.72	2988.00	22.78	1023.66
3506.00	16.00	314.40	2101.00	16.58	542.19	3005.00	23.20	390.83
3529.00	18.50	396.75	2137.00	17.45	612.54	3019.00	27.72	356.44
3553.00	18.55	444.60	2172.00	18.03	620.90	3035.00	21.20	391.36
3575.00	18.35	405.90	2206.00	18.54	621.69	3057.00	24.95	507.65
3597.00	18.15	401.50	2242.00	19.06	676.80	3072.00	24.47	370.65
3633.00	17.90	648.90	2280.00	19.52	733.02	3083.00	26.34	279.46
3684.00	25.10	1096.50	2314.00	18.96	654.16	3094.00	21.94	265.54
3693.00	32.20	257.85	2333.00	18.05	351.60	3114.00	13.48	354.20
Total area		= 63879.35	2347.00	13.53	221.06	3130.00	16.14	236.96
			2360.00	10.08	153.47	3144.00	15.48	221.34
			2368.00	8.05	72.52	3166.00	17.63	364.21
						3179.00	19.77	243.10
						3198.00	14.62	326.71
						3222.00	12.59	326.52
						3235.00	12.88	165.56
						3272.00	14.47	505.98
						3288.00	17.18	253.20
						3306.00	14.00	280.62
						3342.00	18.86	591.48
						3358.00	9.86	229.76
						3378.00	12.91	227.70
						3410.00	14.63	440.64
						3434.00	15.34	359.64
						3447.00	11.94	177.32
						3481.00	13.59	434.01
						3521.00	15.01	572.00
						3561.00	14.59	592.00
						3596.00	14.47	508.55
						3611.00	19.20	252.53
						3638.00	14.11	449.69
						3675.00	15.43	546.49
						3683.00	27.42	171.40
						3688.00	27.84	138.15
						3693.00	33.48	153.30
						3693.00	32.20	0.00
Total Area		= 63887.56						

Table A7 Contd. : Section No. 17

Year 1983			Year 2000		
L/B Dist.	Bed R.L.	Area	L/B Dist.	Bed R.L.	Area
m	m	m ²	m	m	m ²
0.00	34.78	0.00	0.00	34.78	0.00
0.00	34.40	0.00	0.00	34.49	0.00
5.00	34.07	171.18	8.00	34.07	274.24
17.00	32.57	399.84	16.00	33.48	270.20
80.00	29.37	1951.11	21.00	26.47	149.88
102.00	26.57	615.34	41.00	23.04	495.10
130.00	23.37	699.16	93.00	20.39	1129.18
143.00	20.47	284.96	153.00	19.71	1203.00
174.00	22.27	662.47	199.00	22.06	960.71
212.00	23.27	865.26	207.00	17.42	157.92
232.00	22.17	454.40	250.00	16.03	719.18
244.00	22.47	267.84	308.00	16.47	942.50
262.00	21.67	397.26	364.00	16.95	935.76
284.00	18.37	440.44	410.00	14.16	715.53
305.00	16.87	370.02	432.00	7.21	235.07
327.00	17.17	374.44	460.00	5.43	176.96
345.00	17.47	311.76	492.00	5.47	174.40
367.00	17.47	384.34	521.00	5.70	161.97
387.00	17.67	351.40	537.00	5.92	92.96
411.00	10.57	338.88	558.00	6.39	129.26
431.00	5.47	160.40	570.00	6.68	78.42
450.00	5.27	102.03	585.00	10.76	130.80
469.00	5.27	100.13	612.00	16.20	363.96
485.00	5.37	85.12	646.00	17.10	566.10
510.00	5.57	136.75	707.00	17.77	1063.54
530.00	5.77	113.40	757.00	18.74	912.75
555.00	6.37	151.75	814.00	19.56	1091.55
575.00	7.07	134.40	869.00	19.25	1067.28
600.00	15.07	276.75	907.00	18.73	721.62
624.00	16.57	379.68	961.00	18.27	999.00
642.00	16.87	300.96	1038.00	17.83	1389.85
668.00	17.07	441.22	1097.00	17.10	1030.44
690.00	17.07	375.54	1152.00	16.55	925.38
711.00	17.67	364.77	1206.00	16.02	879.39
730.00	17.67	335.73	1264.00	16.18	933.80
757.00	19.87	506.79	1288.00	17.20	400.56
782.00	19.97	498.00	1322.00	21.55	658.75
827.00	19.67	891.90	1374.00	21.23	1112.28
855.00	19.47	547.96	1412.00	20.60	794.77
876.00	19.27	406.77	1483.00	19.89	1437.40
903.00	18.97	516.24	1538.00	19.17	1074.15
932.00	18.47	542.88	1593.00	18.32	1030.98
951.00	18.27	349.03	1648.00	17.42	982.85
974.00	18.07	417.91	1702.00	16.84	925.02
1002.00	17.77	501.76	1754.00	16.53	867.62
1031.00	17.67	513.88	1810.00	16.18	915.88
1050.00	17.37	332.88	1867.00	15.84	912.57
1084.00	16.87	582.08	1920.00	15.47	829.72
1111.00	16.77	454.14	1976.00	15.46	866.04
1148.00	16.47	614.94	2028.00	15.15	795.86
1179.00	16.17	505.92	2084.00	15.35	854.00
1208.00	16.07	467.48	2139.00	15.43	846.45
1255.00	16.07	755.29	2190.00	16.06	803.00
1287.00	18.17	547.84	2247.00	22.81	1107.80
1320.00	21.67	657.36	2287.00	14.98	755.80
1350.00	21.57	648.60	2298.00	14.94	164.56
1388.00	21.17	812.06	2354.00	14.73	830.76
1419.00	20.67	648.52	2411.00	14.84	842.75
1454.00	20.07	712.95	2463.00	14.92	773.76
1500.00	19.67	914.02	2483.00	16.63	315.50
1531.00	19.27	603.57	2517.00	17.25	575.96
1566.00	18.67	663.95	2548.00	14.91	498.48

Section No.17 Contd.

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
1635.00	17.67	
1670.00	17.27	611.45
1702.00	16.97	547.84
1749.00	16.67	790.54
1786.00	16.37	611.24
1828.00	16.17	683.34
1858.00	15.97	482.10
1895.00	15.67	585.34
1944.00	15.57	765.38
1993.00	15.27	755.58
2032.00	15.27	595.53
2082.00	15.47	768.50
2145.00	15.57	977.76
2188.00	15.57	669.51
2218.00	22.17	566.10
2247.00	25.97	698.03
2278.00	18.67	691.92
2312.00	14.97	571.88
2351.00	14.87	581.88
2387.00	14.87	535.32
2422.00	14.87	520.45
2432.00	15.27	150.70
2494.00	17.37	1011.84
2537.00	20.07	804.96
2569.00	29.07	786.24
2611.00	23.37	1101.24
2642.00	19.07	657.82
2693.00	28.77	1219.92
2744.00	34.07	1602.42
2755.00	34.49	377.08
2755.00	34.87	0.00
Total Area	=	50402.01

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
2584.00	18.06	
2611.00	22.91	553.10
2623.00	22.40	271.86
2648.00	20.05	530.63
2687.00	23.83	855.66
2735.00	28.09	1246.08
2741.00	33.48	184.71
2745.00	34.44	135.84
2755.00	34.54	344.90
2755.00	34.87	0.00
Total Area	=	47792.97

Table A7 Contd. : Section No.18

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	34.22	0.00
0.00	34.12	0.00
29.00	31.72	954.68
82.00	26.52	1543.36
116.00	19.22	777.58
213.00	18.82	1844.94
245.00	20.42	627.84
285.00	24.32	894.80
328.00	13.22	807.11
360.00	19.92	530.24
390.00	13.22	497.10
416.00	12.02	328.12
487.00	16.82	1023.82
531.00	16.82	740.08
589.00	16.72	972.66
616.00	16.82	452.79
647.00	17.02	524.52
676.00	17.12	495.03
705.00	17.82	506.63
743.00	18.52	690.46
778.00	18.72	651.70
801.00	19.02	434.01
828.00	18.22	502.74
851.00	18.52	422.51
875.00	15.22	404.88

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	34.22	0.00
0.00	34.18	0.00
10.00	33.94	340.60
20.00	31.86	329.00
25.00	30.70	156.40
30.00	29.76	151.15
56.00	24.33	703.17
70.00	21.18	318.57
82.00	26.14	283.92
130.00	16.42	1021.44
161.00	16.19	505.46
199.00	23.56	755.25
215.00	20.91	355.76
244.00	24.13	653.08
263.00	18.51	405.08
287.00	24.41	515.04
308.00	13.98	403.10
337.00	22.41	527.66
356.00	22.62	427.79
381.00	13.69	453.88
409.00	16.05	416.36
436.00	12.90	390.83
460.00	15.76	343.92
471.00	13.05	158.46
508.00	16.97	555.37

Section No.18 Contd.

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
899.00	6.52	260.88
930.00	6.12	195.92
964.00	6.12	208.08
992.00	6.12	171.36
1023.00	6.22	191.27
1049.00	6.32	163.02
1079.00	6.32	189.60
1110.00	15.22	333.87
1134.00	17.82	396.48
1162.00	18.52	508.76
1191.00	19.42	550.13
1228.00	19.72	724.09
1268.00	19.42	782.80
1300.00	20.82	643.84
1330.00	21.02	627.60
1353.00	20.52	477.71
1373.00	20.02	405.40
1444.00	28.72	1730.27
1506.00	31.72	1873.64
1542.00	34.12	1185.12
1542.00	34.46	0.00
Total Area =		28250.52

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
608.00	16.96	1696.50
708.00	17.42	1719.00
809.00	18.78	1828.10
860.00	18.62	953.70
900.00	6.84	509.20
990.00	6.46	598.50
1086.00	6.96	644.16
1134.00	14.62	517.92
1167.00	18.06	539.22
1230.00	20.11	1202.36
1274.00	19.96	881.54
1304.00	21.33	619.35
1378.00	19.62	1515.15
1437.00	19.30	1148.14
1507.00	29.76	1717.10
1519.00	31.34	366.60
1522.00	32.14	95.22
1537.00	33.39	491.48
1540.00	33.90	100.94
1542.00	34.46	68.36
1542.00	34.46	0.00
Total Area =		27515.79

Table A7 Contd. : Section No.19

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	32.96	0.00
31.00	26.26	917.91
87.00	16.26	1190.56
135.00	15.56	763.68
158.00	14.96	350.98
189.00	14.46	456.01
218.00	14.16	414.99
251.00	13.96	463.98
279.00	13.96	390.88
305.00	13.96	362.96
347.00	13.96	586.32
371.00	13.96	335.04
397.00	13.96	362.96
426.00	13.96	404.84
460.00	14.06	476.34
495.00	14.06	492.10
525.00	14.06	421.80
550.00	14.16	352.75
574.00	14.16	339.84
606.00	14.26	454.72
639.00	14.31	471.41
677.00	14.21	541.88
693.00	14.26	227.76
717.00	24.36	463.44
741.00	14.36	464.64
807.00	14.56	954.36
834.00	14.66	394.47
862.00	14.66	410.48
896.00	14.81	500.99
938.00	15.06	627.27
969.00	15.46	473.06
1002.00	16.06	520.08
1036.00	16.46	552.84
1080.00	17.16	739.64
1141.00	18.76	1095.56
1185.00	19.86	849.64

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.67	0.00
7.00	26.68	211.23
35.00	24.24	712.88
94.00	15.89	1183.84
125.00	15.49	486.39
185.00	14.74	906.90
245.00	13.73	854.10
304.00	13.65	807.71
366.00	13.61	845.06
430.00	13.61	871.04
484.00	13.61	734.94
551.00	13.73	915.89
611.00	13.87	828.00
674.00	13.97	876.96
744.00	14.06	981.05
797.00	14.19	748.63
859.00	14.37	885.36
921.00	14.57	897.14
981.00	15.23	894.00
1042.00	16.05	954.04
1104.00	17.04	1025.79
1164.00	18.65	1070.70
1226.00	20.03	1199.08
1280.00	20.62	1097.55
1336.00	15.84	1020.88
1395.00	13.19	856.39
1454.00	13.21	778.80
1512.00	14.00	789.09
1569.00	17.09	886.07
1630.00	17.98	1069.64
1685.00	18.88	1013.65
1743.00	17.07	1042.55
1801.00	17.75	1009.78
1860.00	18.11	1057.87
1920.00	19.75	1135.80
1979.00	20.78	1195.64

Section 19 Contd.

1218.00	20.36	663.63
1243.00	20.86	515.25
1274.00	21.56	657.51
1308.00	21.81	737.29
1336.00	16.06	530.18
1365.00	14.96	449.79
1394.00	14.06	420.79
1428.00	13.56	469.54
1462.00	13.46	459.34
1507.00	13.96	616.95
1573.00	15.46	970.86
1606.00	15.86	516.78
1673.00	17.36	1112.87
1725.00	18.91	943.02
1764.00	19.61	751.14
1803.00	19.76	767.72
1992.00	20.86	3838.59
2042.00	19.06	998.00
2085.00	20.86	858.28
2127.00	20.96	878.22
2225.00	20.11	2012.43
2300.00	16.46	1371.38
2371.00	15.36	1129.61
2442.76	5.66	754.20
2651.29	-8.84	-331.56
2687.14	-6.44	-273.89
2763.00	-3.44	-374.75
2883.00	2.56	-52.80
2898.00	3.56	45.90
2929.00	5.56	141.36
3000.00	13.46	675.21
3057.00	20.96	980.97
3133.00	21.66	1619.56
3193.00	21.36	1290.60
3233.00	21.46	856.40
3267.00	21.41	728.79
3291.00	21.26	512.04
3324.00	21.06	698.28
3373.00	20.96	1029.49
3412.00	20.96	817.44
3446.00	20.86	710.94
3507.00	20.46	1260.26
3547.00	20.26	814.40
3601.00	20.06	1088.64
3642.00	19.96	820.41
3683.00	19.96	818.36
3730.00	19.46	926.37
3773.00	19.26	832.48
3835.00	19.46	1200.32
3873.00	19.36	737.58
3919.00	19.46	892.86
3958.00	19.46	758.94
4009.00	19.76	1000.11
4051.00	19.66	827.82
4112.00	21.06	1241.96
4163.00	15.26	926.16
4212.00	6.56	534.59
4215.00	6.21	19.16
4281.00	6.26	411.51
4303.00	14.16	224.62
4350.00	34.06	1133.17
4366.00	37.53	572.72
4380.00	39.79	541.24
4380.00	40.12	0.00
Total Area		= 71456.81

2038.00	12.30	975.86
2093.00	20.49	901.73
2150.00	21.64	1200.71
2178.00	22.23	614.18
2209.00	22.70	696.42
2267.00	22.59	1313.41
2324.00	21.27	1250.01
2380.00	23.43	1251.60
2442.00	23.42	1452.35
2498.00	23.07	1301.72
2557.00	22.78	1352.58
2616.00	22.81	1344.91
2668.00	21.97	1164.28
2733.00	21.48	1412.13
2789.00	21.53	1204.28
2848.00	21.81	1278.53
2904.00	22.46	1239.56
2963.00	22.33	1321.31
3022.00	22.32	1317.18
3081.00	22.41	1319.54
3139.00	21.44	1271.65
3196.00	20.08	1183.32
3255.00	18.14	1127.49
3313.00	17.56	1035.30
3370.00	16.91	982.40
3429.00	16.65	990.02
3487.00	16.39	958.16
3603.00	16.25	1893.12
3671.00	16.09	1099.56
3715.00	16.34	713.46
3779.00	16.23	1042.24
3836.00	15.90	915.71
3892.00	14.30	845.60
3954.00	16.18	944.88
4012.00	17.02	962.80
4069.00	19.24	1033.41
4103.00	20.24	671.16
4127.00	9.36	355.20
4145.00	8.20	158.04
4180.00	6.04	249.20
4218.00	5.59	220.97
4251.00	6.84	205.10
4317.00	16.11	757.35
4323.00	21.39	112.50
4329.00	33.67	165.18
4338.00	34.51	306.81
4350.00	35.15	417.96
4353.00	38.04	109.79
4356.00	40.83	118.31
4364.00	44.00	339.32
4370.00	45.12	267.36
4370.00	45.28	0.00
Total Area		= 77201.21

Table A7 Contd : Section No.20

Year 1983			Year 2000		
L/B Dist. m	Bed R.L m	Area m ²	L/B Dist. m	Bed R.L m	Area m ²
0.00	32.71	0.00	0.00	32.71	0.00
2.55	32.38	82.99	1.00	32.32	32.52
16.95	31.68	461.23	20.00	31.16	603.06
40.01	29.08	700.56	32.00	28.98	360.84
70.59	23.58	805.17	43.00	25.76	301.07
101.05	24.38	730.43	60.00	20.69	394.83
147.72	21.88	1079.48	118.00	26.38	1365.03
177.88	20.38	637.28	141.00	23.78	576.84
207.15	19.38	581.89	170.00	19.84	632.49
242.20	23.18	745.86	206.00	19.00	699.12
272.15	23.58	700.23	245.00	19.55	751.73
309.27	19.03	790.84	280.00	23.27	749.35
340.72	18.88	596.13	337.00	21.26	1269.11
376.31	18.88	671.94	391.00	18.41	1071.09
408.93	18.98	617.50	429.00	21.55	759.24
433.44	20.28	481.13	472.00	23.55	969.65
480.80	19.38	939.15	525.00	19.27	1134.73
514.56	22.68	709.97	582.00	21.23	1154.25
542.01	20.78	596.49	612.00	20.12	620.25
571.60	21.48	625.24	648.00	21.56	750.24
611.78	20.88	851.01	682.00	29.41	866.49
642.25	20.58	631.64	703.00	18.84	506.63
675.52	19.18	661.41	727.00	18.68	450.24
727.64	18.88	991.84	751.00	18.56	446.88
773.91	18.83	872.42	776.00	18.55	463.88
813.21	18.68	737.07	796.00	18.41	369.60
845.03	18.43	590.42	831.00	17.98	636.83
900.45	18.53	1024.16	850.00	18.12	342.95
943.27	18.78	798.81	868.00	18.12	326.16
982.69	19.18	748.19	908.00	18.27	727.80
1035.05	20.68	1043.53	938.00	18.41	550.20
1077.80	22.08	914.00	976.00	18.84	707.75
1113.12	22.88	793.99	1010.00	19.83	657.39
1157.65	23.78	1038.88	1027.00	20.12	339.58
1208.74	23.38	1204.70	1049.00	20.69	448.91
1245.07	11.28	629.60	1082.00	21.55	696.96
1277.62	5.63	275.21	1110.00	22.12	611.38
1321.29	5.88	251.32	1137.00	24.12	624.24
1361.24	5.88	234.91	1163.00	24.23	628.55
1407.79	26.98	764.82	1200.00	23.34	880.05
1445.01	30.28	1065.61	1220.00	22.98	463.20
1446.00	34.38	32.01	1233.00	21.56	289.51
1448.00	36.92	71.30	1243.00	17.84	197.00
1458.00	37.93	374.25	1265.00	11.50	322.74
1458.00	38.34	0.00	1287.00	5.70	189.20
Total Area	=	29156.07	1300.00	5.83	74.95
			1312.00	5.84	70.02
			1325.00	6.12	77.74
			1336.00	5.84	65.78
			1349.00	6.27	78.72
			1358.00	6.41	57.06
			1365.00	6.70	45.89
			1374.00	8.41	68.00
			1389.00	15.55	179.70
			1408.00	28.98	423.04
			1436.00	31.48	846.44
			1444.00	34.45	263.72
			1448.00	35.95	140.80
			1451.00	37.61	110.34
			1454.00	37.95	113.34
			1458.00	38.34	152.58
			Total Area	=	29707.61

Table A7 Contd. : Section No.21

Year 1983			Year 2000			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²	m	m	m ²
0.00	38.24	0.00	0.00	38.24	0.00	715.00	18.39	217.26
0.00	37.91	0.00	0.00	37.84	0.00	736.00	26.39	470.19
9.50	35.38	348.13	8.00	35.80	294.56	760.00	21.82	578.52
32.00	28.38	717.30	12.00	34.51	140.62	790.00	18.33	602.25
58.00	22.68	663.78	16.00	32.82	134.66	812.00	17.25	391.38
80.00	20.88	479.16	20.00	30.95	127.54	832.00	16.96	342.10
104.00	29.08	599.52	22.00	28.96	59.91	874.00	17.25	718.41
132.00	33.73	879.34	30.00	27.39	225.40	908.00	17.53	591.26
155.00	28.78	718.87	40.00	27.23	273.10	945.00	17.82	653.98
178.00	27.98	652.74	50.00	27.03	271.30	967.00	18.10	395.12
202.00	20.98	587.52	60.00	27.63	273.30	992.00	18.02	451.50
232.00	22.13	646.65	67.00	30.01	201.74	999.00	17.82	125.44
253.00	18.48	426.41	78.00	28.96	324.34	1019.00	7.70	255.20
282.00	17.38	519.97	86.00	27.46	225.68	1045.00	8.82	214.76
320.00	29.78	896.04	95.00	27.31	246.47	1073.00	14.39	324.94
347.00	29.88	805.41	100.00	27.36	136.68	1106.00	16.76	513.98
380.00	27.58	948.09	105.00	27.66	137.55	1133.00	15.53	435.92
408.00	25.38	741.44	108.00	28.96	84.93	1159.00	14.67	392.60
432.00	25.58	611.52	116.00	30.07	236.12	1190.00	13.87	442.37
465.00	26.98	867.24	120.00	31.18	122.50	1210.00	13.82	276.90
493.00	24.28	717.64	123.00	32.06	94.86	1221.00	14.67	156.70
525.00	19.38	698.56	132.00	33.83	296.51	1251.00	15.82	457.35
561.00	17.28	659.88	140.00	32.95	267.12	1282.00	16.96	508.09
590.00	16.08	483.72	148.00	31.26	256.84	1328.00	24.10	944.38
617.00	16.23	436.19	160.00	28.96	361.32	1348.00	25.53	496.30
648.00	22.28	596.91	165.00	24.25	133.03	1352.00	28.96	108.98
683.00	28.58	890.05	187.00	24.67	538.12	1358.00	30.19	177.45
708.00	23.38	649.50	198.00	21.53	254.10	1366.00	33.94	256.52
748.00	18.28	833.20	203.00	20.25	104.45	1374.00	36.45	281.56
771.00	17.78	414.69	210.00	20.73	143.43	1374.00	37.05	0.00
799.00	17.98	500.64	220.00	24.10	224.15	Total Area =		27465.20
821.00	18.08	396.66	229.00	22.34	208.98			
848.00	18.28	490.86	244.00	18.67	307.58			
879.00	18.58	571.33	255.00	18.59	204.93			
909.00	18.13	550.65	262.00	15.42	119.04			
918.00	18.38	164.30	274.00	14.96	182.28			
938.00	18.58	369.60	302.00	16.10	434.84			
963.00	18.68	465.75	336.00	19.25	600.95			
987.00	18.68	448.32	366.00	21.82	616.05			
1027.00	8.66	546.80	397.00	21.82	676.42			
1068.00	9.63	374.95	407.00	22.67	222.45			
1085.00	15.43	213.01	424.00	20.20	364.40			
1114.00	14.58	435.15	457.00	19.82	660.33			
1142.00	14.48	406.84	489.00	19.07	622.24			
1168.00	16.58	403.78	527.00	18.67	717.06			
1290.00	27.58	2693.76	559.00	18.67	597.44			
1322.00	32.98	968.96	601.00	20.96	832.23			
1369.00	35.38	1606.46	628.00	16.59	506.93			
1374.00	36.47	179.63	667.00	26.39	838.11			
1374.00	37.05	0.00	693.00	19.54	597.09			
Total Area	=	30348.16	703.00	17.82	186.80			

Table A7 Contd. : Section No. 22

Year 1983		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	37.04	0.00
0.00	36.60	0.00
4.00	36.50	146.20
8.00	35.43	143.86
15.00	31.43	234.01
26.00	28.03	327.03
42.00	25.43	427.68
61.00	20.83	439.47
79.00	20.28	369.99
99.00	20.13	404.10
115.00	19.63	318.08
131.00	17.63	298.08
148.00	15.23	279.31
167.00	15.03	287.47
189.00	15.28	333.41
208.00	15.48	292.22
232.00	15.78	375.12
250.00	15.93	285.39
273.00	16.13	368.69
294.00	16.93	347.13
316.00	18.28	387.31
334.00	19.68	341.64
358.00	19.63	471.72
379.00	19.83	414.33
398.00	19.93	377.72
416.00	19.43	354.24
436.00	16.13	355.60
454.00	14.63	276.84
478.00	11.23	310.32
495.00	11.53	193.46
508.00	17.43	188.24
522.00	21.63	273.42
537.00	21.08	320.33
556.00	20.63	396.25
578.00	23.13	481.36
601.00	29.83	609.04
618.00	35.43	554.71
623.00	37.01	181.10
628.00	37.84	187.13
628.00	38.29	0.00
Total Area	=	12351.94

Year 2000		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	37.04	0.00
0.00	36.74	0.00
13.00	32.00	446.81
18.00	29.73	154.33
28.00	25.45	275.90
42.00	22.31	334.32
65.00	20.00	486.57
122.00	15.24	1004.34
140.00	24.59	358.47
160.00	15.00	395.90
196.00	15.23	544.14
233.00	16.15	580.53
272.00	19.65	698.10
306.00	19.36	663.17
333.00	18.93	516.92
354.00	19.00	398.27
379.00	19.63	482.88
400.00	17.28	387.56
413.00	14.61	207.29
431.00	13.19	250.20
442.00	11.83	137.61
457.00	11.23	172.95
473.00	11.04	178.16
487.00	15.73	187.39
486.00	21.21	-18.47
512.00	20.91	547.56
525.00	20.61	269.88
537.00	20.06	244.02
554.00	23.38	369.24
570.00	25.73	392.88
581.00	26.87	289.30
596.00	26.59	400.95
605.00	29.73	253.44
615.00	33.57	316.50
628.00	37.90	464.56
628.00	38.29	0.00
Total Area	=	12428.51

Table A7 Contd. : Section No.23

Year 1983		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	35.54	0.00
0.00	35.16	0.00
0.00	35.46	0.00
15.00	31.56	502.65
35.00	28.56	601.20
62.00	25.06	723.87
93.00	21.61	723.39
118.00	22.46	550.88
144.00	28.78	665.86
166.00	27.16	615.12
193.00	31.46	791.37
215.00	30.26	678.92
235.00	28.36	586.20
256.00	26.46	575.61

Year 2000		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	35.54	0.00
0.00	35.17	0.00
8.00	33.79	275.84
13.00	32.27	165.15
18.00	24.98	143.13
48.00	23.13	721.65
74.00	21.41	579.02
91.00	20.84	359.13
97.00	21.13	125.91
110.00	25.13	300.69
127.00	27.41	446.59
148.00	26.18	562.70
168.00	27.70	538.80
193.00	30.56	728.25

Section No. 23 Contd.

271.00	24.16	379.65
288.00	22.66	397.97
310.00	22.66	498.52
325.00	22.64	339.75
348.00	22.76	522.10
376.00	23.06	641.48
393.00	23.11	392.45
413.00	23.31	464.20
433.00	23.51	468.20
454.00	23.71	495.81
469.00	24.06	358.28
486.00	22.26	393.72
503.00	24.36	396.27
523.00	24.41	487.70
547.00	23.06	569.64
566.00	21.21	420.57
593.00	21.21	572.67
614.00	21.21	445.41
636.00	21.36	468.27
662.00	23.36	581.36
685.00	23.26	536.13
707.00	21.31	490.27
725.00	21.31	383.58
743.00	21.31	383.58
766.00	21.56	493.01
786.00	21.71	432.70
807.00	24.16	481.64
825.00	23.76	431.28
843.00	24.26	432.18
868.00	32.46	709.00
880.00	35.46	407.52
888.00	36.68	288.56
888.00	36.99	0.00
Total Area		= 21778.51

251.00	26.27	1648.07
261.00	25.13	257.00
289.00	24.13	689.64
314.00	22.28	580.13
356.00	22.12	932.40
367.00	22.25	244.04
385.00	22.44	402.21
418.00	22.67	744.32
447.00	22.93	661.20
475.00	23.37	648.20
499.00	23.66	564.36
532.00	23.79	782.93
544.00	23.70	284.94
553.00	21.70	204.30
577.00	20.79	509.88
602.00	20.84	520.38
644.00	21.66	892.50
681.00	22.51	817.15
709.00	20.86	607.18
758.00	21.17	1029.74
784.00	23.41	579.54
803.00	23.23	443.08
845.00	26.48	1043.91
861.00	27.07	428.40
868.00	32.27	207.69
872.00	33.19	130.92
876.00	34.54	135.46
880.00	35.56	140.20
888.00	36.63	288.76
888.00	36.99	0.00
Total Area		= 21365.34

Table A7 Contd. : Section No. 24

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.77	0.00
0.00	36.47	0.00
5.00	35.49	179.90
14.00	33.89	312.21
33.00	29.69	604.01
59.00	23.14	686.79
84.00	22.84	574.75
112.00	22.84	639.52
149.00	24.39	873.76
185.00	23.34	859.14
213.00	23.19	651.42
243.00	23.24	696.45
268.00	23.09	579.13
303.00	22.99	806.40
330.00	22.74	617.36
362.00	22.74	727.68
389.00	21.59	598.46
424.00	21.59	755.65
460.00	25.89	854.64
500.00	23.49	987.60
532.00	30.49	863.68
569.00	33.19	1178.08
614.00	28.29	1383.30
649.00	23.89	913.15

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.77	0.00
0.00	36.45	0.00
10.00	34.62	355.31
20.00	33.28	339.50
30.00	31.44	323.62
33.00	31.32	94.14
38.00	29.55	152.18
43.00	24.24	134.46
61.00	23.59	430.42
87.00	23.09	606.76
112.00	23.13	577.68
137.00	22.99	576.43
161.00	23.15	553.61
189.00	23.03	646.44
214.00	22.95	574.68
239.00	22.90	573.05
259.00	22.87	457.64
282.00	22.82	525.37
304.00	22.76	501.31
325.00	22.70	477.27
348.00	22.45	519.16
371.00	21.78	508.58
394.00	21.92	502.48
408.00	21.69	305.23

Section No. 24 Contd.

660.00	21.79	251.24
718.00	21.79	1263.82
748.00	23.59	680.70
778.00	21.84	681.45
817.00	25.94	931.71
843.00	28.89	712.79
873.00	29.44	874.95
917.00	25.39	1206.26
957.00	29.49	1097.60
995.00	25.99	1054.12
1017.00	24.29	553.08
1056.00	24.19	945.36
1091.00	24.84	858.03
1120.00	24.29	712.39
1148.00	23.34	666.82
1176.00	23.14	650.72
1206.00	22.69	687.45
1224.00	22.29	404.82
1265.00	22.24	912.87
1296.00	22.24	689.44
1333.00	23.34	843.23
1367.00	23.04	788.46
1393.00	22.69	594.49
1425.00	23.39	737.28
1456.00	26.59	774.69
1482.00	28.39	714.74
1528.00	27.74	1290.99
1549.00	35.49	663.92
1552.00	35.86	107.03
1552.00	36.24	0.00
Total Area =		38697.04

434.00	23.36	585.57
455.00	21.75	473.59
463.00	21.49	172.94
485.00	23.50	494.82
500.00	25.55	367.83
512.00	27.27	316.88
523.00	29.55	312.48
548.00	31.89	767.96
568.00	32.43	643.20
593.00	31.88	803.88
615.00	29.55	675.70
622.00	29.55	206.83
634.00	29.55	354.56
648.00	29.55	413.66
655.00	29.55	206.83
664.00	29.55	265.92
680.00	29.55	472.75
695.00	29.55	443.21
745.00	29.55	1477.35
775.00	29.55	886.41
793.00	29.55	531.85
818.00	29.55	738.68
830.00	29.55	354.56
836.00	29.55	177.28
866.00	29.29	882.56
895.00	29.55	853.14
917.00	25.68	607.50
945.00	29.88	777.84
971.00	29.55	772.55
986.00	24.98	681.55
1050.00	24.50	1335.80
1121.00	25.27	1766.62
1156.00	23.96	861.42
1194.00	23.86	908.47
1239.00	23.85	1073.34
1269.00	23.43	709.11
1301.00	23.32	747.90
1324.00	23.05	533.19
1356.00	23.35	742.30
1392.00	23.09	835.81
1415.00	25.15	554.69
1442.00	27.25	707.32
1454.00	27.60	329.06
1459.00	29.55	142.86
1469.00	29.88	297.14
1508.00	25.85	1086.74
1536.00	29.55	775.56
1540.00	31.19	121.46
1544.00	33.41	129.18
1552.00	35.86	277.04
1552.00	36.24	0.00
Total Area =		40356.45

Table A7 Contd. : Section No.25

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	35.69	0.00
0.00	35.31	0.00
48.00	24.79	1442.40
75.00	24.74	668.66
97.00	24.39	540.43
129.00	24.14	776.48
155.00	24.19	628.29
195.00	24.19	967.60
218.00	24.69	562.12
248.00	24.89	743.70
278.00	25.19	751.20
303.00	25.44	632.88
329.00	25.24	658.84
349.00	25.09	503.30
376.00	24.79	673.38
402.00	24.69	643.24
427.00	23.79	606.00
455.00	23.69	664.72
480.00	24.54	602.68
502.00	23.89	532.73
521.00	24.29	457.71
554.00	23.94	795.80
582.00	23.69	666.82
606.00	25.65	592.08
628.00	27.39	583.44
651.00	26.64	621.35
674.00	26.44	610.42
694.00	27.49	539.30
715.00	29.94	603.02
722.00	30.99	213.26
737.00	31.34	467.48
756.00	29.29	575.99
774.00	28.89	523.62
796.00	33.19	682.88
811.00	33.49	500.10
822.00	33.94	370.87
833.00	33.99	373.62
863.00	34.68	1030.05
863.00	35.04	0.00
Total Area	=	22806.61

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	35.69	0.00
0.00	35.38	0.00
8.00	34.80	280.75
9.00	31.15	32.98
14.00	29.40	151.37
19.00	27.40	141.98
45.00	26.17	696.31
59.00	25.40	360.93
89.00	25.11	757.53
120.00	24.91	775.19
141.00	23.32	506.33
157.00	23.40	373.70
172.00	24.54	359.49
200.00	25.32	697.93
231.00	25.45	786.81
291.00	25.77	1536.33
301.00	25.69	257.26
353.00	25.55	1332.03
369.00	25.29	406.66
405.00	24.83	902.02
434.00	24.54	715.75
461.00	24.66	664.09
483.00	24.54	541.11
499.00	24.31	390.74
521.00	24.20	533.52
543.00	23.97	529.78
563.00	23.69	476.52
575.00	23.97	285.91
585.00	25.69	248.26
593.00	26.26	207.77
612.00	25.97	496.11
629.00	26.80	448.48
641.00	25.97	316.57
665.00	25.11	612.86
684.00	25.91	484.61
704.00	27.31	532.12
725.00	27.40	574.37
738.00	26.83	352.44
751.00	26.54	346.85
760.00	26.26	237.56
766.00	27.69	161.83
772.00	27.69	166.12
776.00	29.40	114.16
811.00	32.90	1090.15
826.00	32.82	492.86
835.00	32.14	292.29
863.00	34.67	935.31
863.00	35.04	0.00
Total Area	=	22603.73

Table A7Contd. : Section No. 26

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.76	0.00
0.00	35.38	0.00
15.00	33.62	517.52
49.00	29.72	1076.81
57.00	28.12	231.37
81.00	27.57	668.30
101.00	26.07	536.42
116.00	25.77	388.82
128.00	25.87	309.85
145.00	26.12	441.93
157.00	25.97	312.55
168.00	25.67	284.03
180.00	25.67	308.05
193.00	25.82	334.70
208.00	25.97	388.44
220.00	26.07	312.25
241.00	27.67	564.29
252.00	27.77	304.93
268.00	27.87	445.14
280.00	28.02	335.35
290.00	28.12	280.71
303.00	28.27	366.55
317.00	28.42	396.84
336.00	28.42	540.00
352.00	28.37	454.34
366.00	28.37	397.19
377.00	28.37	312.08
382.00	28.27	141.61
400.00	28.07	507.08
406.00	27.87	167.83
425.00	28.92	539.52
432.00	31.27	210.67
442.00	35.52	333.96
446.00	36.44	143.92
446.00	36.64	0.00
Total Area		= 12553.06

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.76	0.00
0.00	35.37	0.00
20.00	33.88	692.52
32.00	31.52	392.41
36.00	30.28	123.60
45.00	29.30	268.12
50.00	27.87	142.94
60.00	27.30	275.87
68.00	26.44	214.98
83.00	25.47	389.36
94.00	25.24	278.93
103.00	24.70	224.75
111.00	24.61	197.26
118.00	24.16	170.71
129.00	24.01	264.96
137.00	24.16	192.70
148.00	23.87	264.19
158.00	23.30	235.87
165.00	24.07	165.81
172.00	24.16	168.82
180.00	24.59	195.02
188.00	24.73	197.30
202.00	25.16	349.26
209.00	25.30	176.62
216.00	25.87	179.11
224.00	26.96	211.34
231.00	27.01	188.91
248.00	27.30	461.67
253.00	29.30	141.51
266.00	29.39	381.50
306.00	29.53	1178.40
346.00	29.42	1179.00
363.00	29.30	499.14
386.00	29.02	670.66
396.00	28.85	289.31
406.00	28.67	287.58
416.00	28.22	284.43
421.00	28.30	141.29
426.00	29.30	144.01
432.00	30.77	180.22
440.00	33.36	256.52
442.00	34.33	67.69
446.00	36.26	141.17
446.00	36.64	0.00
Total Area		= 12465.39

Table A7 Contd. : Section No. 27

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	39.14	0.00
0.00	38.75	0.00
4.00	37.57	152.64
10.00	35.54	219.32
17.00	34.04	243.50
26.00	32.24	298.22
46.00	28.24	604.72
54.00	27.44	222.69
66.00	27.59	330.13
78.00	27.74	331.93

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	39.14	0.00
0.00	38.75	0.00
8.00	36.17	299.65
9.00	35.91	36.04
20.00	33.65	382.62
29.00	32.08	295.82
34.00	28.68	151.92
57.00	28.65	659.39
81.00	30.08	704.86
112.00	30.08	932.60

Section No.27 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
89.00	28.29	308.12
103.00	29.44	404.05
116.00	29.04	380.07
129.00	29.19	378.44
140.00	29.74	324.07
154.00	29.84	417.00
170.00	30.44	482.18
185.00	29.84	452.04
199.00	25.74	389.00
209.00	25.64	256.86
229.00	25.89	515.22
250.00	25.74	542.03
263.00	25.74	334.57
280.00	26.24	441.76
297.00	29.09	470.24
317.00	29.14	582.22
338.00	28.64	606.61
351.00	27.89	367.39
373.00	27.84	612.94
396.00	32.24	690.83
397.00	35.34	33.79
397.00	35.60	0.00
Total area	=	11392.59

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
149.00	30.08	1113.11
175.00	29.58	775.68
194.00	29.23	558.77
205.00	28.65	318.38
218.00	26.08	355.80
242.00	26.08	626.02
270.00	25.18	717.75
277.00	24.88	175.24
284.00	26.94	181.40
295.00	30.08	313.65
314.00	28.66	558.11
329.00	28.66	429.96
335.00	29.22	173.66
343.00	28.37	230.39
360.00	26.51	466.55
379.00	30.08	537.68
384.00	32.08	155.42
387.00	33.03	97.67
397.00	35.54	342.83
397.00	35.60	0.00
Total Area	=	11590.97

Table A7 Contd. : Section No. 28

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.67	0.00
0.00	35.29	0.00
15.00	29.80	488.18
33.00	25.05	493.65
41.00	23.90	195.80
49.00	23.95	191.40
56.00	24.75	170.45
66.00	24.20	244.75
71.00	24.45	121.63
77.00	25.00	148.35
82.00	24.90	124.75
88.00	24.95	149.55
95.00	25.25	175.70
99.00	26.65	103.80
104.00	29.35	140.00
110.00	30.70	180.15
117.00	30.95	215.78
128.00	30.45	337.70
129.00	31.15	30.80
135.00	35.55	200.10
140.00	37.39	182.35
140.00	37.78	0.00
Total Area	=	3895.44

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.67	0.00
0.00	35.28	0.00
5.00	33.92	173.00
9.00	32.24	132.32
20.00	31.19	348.87
30.00	28.79	299.90
40.00	26.79	277.90
50.00	26.22	265.05
60.00	26.24	262.30
70.00	26.49	263.65
80.00	26.79	266.40
90.00	25.69	262.40
100.00	27.24	264.65
110.00	31.41	293.25
120.00	31.06	312.35
125.00	30.34	153.50
128.00	32.24	93.87
132.00	33.91	132.30
134.00	35.28	69.19
137.00	36.30	107.37
138.00	37.39	36.85
140.00	37.78	75.17
Total Area	=	4090.38

Table A7 Contd. : Section No. 29

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.77	0.00
0.00	35.55	0.00
18.90	34.65	663.39
26.10	33.40	244.98
39.90	31.85	450.23
58.30	30.95	577.76
72.90	31.00	452.24
89.50	30.95	514.19
104.80	31.20	475.45
124.60	31.75	623.21
134.20	28.55	289.44
146.40	25.95	332.45
157.10	25.15	273.39
168.10	24.95	275.55
178.20	25.50	254.77
185.70	25.25	190.31
197.10	26.75	296.40
207.40	31.90	302.05
218.00	35.16	355.42
218.00	35.51	0.00
Total Area		= 6572.08

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.77	0.00
0.00	35.41	0.00
8.00	34.86	281.08
16.00	35.15	280.04
24.00	33.52	274.68
32.00	33.05	266.29
41.00	32.25	293.85
52.00	33.79	363.22
62.00	31.43	326.10
70.00	31.33	251.04
78.00	31.48	251.24
86.00	31.42	251.60
94.00	31.16	250.32
102.00	31.63	251.16
110.00	32.25	255.52
118.00	32.42	258.68
126.00	32.60	260.08
134.00	32.62	260.88
140.00	32.25	194.61
145.00	28.25	151.25
150.00	25.25	133.75
155.00	24.75	125.00
160.00	25.75	126.25
165.00	26.25	130.00
170.00	26.15	131.00
175.00	26.55	131.75
180.00	26.75	133.25
185.00	27.25	135.00
190.00	27.95	138.00
195.00	27.95	139.75
200.00	29.34	143.23
208.00	32.25	246.36
214.00	34.29	199.62
216.00	35.17	69.46
218.00	35.51	70.68
Total Area		= 6774.33

Table A7 Contd. : Section No. 30

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.99	0.00
0.00	35.43	0.00
9.60	32.68	326.93
44.50	31.98	1128.32
64.80	32.33	652.75
84.40	32.53	635.63
99.30	32.08	481.34
117.20	28.13	538.88
133.00	27.58	440.11
145.30	27.28	337.39
155.90	27.28	289.17
165.20	28.48	259.28
200.30	32.73	1074.24
215.80	32.33	504.22
230.40	32.38	472.38
243.80	32.38	433.89
268.00	32.13	780.57
281.90	31.68	443.48
294.50	30.43	391.29
308.6	30.28	427.95

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.99	0.00
0.00	35.61	0.00
10.00	34.66	351.35
25.00	34.36	517.65
35.00	34.16	342.60
48.00	33.21	437.91
60.00	32.22	392.58
72.00	31.43	381.90
80.00	31.13	250.24
89.00	32.22	285.08
95.00	33.18	196.20
98.00	32.22	98.10
103.00	29.72	154.85
108.00	27.72	143.60
113.00	26.17	134.73
118.00	26.07	130.60
123.00	26.02	130.23
128.00	26.12	130.35
133.00	26.42	131.35
138.00	26.77	132.98

Section No. 30 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
322.50	29.88	418.11
336.90	29.88	430.27
353.30	29.73	488.80
377.00	29.68	704.01
379.70	29.68	80.14
391.50	29.73	350.52
402.80	29.88	336.80
417.40	30.13	438.07
433.50	29.63	481.07
449.30	29.43	466.57
465.30	33.88	506.48
477.50	35.58	423.71
478.00	36.08	17.92
478.00	36.39	0.00
Total Area =		14758.42

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
143.00	27.22	134.98
148.00	30.17	143.48
153.00	32.22	155.98
165.00	33.46	394.08
180.00	33.11	499.28
195.00	32.49	492.00
205.00	32.39	324.40
218.00	32.28	420.36
228.00	32.22	322.50
243.00	32.20	483.15
258.00	32.05	481.88
273.00	31.84	479.18
288.00	31.76	477.00
313.00	31.66	792.75
328.00	30.03	462.68
343.00	29.90	449.48
358.00	29.83	447.98
373.00	29.83	447.45
388.00	29.76	446.93
403.00	29.99	448.13
418.00	30.23	451.65
433.00	29.75	449.85
448.00	29.51	444.45
460.00	32.22	370.38
468.00	34.14	265.44
472.00	34.09	136.46
478.00	36.39	211.44
Total Area =		14974.13

Table A7 Contd. : Section No. 31

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.06	0.00
0.00	35.70	0.00
5.00	35.59	178.23
14.70	34.19	338.43
28.20	32.54	450.43
39.90	30.49	368.73
54.70	32.49	466.05
63.47	32.84	286.47
71.40	32.79	260.22
79.00	32.79	249.20
87.20	32.94	269.49
96.90	32.79	318.79
104.30	33.04	243.57
112.50	33.69	273.59
126.30	27.59	422.83
134.20	26.49	213.62
140.30	27.39	164.33
146.50	26.29	172.61
155.80	28.74	265.19
163.80	28.84	230.32
170.60	29.34	197.81
179.80	30.74	276.37
190.40	32.39	334.59
196.20	32.99	189.60
206.20	33.49	332.40
214.70	32.79	281.69
222.70	32.59	261.52
232.30	30.49	302.78
242.50	29.34	305.13

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.06	0.00
0.00	35.68	0.00
11.00	34.98	388.63
27.00	32.89	542.96
32.00	31.62	161.28
36.00	31.29	125.82
39.00	31.80	94.64
46.00	32.89	226.42
59.00	32.98	428.16
82.00	33.30	762.22
91.00	33.63	301.19
102.00	34.64	375.49
106.00	32.28	133.84
111.00	29.28	153.90
116.00	28.28	143.90
121.00	27.78	140.15
126.00	28.08	139.65
131.00	28.03	140.28
136.00	29.08	142.78
141.00	29.28	145.90
146.00	30.28	148.90
151.00	30.88	152.90
156.00	31.78	156.65
162.00	32.28	192.18
172.00	33.57	329.25
184.00	33.23	400.80
196.00	33.77	402.00
208.00	33.74	405.06
220.00	33.17	401.46

Section No. 31 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
254.60	31.04	365.30
262.40	32.89	249.33
269.00	32.89	217.07
275.60	32.89	217.07
294.00	35.59	630.02
299.00	35.97	178.90
299.00	36.33	0.00
Total Area	=	9509.97

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
232.00	32.28	392.70
238.00	31.48	191.28
243.00	30.40	154.70
248.00	30.45	152.13
253.00	34.02	161.18
258.00	29.04	157.65
263.00	32.28	153.30
267.00	32.69	129.94
279.00	33.19	395.28
287.00	34.36	270.20
291.00	35.94	140.60
299.00	36.33	289.08
Total Area	=	9723.95

Table A7 Contd. : Section No.32

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.44	0.00
0.00	35.12	0.00
32.10	33.42	1100.07
36.90	28.22	147.94
44.20	28.22	206.01
51.30	28.47	201.25
58.00	28.57	191.08
70.80	29.52	371.78
78.90	29.92	240.73
86.90	29.92	239.36
94.50	29.82	227.01
101.40	30.62	208.52
108.20	31.42	210.94
114.20	33.92	196.02
122.00	34.82	268.09
136.00	35.62	493.08
136.00	35.38	0.00
136.00	35.76	0.00
Total Area	=	4301.32

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.44	0.00
0.00	35.22	0.00
12.00	35.44	423.96
24.00	35.25	424.14
26.00	32.34	67.59
31.00	30.59	157.33
36.00	30.54	152.83
41.00	30.84	153.45
46.00	30.24	152.70
51.00	30.04	150.70
56.00	30.09	150.33
61.00	30.14	150.58
66.00	30.09	150.58
71.00	30.14	150.58
76.00	30.09	150.58
81.00	30.34	151.08
86.00	32.34	156.70
106.00	35.53	678.70
121.00	35.43	532.20
135.00	35.90	499.31
136.00	35.76	35.83
Total Area	=	4489.04

Table A7 Contd. : Section No. 33

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	33.99	0.00
0.00	33.64	0.00
19.56	29.54	617.90
39.19	26.14	546.50
55.52	23.74	407.27
86.29	22.54	712.02
113.48	22.54	612.86
134.61	22.69	477.85
152.16	22.99	400.84
181.72	23.49	686.97
201.39	23.84	465.49
229.61	24.19	677.70
247.62	24.44	437.91
294.39	24.29	1139.55
320.08	24.24	623.37
341.30	24.04	512.25
362.78	24.14	517.45
382.70	24.14	480.87
401.18	24.14	446.11
416.49	23.79	366.90
433.00	21.84	376.68
486.78	19.44	1110.02
509.39	15.64	396.58
529.64	8.94	248.87
556.91	8.24	234.25
577.29	8.19	167.42
598.13	8.04	169.12
622.45	7.44	188.24
643.20	7.64	156.46
668.46	10.34	227.09
693.09	15.24	315.02
716.50	25.04	471.48
743.00	29.84	727.16
768.00	34.04	798.50
774.00	35.34	208.14
777.00	35.52	106.29
777.00	36.02	0.00
Total Area	=	16031.90

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	33.99	0.00
0.00	33.60	0.00
8.00	31.44	260.16
14.00	28.62	180.18
20.00	25.48	162.30
53.00	22.91	798.44
82.00	22.62	660.19
124.00	22.91	956.13
166.00	23.76	980.07
207.00	24.34	986.05
243.00	24.56	880.20
268.00	24.33	611.13
300.00	24.05	774.08
332.00	23.76	764.96
367.00	23.76	831.60
413.00	23.19	1079.85
425.00	23.48	280.02
438.00	22.31	297.64
453.00	21.05	325.20
465.00	20.91	251.76
480.00	15.71	274.65
495.00	10.85	199.20
512.00	9.48	172.81
540.00	9.48	265.44
575.00	9.48	331.80
596.00	9.34	197.61
617.00	9.73	200.24
636.00	11.48	201.50
647.00	13.48	137.28
662.00	16.91	227.93
674.00	18.91	214.92
698.00	22.91	501.84
712.00	25.19	336.70
729.00	25.62	431.89
734.00	28.62	135.60
737.00	30.35	88.46
747.00	32.44	313.95
757.00	34.19	333.15
767.00	34.10	341.45
777.00	35.63	348.65
777.00	36.02	0.00
Total Area	=	16336.44

Table A7 Contd. : Section No. 34

Year 1983			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²
0.00	37.86	0.00	0.00	37.86	0.00
0.00	37.47	0.00	0.00	37.51	0.00
4.00	35.35	145.64	16.00	35.18	581.52
35.79	29.35	1028.41	20.00	31.69	133.74
60.61	25.85	685.03	24.00	28.59	120.56
91.92	26.65	821.89	32.00	26.16	219.00
103.75	26.55	314.68	54.00	25.68	570.24
121.14	24.65	445.18	83.00	24.88	733.12
141.36	26.50	517.13	133.00	24.88	1244.00
161.20	25.20	512.86	164.00	24.59	766.79
181.89	25.25	521.91	198.00	24.22	829.77
205.21	24.65	581.83	211.00	24.30	315.38
225.28	24.50	493.22	230.00	18.59	407.46
239.53	20.95	323.83	248.00	10.31	260.10
253.47	14.95	250.22	250.00	10.30	20.61
274.12	8.80	245.22	272.00	11.16	236.06
290.70	8.95	147.15	289.00	11.45	192.19
309.33	9.35	170.46	311.00	11.45	251.90
326.03	9.35	156.15	334.00	11.45	263.35
342.84	9.05	154.65	362.00	12.54	335.86
355.94	8.85	117.25	376.00	14.88	191.94
371.54	8.65	136.50	384.00	16.45	125.32
386.76	8.75	132.41	396.00	16.02	194.82
405.92	9.15	171.48	412.00	15.30	250.56
418.95	9.80	123.46	432.00	15.99	312.90
434.90	15.05	198.18	448.00	17.02	264.08
450.49	14.55	230.73	473.00	18.88	448.75
461.18	12.25	143.25	493.00	20.02	389.00
476.91	12.95	198.20	508.00	21.45	311.03
490.03	15.15	184.34	525.00	23.16	379.19
507.19	17.65	281.42	541.00	24.59	382.00
520.88	20.85	263.53	544.00	28.59	79.77
534.29	23.95	300.38	548.00	32.26	121.70
554.31	32.85	568.57	552.00	35.46	135.44
555.00	35.35	23.53	558.00	36.21	215.01
558.00	36.21	107.34	558.00	36.55	0.00
558.00	36.55	0.00			
Total Area		= 10697.69	Total Area		= 11283.62

Table A7 Contd. : Section No. 35

Year 1983			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²
0.00	34.75	0.00	0.00	34.75	0.00
0.00	34.4	0.00	0.00	34.40	0.00
11.00	28.74	347.27	21.00	28.50	660.45
26.00	27.39	420.98	29.00	21.93	201.72
39.00	25.39	343.07	47.00	22.73	401.94
50.00	21.89	260.04	67.00	18.00	407.30
62.00	17.59	236.88	77.00	19.36	186.80
74.00	17.39	209.88	89.00	18.79	228.90
87.00	17.14	224.45	103.00	19.64	269.01
106.00	17.59	329.94	111.00	20.21	159.40
116.00	16.99	172.90	125.00	19.02	274.61
123.00	19.59	128.03	148.00	20.93	459.43
143.00	19.39	389.80	154.00	21.36	126.87
157.00	20.79	281.26	160.00	19.93	123.87
174.00	21.39	358.53	173.00	16.50	236.80
183.00	19.09	182.16	187.00	16.10	228.20
197.00	15.59	242.76	196.00	15.64	142.83
211.00	8.99	172.06	206.00	15.36	155.00
222.00	8.19	94.49	218.00	15.33	184.14

Section No. 35 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
235.00	8.29	107.12
241.00	8.39	50.04
258.00	8.34	142.21
270.00	8.29	99.78
281.00	8.29	91.19
292.00	8.54	92.57
306.00	14.29	159.81
314.00	23.79	152.32
330.00	25.34	393.04
332.00	24.09	49.43
355.00	28.49	604.67
356.00	34.59	31.54
392.00	35.29	1257.84
400.00	37.27	290.24
400.00	37.63	0.00
Total Area	=	7916.28

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
230.00	15.19	183.13
246.00	14.79	239.86
255.00	14.79	133.12
267.00	14.79	177.49
277.00	14.79	147.91
286.00	14.93	133.75
297.00	15.07	165.01
311.00	16.50	221.00
321.00	21.36	189.31
328.00	24.50	160.52
337.00	25.07	223.07
350.00	24.27	320.72
372.00	24.50	536.49
376.00	28.50	106.00
382.00	30.96	178.38
392.00	34.53	327.43
400.00	37.25	287.10
400.00	37.63	0.00
Total Area	=	8177.45

Table A7 Contd. : Section No. 36

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	31.85	0.00
0.00	31.50	0.00
13.00	28.10	387.40
34.00	23.70	543.90
57.00	14.20	435.85
84.00	13.80	378.00
109.00	13.85	345.63
130.00	13.80	290.33
154.00	14.15	335.40
174.00	15.80	299.50
196.00	20.15	395.45
222.00	23.90	572.65
242.00	26.10	500.00
272.00	27.10	798.00
292.00	26.90	540.00
315.00	27.10	621.00
335.00	27.10	542.00
355.00	27.10	542.00
382.00	27.30	734.40
406.00	26.90	650.40
429.00	20.80	548.55
455.00	21.10	544.70
477.00	22.20	476.30
499.00	23.70	504.90
522.00	25.90	570.40
548.00	25.90	673.40
574.00	25.70	670.80
596.00	25.60	564.30
617.00	23.90	519.75
637.00	21.60	455.00
662.00	21.10	533.75
688.00	24.50	592.80
723.00	28.15	921.38
753.00	31.40	893.25
761.00	34.00	261.60
761.00	34.35	0.00
Total Area	=	17645.02

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.35	0.00
0.00	33.98	0.00
1.00	33.70	33.84
5.00	31.13	129.66
25.00	27.70	588.30
73.00	24.27	1247.28
85.00	21.13	272.40
94.00	20.84	188.87
131.00	20.84	771.08
156.00	20.85	521.13
177.00	20.87	438.06
201.00	20.81	500.16
221.00	20.56	413.70
240.00	20.56	390.64
264.00	21.99	510.60
287.00	24.84	538.55
309.00	26.56	565.40
325.00	27.02	428.64
342.00	27.07	459.77
358.00	27.26	434.64
372.00	27.25	381.57
392.00	27.13	543.80
409.00	27.13	461.21
424.00	27.33	408.45
441.00	27.42	465.38
463.00	26.56	593.78
479.00	26.50	424.48
495.00	26.27	422.16
510.00	26.21	393.60
527.00	26.27	446.08
543.00	26.45	421.76
562.00	26.84	506.26
577.00	26.39	399.23
593.00	25.84	417.84
609.00	25.70	412.32
626.00	26.24	441.49
645.00	23.33	470.92
662.00	23.27	396.10

Section No.36 Contd.

Year 2000		
L/B Dist.	Bed R.L	Area
m	m	m ²
678.00	24.54	382.48
696.00	26.84	462.42
709.00	27.41	352.63
724.00	28.41	418.65
739.00	30.22	439.73
752.00	31.60	401.83
761.00	31.85	285.53
768.00	31.13	220.43
784.00	31.42	500.40
790.00	31.13	187.65
801.00	29.13	331.43
814.00	28.52	374.73
827.00	27.93	366.93
843.00	29.13	456.48
857.00	31.70	425.81
869.00	31.70	380.40
874.00	33.70	163.50
876.00	34.07	67.77
880.00	34.68	137.50
884.00	35.88	141.12
884.00	36.05	0.00
Total Area	=	22934.68

Table A7 Contd. : Section No. 36A

Year 1983			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²
0.00	36.98	0.00	0.00	36.98	0.00
0.00	36.68	0.00	0.00	36.61	0.00
4.70	35.24	169.01	4.00	35.62	144.46
12.00	26.44	225.13	8.00	33.70	138.64
40.00	22.14	680.12	14.00	29.70	190.20
70.00	21.39	652.95	23.00	28.84	263.43
100.00	21.04	636.45	42.00	25.41	515.38
138.00	21.04	799.52	51.00	23.99	222.30
162.00	21.84	514.56	64.00	23.13	306.28
200.00	22.09	834.67	73.00	22.61	205.83
222.00	18.74	449.13	85.00	21.99	267.60
248.00	14.24	428.74	100.00	21.56	326.63
284.00	14.29	513.54	113.00	20.84	275.60
310.00	14.79	378.04	125.00	20.27	246.66
334.00	15.49	363.36	138.00	20.56	265.40
365.00	14.79	469.34	148.00	20.84	207.00
395.00	14.39	437.70	161.00	21.41	274.63
425.00	14.39	431.70	174.00	20.84	274.63
458.00	14.39	474.87	187.00	21.13	272.81
488.00	14.44	432.45	205.00	21.70	385.47
518.00	14.54	434.70	223.00	21.70	390.60
552.00	14.94	501.16	246.00	22.21	504.97
579.00	16.24	420.93	252.00	21.70	131.73
616.00	17.84	630.48	262.00	17.41	195.55
644.00	17.34	492.52	276.00	17.70	245.77
684.00	16.14	669.60	290.00	17.41	245.77
722.00	14.74	586.72	305.00	18.27	267.60
761.00	15.24	584.61	316.00	17.56	197.07
790.00	15.34	443.41	325.00	17.99	159.98
832.00	20.84	759.78	332.00	20.56	134.93
867.00	17.74	675.15	345.00	20.84	269.10
906.00	21.34	762.06	373.00	20.56	579.60
937.00	21.99	671.62	405.00	20.27	653.28
966.00	22.44	644.24	432.00	19.99	543.51
998.00	21.04	695.68	462.00	19.64	594.45

Section 36A Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
1025.00	21.04	568.08
1051.00	21.19	548.99
1069.00	27.39	437.22
1110.00	35.24	1283.92
1118.00	40.35	302.36
1118.00	40.70	0.00
Total Area		= 20998.91

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
474.00	19.42	234.36
492.00	18.27	339.21
520.00	17.41	499.52
561.00	16.99	705.20
574.00	18.50	230.69
602.00	19.13	526.82
615.00	21.93	266.89
654.00	21.13	839.67
668.00	18.84	279.79
687.00	18.56	355.30
718.00	18.56	575.36
749.00	18.84	579.70
768.00	21.13	379.72
804.00	21.67	770.40
842.00	21.99	829.54
877.00	21.99	769.65
906.00	19.41	600.30
979.00	21.84	1505.63
1012.00	22.27	727.82
1058.00	25.41	1096.64
1102.00	27.64	1167.10
1107.00	33.70	153.35
1112.00	37.45	177.88
1118.00	40.34	233.37
1118.00	40.70	0.00
Total Area		= 23739.58

Table A7 Contd. : Section No.37

Year 1983		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	33.54	0.00
0.00	33.15	0.00
20.00	31.46	646.10
45.00	21.41	660.88
64.00	17.81	372.59
93.00	18.06	520.12
124.00	18.71	569.94
144.00	19.71	384.20
170.00	20.91	528.06
197.00	24.41	611.82
222.00	27.31	646.50
246.00	28.26	666.84
275.00	26.21	789.82
305.00	20.11	694.80
330.00	19.81	499.00
355.00	19.56	492.13
378.00	24.21	503.36
399.00	24.41	510.51
424.00	23.36	597.13
443.00	22.81	438.62
461.00	23.01	412.38
485.00	21.41	533.04
521.00	21.96	780.66
544.00	26.21	553.96
575.00	34.83	946.12
575.00	35.20	0.00
Total Area		= 13357.99

Year 2000		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	33.54	0.00
0.00	33.34	0.00
0.00	33.77	0.00
5.00	29.49	158.15
13.00	29.77	237.04
35.00	28.35	639.32
55.00	26.06	544.10
81.00	26.02	677.04
96.00	25.75	388.28
113.00	25.75	437.75
134.00	25.77	540.96
151.00	26.02	440.22
169.00	26.48	472.50
182.00	26.63	345.22
201.00	26.77	507.30
219.00	28.03	493.20
238.00	28.28	534.95
252.00	28.57	397.95
259.00	28.57	199.99
269.00	26.63	276.00
283.00	25.69	366.24
304.00	25.20	534.35
321.00	25.17	428.15
336.00	24.49	372.45
351.00	25.20	372.68
359.00	26.34	206.16
368.00	26.05	235.76
383.00	24.91	382.20
398.00	24.34	369.38
413.00	24.32	364.95
426.00	24.28	315.90
439.00	24.60	317.72
452.00	24.31	317.92
464.00	22.10	278.46
477.00	21.74	284.96
489.00	22.06	262.80
501.00	24.06	276.72
518.00	24.63	413.87
531.00	26.20	330.40
548.00	30.63	483.06
558.00	31.77	312.00
563.00	33.77	163.85
571.00	34.70	273.88
575.00	35.20	139.80
575.00	35.20	0.00
Total Area		= 15094.62

Table A7 Contd. : Section No. 38

Year 1983		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	33.78	0.00
0.00	33.42	0.00
16.25	32.06	532.03
36.70	28.76	621.88
60.82	24.06	637.01
87.62	18.96	576.47
110.74	21.56	468.41
130.73	23.11	446.48
150.82	27.76	510.99
173.86	25.46	613.09
195.38	24.66	539.29
214.49	24.56	470.30

Year 2000		
L/B Dist.	Bed R.L	Area
m	m	m ²
0.00	33.78	0.00
0.00	33.41	0.00
0.00	33.71	0.00
4.00	29.43	126.28
9.00	29.86	148.23
22.00	31.16	396.63
40.00	29.45	545.49
61.00	27.01	592.83
80.00	26.17	505.21
108.00	26.22	733.46
122.00	26.59	369.67
138.00	26.89	427.84

Section No.38 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
237.04	24.36	551.57
255.47	24.11	446.65
273.01	23.36	416.31
299.55	23.66	623.96
320.40	23.51	491.75
343.89	23.81	555.77
365.03	25.66	522.90
385.97	24.61	526.33
400.41	22.06	336.96
436.23	21.86	786.61
467.12	21.81	674.48
494.08	22.41	596.09
512.66	24.46	435.42
535.00	25.41	557.05
555.54	28.76	556.33
566.00	34.56	331.16
571.00	37.66	180.55
571.00	37.66	0.00
Total Area		= 14008.11

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
143.00	28.88	139.43
156.00	29.59	380.06
171.00	29.41	442.50
184.00	29.23	381.16
201.00	29.05	495.38
216.00	29.16	436.58
234.00	29.09	524.25
252.00	29.07	523.44
272.00	29.35	584.20
285.00	29.13	380.12
307.00	28.91	638.44
327.00	28.79	577.00
339.00	28.96	346.50
351.00	29.11	348.42
370.00	29.49	556.70
384.00	29.96	416.15
399.00	29.91	449.03
411.00	28.81	352.32
429.00	27.79	509.40
442.00	26.92	355.62
458.00	26.29	425.68
469.00	25.81	286.55
484.00	24.89	380.25
495.00	24.75	273.02
507.00	24.87	297.72
516.00	28.37	239.58
530.00	29.93	408.10
537.00	29.51	208.04
545.00	29.46	235.88
551.00	29.43	176.67
557.00	29.49	176.76
561.00	29.54	118.06
565.00	33.71	126.50
566.00	34.37	34.04
568.00	36.04	70.41
571.00	37.4	110.16
571.00	37.66	0.00
Total Area		= 16247.45

Table A7 Contd. : Section No.39

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.91	0.00
0.00	35.53	0.00
47.00	34.57	1647.35
54.00	24.77	207.69
80.00	26.87	671.32
108.00	17.57	622.16
132.00	16.47	408.48
161.00	19.57	522.58
187.00	16.67	471.12
214.00	17.57	462.24
244.00	14.22	476.85
272.00	16.97	436.66
300.00	14.17	435.96
328.00	14.12	396.06
358.00	14.12	423.60
399.00	14.17	579.95
419.00	14.27	284.40
451.00	14.32	457.44
481.00	14.32	429.60

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.91	0.00
0.00	35.53	0.00
9.00	32.30	305.24
14.00	28.65	152.38
18.00	26.08	109.46
26.00	20.37	185.80
39.00	17.69	247.39
45.00	17.22	104.73
68.00	24.62	481.16
81.00	17.79	275.67
93.00	16.89	208.08
118.00	17.39	428.50
132.00	19.80	260.33
149.00	17.02	312.97
176.00	16.94	458.46
190.00	19.08	252.14
199.00	16.79	161.42
213.00	16.11	230.30
228.00	16.65	245.70

Section No. 39 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
514.00	14.32	472.56
541.00	14.32	386.64
571.00	14.32	429.60
603.00	14.37	459.04
638.00	14.42	503.83
662.00	14.57	347.88
698.00	14.62	525.42
706.00	14.62	116.96
729.00	14.57	335.69
750.00	14.57	305.97
775.00	14.57	364.25
790.00	19.97	259.05
856.00	24.27	1459.92
928.00	18.07	1524.24
945.00	14.77	279.14
967.00	16.67	345.84
988.00	20.37	388.92
1000.00	15.67	216.24
1040.00	21.77	748.80
1056.00	21.87	349.12
1088.00	17.07	623.04
1107.00	24.37	393.68
1121.00	13.27	263.48
1135.00	33.98	330.75
1135.00	34.98	0.00
Total Area		= 20362.61

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
238.00	21.61	191.30
258.00	22.73	443.40
272.00	19.51	295.68
286.00	20.65	281.12
298.00	17.45	228.60
312.00	16.37	236.74
338.00	16.75	430.56
370.00	16.90	538.40
403.00	16.86	557.04
432.00	17.49	498.08
460.00	20.45	531.16
481.00	23.09	457.17
501.00	25.33	484.20
522.00	26.26	541.70
550.00	24.70	713.44
578.00	24.67	691.18
612.00	22.37	799.68
625.00	18.08	262.93
635.00	17.52	178.00
665.00	17.68	528.00
688.00	17.76	407.56
715.00	17.73	479.12
748.00	17.89	587.73
775.00	18.23	487.62
803.00	18.85	519.12
815.00	24.27	258.72
833.00	22.65	422.28
859.00	18.57	535.86
887.00	20.63	548.80
891.00	21.22	83.70
915.00	18.34	474.72
927.00	19.22	225.36
947.00	17.89	371.10
975.00	18.56	510.30
987.00	20.08	231.84
1016.00	18.05	552.89
1035.00	18.22	344.57
1050.00	20.93	293.63
1060.00	19.37	201.50
1069.00	18.05	168.39
1088.00	18.96	351.60
1100.00	22.37	247.98
1112.00	26.19	291.36
1116.00	28.65	109.68
1125.00	31.84	272.21
1135.00	34.25	330.45
1135.00	34.34	0.00
Total Area		= 22612.78

Table A7 Contd. : Section No. 40

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	40.58	0.00
0.00	40.19	0.00
62.00	34.62	2319.11
79.00	30.52	553.69
101.00	19.92	554.84
119.00	19.82	357.66
135.00	19.92	317.92
144.00	11.82	142.83
181.00	11.72	435.49

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	40.58	0.00
0.00	40.24	0.00
12.00	39.28	477.12
40.00	34.59	1034.18
66.00	32.62	873.73
73.00	31.71	225.16
82.00	29.38	274.91
87.00	25.67	137.63
92.00	25.96	129.08

Section No.40 Contd.

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
216.00	17.62	513.45
259.00	17.12	746.91
290.00	17.92	543.12
318.00	17.72	498.96
340.00	16.92	381.04
372.00	17.62	552.64
390.00	19.72	336.06
411.00	26.72	487.62
432.00	25.72	550.62
452.00	20.02	457.40
473.00	14.52	362.67
500.00	17.42	431.19
532.00	25.02	679.04
562.00	31.32	845.10
583.00	32.32	668.22
586.00	32.45	97.16
586.00	32.81	0.00
Total Area	=	12833.75

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
98.00	25.67	154.89
101.00	23.95	74.43
104.00	20.24	66.29
109.00	19.37	99.03
120.00	19.81	215.49
125.00	19.95	99.40
139.00	16.61	255.92
149.00	13.67	151.40
160.00	13.10	147.24
174.00	12.87	181.79
190.00	13.50	210.96
196.00	16.82	90.96
207.00	23.09	219.51
220.00	19.95	279.76
234.00	17.09	259.28
249.00	16.81	254.25
265.00	15.68	259.92
285.00	17.67	333.50
307.00	19.68	410.85
314.00	19.10	135.73
327.00	16.52	231.53
332.00	15.95	81.18
341.00	16.38	145.49
365.00	17.38	405.12
385.00	18.69	360.70
396.00	23.50	232.05
408.00	25.68	295.08
415.00	26.41	182.32
422.00	25.38	181.27
428.00	25.38	152.28
448.00	19.18	445.60
468.00	14.92	341.00
475.00	14.38	102.55
485.00	16.95	156.65
492.00	19.44	127.37
499.00	18.41	132.48
506.00	17.38	125.27
516.00	18.52	179.50
528.00	23.44	251.76
542.00	27.40	355.88
547.00	29.38	141.95
552.00	29.95	148.33
558.00	31.43	184.14
570.00	32.32	382.50
578.00	32.37	258.76
586.00	32.45	259.28
586.00	32.81	0.00
Total Area	=	12911.22

Table A7 Contd. : Section No. 41

Year 1983			Year 2000		
L/B Dist.	Bed R.L	Area	L/B Dist.	Bed R.L	Area
m	m	m ²	m	m	m ²
0	34.45	0.00	0.00	34.45	0.00
0	34.09	0.00	0.00	34.13	0.00
11	26.49	333.19	12.00	27.58	370.26
19	28.69	220.72	30.00	32.22	538.20
27	27.49	224.72	68.00	28.42	1152.16
49	25.69	584.98	75.00	25.28	187.95
66	24.59	427.38	81.00	24.71	149.97
83	22.29	398.48	88.00	18.82	152.36
106	20.59	493.12	108.00	18.23	370.50
122	19.79	323.04	125.00	17.28	301.84
139	18.69	327.08	127.00	18.16	35.44
161	18.48	408.87	144.00	18.67	313.06
183	18.69	408.87	162.00	20.23	350.10
198	18.99	282.60	170.00	17.85	152.32
226	17.99	517.72	196.00	18.99	478.92
244	19.69	339.12	222.00	17.87	479.18
260	20.29	319.84	267.00	19.85	848.70
275	20.29	304.35	285.00	18.51	345.24
287	19.69	239.88	317.00	17.56	577.12
303	18.29	303.84	360.00	18.96	785.18
320	17.69	305.83	452.00	19.05	1748.46
336	18.79	291.84	516.00	18	1185.60
356	20.29	390.80	524.00	15.95	135.80
381	19.89	502.25	530.00	18.17	102.36
412	19.89	616.59	570.00	19.28	749.00
433	20.09	419.79	612.00	16.71	755.79
466	20.09	662.97	619.00	17.32	119.11
489	19.79	458.62	667.00	20.12	898.56
511	19.79	435.38	698.00	17.37	581.10
536	18.69	481.00	709.00	16.99	188.98
557	19.99	406.14	737.00	19.43	509.88
585	19.09	547.12	760.00	23.3	491.40
609	18.49	450.96	807.00	21.37	1049.75
631	17.49	395.78	832.00	22.9	553.38
654	18.29	411.47	858.00	23.57	604.11
678	20.19	461.76	892.00	22.42	781.83
698	21.49	416.80	925.00	21.27	720.89
723	18.19	496.00	938.00	20.13	269.10
785	22.69	1267.28	975.00	17.85	702.63
819	24.39	800.36	1004.00	16.99	505.18
861	19.69	925.68	1044.00	18.71	714.00
889	19.49	548.52	1091.00	20.13	912.74
922	19.99	651.42	1117.00	19.85	519.74
978	22.99	1203.44	1146.00	21.85	604.65
1010	23.39	742.08	1178.00	15.85	603.20
1042	22.09	727.68	1201.00	19.28	404.00
1068	20.49	553.54	1213.00	16.71	215.94
1112	18.69	861.96	1230.00	20.71	318.07
1135	19.69	441.37	1267.00	21.85	787.36
1168	20.19	658.02	1301.00	22.13	747.66
1210	20.49	854.28	1328.00	24.13	624.51
1249	20.39	797.16	1334.00	24.13	144.78
1275	16.69	482.04	1362.00	15.28	551.74
1307	19.89	585.28	1371.00	12.71	125.96
1323	21.19	328.64	1380.00	11.85	110.52
1383	11.09	968.40	1388.00	11.28	92.52
1412	10.69	315.81	1411.00	10.71	252.89
1429	10.89	183.43	1437.00	10.42	274.69
1505	20.19	1181.04	1456.00	10.99	203.40
1535	23.39	653.70	1468.00	17.85	173.04
1568	24.29	786.72	1483.00	19.85	282.75
1600	24.94	787.68	1501.00	16.99	331.56

Section No. Contd. 41

L/B Dist.	Year 1983	
	Bed R.L.	Area
m	m	m ²
1631	24.69	769.27
1670	21.19	894.66
1697	20.59	564.03
1733	19.29	717.84
1766	21.69	676.17
1801	23.79	795.90
1835	22.59	788.46
1875	22.59	903.60
1913	16.29	738.72
1950	19.39	660.08
1986	26.19	820.44
2041	23.69	1371.70
2089	25.29	1175.52
2123	20.09	771.46
2159	26.49	838.44
2185	24.29	660.14
2220	18.89	755.65
2260	19.89	775.60
2304	21.29	905.96
2349	19.69	922.05
2374	19.79	493.50
2420	25.39	1039.14
2455	30.59	979.65
2477	34.09	711.48
2483	34.96	207.15
2483	35.35	0.00
Total Area	=	51839.98

L/B Dist.	Year 2000	
	Bed R.L.	Area
m	m	m ²
1507.00	14.42	94.23
1530.00	15.56	344.77
1567.00	20.13	660.27
1584.00	19.85	339.83
1600.00	20.71	324.48
1637.00	19.57	745.18
1653.00	18.42	303.92
1683.00	23.56	629.70
1716.00	24.13	786.89
1731.00	24.13	361.95
1761.00	15.28	591.15
1775.00	20.71	251.93
1796.00	21.56	443.84
1834.00	20.13	792.11
1865.00	19.56	615.20
1891.00	21.57	534.69
1913.00	24.42	505.89
1928.00	26.42	381.30
1948.00	25.56	519.80
1971.00	25.28	584.66
2012.00	26.13	1053.91
2053.00	23.28	1012.91
2075.00	21.56	493.24
2097.00	19.85	455.51
2109.00	18.99	233.04
2135.00	18.71	490.10
2160.00	22.71	517.75
2182.00	24.13	515.24
2208.00	20.42	579.15
2231.00	20.13	466.33
2250.00	22.99	409.64
2261.00	22.71	251.35
2295.00	19.56	718.59
2315.00	18.99	385.50
2340.00	19.85	485.50
2364.00	20.42	483.24
2391.00	21.85	570.65
2417.00	24.13	597.74
2437.00	25.56	496.90
2442.00	28.42	134.95
2464.00	32.51	670.23
2483.00	35.08	642.11
2483.00	35.35	0.00
Total Area	=	50708.37

Table A7 Contd. : Section No. 42

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	33.07	0.00
0.00	32.71	0.00
18.00	31.02	573.57
26.00	27.87	235.56
70.00	26.72	1200.98
118.00	24.77	1235.76
143.00	21.57	579.25
166.00	24.72	532.34
183.00	24.87	421.52
203.00	25.32	501.90
240.00	27.02	968.29
283.00	27.02	1161.86
296.00	26.22	346.06
314.00	25.42	464.76
338.00	24.82	602.88
354.00	24.52	394.72
372.00	24.32	439.56
397.00	26.32	633.00
417.00	27.52	538.40
445.00	28.82	788.76
452.00	29.07	202.62
454.00	28.42	57.49
488.00	27.97	958.63
515.00	28.22	758.57
534.00	28.22	536.18
553.00	27.87	532.86
585.00	27.42	884.64
605.00	25.62	530.40
633.00	26.37	727.86
655.00	26.57	582.34
670.00	27.42	404.93
684.00	29.87	401.03
697.00	31.02	395.79
715.00	32.47	571.41
715.00	32.79	0.00
Total Area	=	19235.17

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	33.07	0.00
0.00	32.71	0.00
8.00	32.26	259.88
16.00	30.09	249.40
26.00	29.04	295.65
35.00	27.71	255.38
44.00	26.42	243.59
53.00	25.41	233.24
75.00	26.92	575.63
87.00	26.71	321.78
100.00	25.41	338.78
120.00	25.09	505.00
140.00	24.82	499.10
160.00	25.11	499.30
180.00	26.18	512.90
195.00	27.11	399.68
210.00	27.66	410.78
225.00	28.51	421.28
240.00	28.72	429.23
250.00	28.41	285.65
265.00	28.57	427.35
280.00	26.41	412.35
295.00	26.34	395.63
310.00	25.31	387.38
325.00	25.11	378.15
340.00	24.91	375.15
350.00	25.31	251.10
360.00	24.96	251.35
370.00	25.19	250.75
385.00	25.72	381.83
400.00	26.31	390.23
415.00	28.94	414.38
432.00	29.04	492.83
448.00	29.9	471.52
460.00	29.71	357.66
475.00	29.04	440.63
492.00	28.76	491.30
505.00	28.56	372.58
520.00	28.81	430.28
536.00	29.04	462.80
550.00	28.34	401.66
565.00	28.14	423.60
580.00	26.55	410.18
595.00	25.94	393.68
612.00	26.09	442.26
629.00	26.19	444.38
642.00	27.04	346.00
655.00	27.14	352.17
668.00	27.74	356.72
681.00	29.04	369.07
695.00	30.75	418.53
705.00	32.03	313.90
711.00	32.45	193.44
715.00	32.79	130.48
Total Area	=	19567.41

Table A7 Contd. : Section No.43

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.65	0.00
0.00	33.30	0.00
2.00	33.26	66.56
5.30	32.26	108.11
30.90	30.66	805.38
42.40	23.26	310.04
54.80	23.41	289.35
66.30	23.51	269.79
79.80	23.46	317.05
90.60	23.91	255.80
107.60	24.16	408.60
126.00	26.46	465.70
136.80	29.96	304.67
152.20	29.56	458.30
169.40	29.36	506.71
179.60	30.81	306.87
187.34	31.66	241.76
194.50	32.46	229.55
201.10	33.06	216.22
298.00	34.19	3258.26
298.00	34.55	0.00
Total Area		= 8819.30

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.65	0.00
0.00	33.26	0.00
20.00	31.38	646.40
28.00	31.29	250.68
32.00	28.74	120.06
36.00	25.60	108.68
38.00	25.31	50.91
42.00	25.06	100.74
44.00	25.03	50.09
48.00	25.23	100.52
50.00	25.31	50.54
53.00	25.32	75.95
56.00	25.43	76.13
59.00	25.60	76.55
62.00	25.48	76.62
64.00	25.53	51.01
68.00	25.63	102.32
73.00	25.93	128.90
77.00	26.17	104.20
81.00	26.20	104.74
85.00	26.37	105.14
90.00	26.31	131.70
92.00	26.26	52.57
94.00	26.23	52.49
97.00	26.17	78.60
101.00	26.18	104.70
105.00	26.34	105.04
114.00	26.74	238.86
119.00	27.03	134.43
127.00	27.04	216.28
132.00	28.74	139.45
136.00	30.51	118.50
146.00	30.56	305.35
156.00	30.07	303.15
166.00	29.67	298.70
178.00	31.13	364.80
191.00	32.16	411.39
201.00	34.19	331.75
211.00	34.55	343.70
Total Area		= 6111.91

Table A7 Contd.: Section No. 44

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	36.07	0.00
0.00	35.68	0.00
4.00	34.77	140.90
18.54	32.52	489.20
29.03	29.52	325.40
57.20	27.92	809.04
69.78	28.07	352.18
81.95	27.37	337.35
91.23	26.47	249.82
100.45	28.07	251.43
110.00	27.72	266.40
122.06	26.62	327.67
134.36	24.97	317.28
144.42	23.62	244.41
163.95	23.52	460.32
178.60	23.47	344.20
193.21	23.57	343.63

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	36.07	0.00
0.00	35.78	0.00
20.00	30.79	665.70
30.00	29.43	301.10
40.00	29.11	292.70
48.00	29.43	234.16
60.00	29.66	354.54
62.00	28.76	58.42
70.00	27.28	224.16
80.00	28.76	280.20
90.00	29.85	293.05
100.00	29.90	298.75
110.00	29.89	298.95
120.00	29.82	298.55
129.00	28.76	263.61
133.00	25.85	109.22
136.00	25.76	77.42

Section No.44 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
206.92	24.17	327.26
222.76	29.57	425.62
238.22	29.87	459.47
255.72	30.87	531.48
269.22	33.27	432.95
280.45	33.37	374.18
287.37	33.37	230.92
293.00	34.02	189.70
293.00	34.37	0.00
Total Area		= 8230.21

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
139.00	25.68	77.16
143.00	25.62	102.60
148.00	25.48	127.75
151.00	25.33	76.22
155.00	25.19	101.04
160.00	25.11	125.75
164.00	24.99	100.20
167.00	24.96	74.93
170.00	24.91	74.81
173.00	24.76	74.51
177.00	24.48	98.48
180.00	24.19	73.01
183.00	24.11	72.45
185.00	23.98	48.09
188.00	24.01	71.99
191.00	23.99	72.00
195.00	23.76	95.50
200.00	23.90	119.15
205.00	23.99	119.73
208.00	24.19	72.27
211.00	24.76	73.43
214.00	24.91	74.51
217.00	25.76	76.01
221.00	26.48	104.48
225.00	28.76	110.48
231.00	30.68	178.32
245.00	30.46	427.98
273.00	33.30	892.64
283.00	33.31	333.05
293.00	33.97	336.40
293.00	34.37	0.00
Total Area		= 8434.97

Table A7 Contd. : Section No. 45

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.17	0.00
0.00	33.82	0.00
22.58	29.32	712.85
31.59	27.82	257.42
40.52	27.72	247.99
49.94	28.27	263.71
62.20	28.52	348.12
70.96	28.57	250.05
76.47	28.67	157.70
86.79	28.72	296.13
93.78	28.67	200.58
101.24	28.32	212.57
112.33	27.52	309.63
127.94	24.17	403.44
142.20	23.57	340.39
148.82	23.17	154.71
169.80	22.97	484.01
192.51	24.67	540.95
208.67	28.02	425.74
225.45	28.87	477.31
242.38	29.62	495.12
253.32	30.17	327.05
267.16	29.62	413.75
278.07	32.17	337.06
285.70	34.82	255.57

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.17	0.00
0.00	33.98	0.00
12.00	32.31	397.74
16.00	31.30	127.22
24.00	30.03	245.32
32.00	29.30	237.32
40.00	29.09	233.56
50.00	29.34	292.15
60.00	29.62	294.80
70.00	29.74	296.80
80.00	29.95	298.45
90.00	30.04	299.95
100.00	30.05	300.45
110.00	30.05	300.50
122.00	29.90	359.70
133.00	29.98	329.34
137.00	26.84	113.64
142.00	26.01	132.13
145.00	25.55	77.34
152.00	24.87	176.47
157.00	24.64	123.78
161.00	24.47	98.22
165.00	24.41	97.76
168.00	24.41	73.23
172.00	24.35	97.52

Section No. 45 Contd.

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
289.00	36.04	116.92
291.00	36.42	72.46
291.00	36.81	0.00
Total Area	=	8102.07

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
175.00	24.36	73.07
178.00	24.97	74.00
181.00	24.20	73.76
184.00	24.18	72.57
189.00	24.41	121.48
194.00	24.70	122.78
199.00	26.12	127.05
204.00	27.27	133.48
208.00	28.98	112.50
216.00	29.95	235.72
231.00	30.36	452.33
246.00	30.71	458.03
261.00	30.22	456.98
276.00	31.44	462.45
284.00	33.98	261.68
291.00	36.46	246.54
291.00	36.81	0.00
Total Area	=	8480.47

Table A7 Contd. : Section No.46

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	35.41	0.00
0.00	34.86	0.00
5.00	32.46	168.30
17.00	29.96	374.52
33.00	29.86	478.56
41.00	29.91	239.08
47.00	30.01	179.76
56.00	30.16	270.77
68.00	30.66	364.92
81.00	30.56	397.93
91.00	30.56	305.60
103.00	30.86	368.52
118.00	30.56	460.65
134.00	27.61	465.36
149.00	27.36	412.28
162.00	26.46	349.83
172.00	26.06	262.60
202.00	32.16	873.30
211.00	34.86	301.59
215.00	36.85	143.42
217.00	37.23	74.08
217.00	37.61	0.00
Total Area	=	6491.69

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	35.41	0.00
0.00	35.02	0.00
4.00	33.21	136.46
8.00	31.86	130.14
25.00	30.32	528.53
46.00	30.49	638.51
60.00	31.00	430.43
80.00	31.33	623.30
94.00	31.49	439.74
102.00	31.59	252.32
120.00	31.48	567.63
131.00	30.83	342.71
139.00	30.82	246.60
146.00	30.62	215.04
157.00	29.52	330.77
161.00	28.12	115.28
164.00	27.62	83.61
167.00	27.57	82.79
170.00	27.42	82.49
173.00	27.12	81.81
177.00	26.92	108.08
180.00	27.02	80.91
182.00	27.12	54.14
185.00	27.42	81.81
187.00	27.62	55.04
189.00	29.52	57.14
194.00	29.01	146.33
197.00	31.01	90.03
205.00	31.66	250.68
209.00	33.90	131.12
213.00	37.29	142.38
217.00	37.61	149.80
Total Area	=	6675.53

Table A7 Contd. : Section No.47

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.23	0.00
0.00	33.23	0.00
7.00	32.38	229.64
12.00	31.23	159.03
17.00	29.68	149.78
21.00	27.13	111.62
27.00	27.68	164.43
32.00	27.98	139.15
37.00	27.88	139.65
41.00	27.63	111.02
49.00	26.93	218.24
54.00	26.33	133.15
58.00	26.23	105.12
65.00	25.98	182.74
72.00	32.98	206.36
82.00	34.88	339.30
84.00	35.01	69.89
84.00	35.40	0.00
Total Area		= 2458.69

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.23	0.00
0.00	33.58	0.00
7.00	33.26	233.94
13.00	32.05	195.93
18.00	30.43	156.20
22.00	28.95	118.76
26.00	27.93	113.76
30.00	28.35	112.56
34.00	28.20	113.10
38.00	28.73	113.86
42.00	27.95	113.36
48.00	28.10	168.15
52.00	27.80	111.80
56.00	27.20	110.00
60.00	26.85	108.10
64.00	28.85	111.40
67.00	29.35	87.30
70.00	32.05	92.10
75.00	34.41	166.15
79.00	34.51	137.84
83.00	35.16	139.34
84.00	35.40	35.28
Total Area		= 2538.66

Table A7 Contd. : Section NO. 48

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	36.54	0.00
0.00	36.18	0.00
4.00	35.27	142.90
6.00	34.88	70.15
15.00	29.88	291.42
22.00	28.28	203.56
28.00	26.53	164.43
34.00	26.88	160.23
39.00	26.48	133.40
44.00	26.73	133.03
50.00	26.93	160.98
54.00	26.98	107.82
61.00	28.03	192.54
71.00	27.28	276.55
73.00	27.98	55.26
81.00	29.78	231.04
86.00	33.23	157.53
90.00	34.88	136.22
93.00	35.17	105.08
93.00	35.55	0.00
Total Area		= 2722.81

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	36.54	0.00
0.00	36.18	0.00
10.00	34.21	351.95
14.00	34.15	136.72
18.00	33.35	135.00
21.00	32.31	98.49
25.00	29.96	124.54
28.00	28.46	87.63
32.00	27.39	111.70
35.00	26.87	81.39
39.00	26.86	107.46
42.00	26.92	80.67
45.00	27.30	81.33
49.00	27.53	109.66
52.00	27.65	82.77
55.00	27.89	83.31
58.00	28.75	84.96
61.00	28.80	86.33
64.00	28.00	85.20
68.00	27.98	111.96
72.00	28.93	113.82
75.00	32.31	91.86
79.00	33.97	132.56
83.00	34.21	136.36
88.00	35.09	173.25
91.00	35.44	105.80
93.00	35.55	70.99
Total Area		= 2865.73

Table A7 Contd. : Section No.49

Year 1983			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.64	0.00	0.00	34.64	0.00
0.00	34.26	0.00	0.00	34.36	0.00
11.49	31.835	379.72	8.00	34.58	275.75
24.70	29.235	403.37	20.00	31.95	399.17
43.56	29.185	550.90	32.00	29.37	367.87
56.61	29.485	382.82	48.00	29.42	470.28
71.90	29.935	454.27	66.00	29.78	532.78
91.65	27.985	571.96	78.00	30.30	360.44
110.34	28.935	531.92	92.00	29.54	418.84
123.65	29.985	392.11	100.00	28.72	233.02
135.25	30.285	349.57	110.00	29.54	291.27
147.59	30.385	374.33	120.00	29.78	296.58
158.38	30.435	328.12	132.00	30.67	362.65
166.77	30.435	255.35	145.00	31.18	402.01
176.00	30.485	281.15	154.00	31.25	280.97
187.81	30.485	360.03	162.00	31.27	250.11
197.22	30.085	284.98	172.00	31.34	313.07
209.03	29.535	352.06	182.00	31.33	313.34
220.78	27.835	337.05	190.00	31.46	251.14
233.18	26.985	339.88	196.00	31.43	188.67
247.18	26.985	377.79	207.00	29.54	335.35
259.31	26.985	327.33	213.00	27.74	171.83
272.14	27.285	348.14	219.00	27.34	165.23
287.28	27.835	417.26	225.00	26.94	162.83
298.78	29.685	330.74	231.00	27.29	162.68
308.97	29.985	304.02	237.00	27.12	163.22
318.13	30.335	276.27	243.00	27.04	162.47
331.08	29.985	390.57	249.00	26.99	162.08
345.10	29.985	420.39	255.00	26.49	160.43
363.63	30.235	557.94	261.00	26.44	158.78
380.74	30.185	516.89	267.00	27.26	161.09
394.91	28.885	418.51	273.00	27.19	163.34
407.58	28.185	361.54	279.00	28.15	166.01
424.09	28.585	468.64	285.00	29.54	173.06
444.84	29.285	600.40	293.00	30.75	241.15
456.84	28.885	349.02	298.00	30.75	153.75
470.37	29.585	395.55	308.00	30.83	307.91
485.00	30.235	437.58	318.00	30.86	308.43
505.00	34.305	645.40	328.00	30.86	308.56
505.00	34.685	0.00	338.00	30.84	308.49
Total Area		= 14873.55	Total Area		= 15138.82

Table A7 Contd. : Section No.50

Year 1983			Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²	L/B Dist. m	Bed R.L. m	Area m ²
0.00	32.94	0.00	0.00	32.94	0.00
0.00	32.56	0.00	0.00	33.00	0.00
4.95	32.51	161.04	8.00	32.47	261.88
8.15	29.31	98.91	12.00	30.69	126.32

Section No. Contd.50

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
12.37	27.51	119.88
18.21	26.71	158.31
22.89	27.01	125.70
28.79	27.26	160.08
33.60	27.31	131.23
37.73	27.31	112.78
43.47	27.11	156.17
51.14	26.71	206.38
72.25	26.21	558.53
79.75	26.66	198.25
83.72	30.21	112.88
89.00	34.91	171.91
92.00	35.30	105.30
92.00	35.66	0.00
Total Area		= 2577.35

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
	29.19	-359.28
19.00	28.89	551.76
24.00	28.64	143.83
29.00	28.59	143.08
34.00	28.39	142.45
39.00	27.69	140.20
44.00	27.19	137.20
49.00	26.69	134.70
54.00	26.79	133.70
59.00	26.79	133.95
64.00	27.69	136.20
69.00	27.89	138.95
74.00	27.94	139.58
79.00	28.50	141.10
82.00	30.69	88.79
83.00	31.32	31.01
84.00	32.49	31.91
86.00	33.63	66.12
88.00	34.42	68.05
90.00	37.27	71.69
92.00	37.66	74.93
Total Area		= 2678.09

Table A7 Contd. : Section No. 51

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.25	0.00
0.00	32.95	0.00
6.60	33.28	218.56
10.00	33.13	112.90
12.50	32.63	82.20
17.30	29.93	150.14
21.90	26.93	130.78
29.70	25.63	204.98
34.90	25.03	131.72
38.40	24.73	87.08
43.30	24.13	119.71
47.30	23.78	95.82
54.50	23.48	170.14
59.00	23.53	105.77
64.40	27.13	136.78
69.60	30.83	150.70
80.00	34.61	340.29
80.00	34.86	0.00
Total Area		= 2237.56

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.25	0.00
0.00	33.40	0.00
4.00	33.42	133.64
8.00	33.85	134.54
12.00	33.45	134.60
16.00	33.44	133.78
19.00	32.29	98.60
22.00	31.00	94.94
27.00	27.95	147.38
31.00	27.60	111.10
34.00	27.30	82.35
37.00	26.90	81.30
41.00	26.85	107.50
45.00	26.20	106.10
49.00	25.80	104.00
52.00	25.50	76.95
55.00	25.15	75.98
58.00	24.80	99.90
62.00	23.20	72.00
66.00	27.95	102.30
70.00	31.00	117.90
76.00	33.47	193.41
78.00	34.77	68.24
79.00	34.72	34.75
80.00	34.96	34.84
Total Area		= 2346.08

Table A7 Contd. : Section No.52

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.46	0.00
0.00	33.16	0.00
6.80	33.54	226.75
15.20	31.94	274.98
19.70	29.54	138.31
23.20	28.19	101.01
26.30	27.84	86.83
32.10	27.14	159.42
36.50	26.59	118.19
40.00	26.24	92.44
44.70	25.79	122.25
49.20	25.54	115.47
54.30	25.14	129.21
62.60	25.74	211.12
68.90	25.94	162.77
77.80	31.74	256.64
81.70	33.44	127.09
89.60	34.94	270.07
92.00	37.40	86.80
92.00	35.79	0.00
Total Area		= 2679.36

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	33.46	0.00
0.00	33.72	0.00
4.00	34.22	135.88
8.00	34.15	136.74
12.00	34.25	136.82
16.00	33.15	134.81
20.00	31.61	129.51
24.00	29.20	121.60
28.00	28.36	115.10
32.00	28.21	113.12
36.00	27.81	112.02
40.00	27.71	111.02
44.00	27.66	110.72
48.00	27.69	110.68
52.00	27.21	109.78
56.00	27.31	109.02
60.00	27.16	108.92
64.00	27.21	108.72
68.00	27.71	109.82
72.00	28.21	111.82
77.00	31.61	149.53
78.00	33.18	32.40
85.00	34.35	236.38
89.00	35.37	139.43
92.00	35.79	106.73
Total Area		= 2790.61

Table A7 Contd. : Section No. 53

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	34.76	0.00
0.00	34.45	0.00
0.98	33.78	33.43
17.68	30.98	540.78
22.31	29.48	139.97
27.58	28.48	152.74
32.34	27.98	134.38
38.30	27.28	164.69
44.84	26.98	177.44
50.89	26.58	162.03
57.18	26.48	166.89
64.78	26.38	200.88
71.52	27.28	180.85
76.87	30.28	153.98
84.51	34.58	247.78
88.00	34.58	120.69
88.00	34.88	0.00
Total area		= 2576.54

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	34.76	0.00
0.00	35.62	0.00
8.00	34.75	281.49
15.00	34.67	242.97
20.00	34.18	172.13
29.00	31.83	297.05
33.00	33.13	129.93
36.00	33.98	100.67
39.00	29.03	94.52
42.00	28.53	86.35
45.00	27.33	83.80
49.00	26.63	107.93
54.00	26.58	133.04
59.00	27.13	134.29
64.00	27.68	137.04
69.00	27.73	138.54
74.00	27.83	138.91
79.00	30.03	144.66
83.00	31.83	123.73
85.00	34.24	66.07
88.00	34.88	103.68
Total area		= 2716.78

Table A7 Contd. : Section No.54

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.08	0.00
0.00	35.04	0.00
11.80	34.99	413.18
25.00	31.49	438.77
29.90	29.19	148.67
36.10	27.59	176.02
42.70	27.14	180.61
48.30	26.79	151.00
54.90	26.09	174.50
60.60	25.49	147.00
69.00	25.14	212.65
75.60	24.89	165.10
81.00	25.29	135.49
85.10	25.59	104.30
93.10	26.69	209.12
97.40	28.59	118.85
101.00	29.89	105.26
109.30	34.99	269.25
132.00	35.07	795.18
132.00	35.13	0.00
Total area		= 3944.95

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.08	0.00
0.00	35.47	0.00
8.00	35.43	283.60
15.00	35.39	247.87
22.00	35.26	247.28
27.00	34.35	174.03
37.00	32.65	335.00
47.00	32.25	324.50
57.00	31.15	317.00
67.00	30.15	306.50
77.00	28.85	295.00
87.00	26.55	277.00
97.00	26.35	264.50
102.00	26.05	131.00
107.00	25.95	130.00
112.00	25.90	129.63
117.00	25.85	129.38
122.00	26.65	131.25
127.00	27.45	135.25
132.00	28.55	140.00
137.00	29.05	144.00
143.00	34.35	190.20
148.00	35.00	173.38
149.00	35.08	35.04
150.00	35.60	35.34
Total area		= 4576.73

Table A7 Contd. : Section No. 54A

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.72	0.00
0.00	35.49	0.00
8.90	35.00	313.68
14.50	30.20	182.56
19.10	30.00	138.46
23.40	29.40	127.71
27.10	29.50	108.97
32.00	29.40	144.31
36.70	29.25	137.83
41.30	29.00	133.98
46.40	28.80	147.39
51.20	28.60	137.76
55.20	28.40	114.00
60.50	28.25	150.12
64.80	28.20	121.37
69.40	28.90	131.33
72.70	30.50	98.01
74.40	32.65	53.68
81.00	35.00	223.25
87.00	36.21	213.63
91.00	37.06	146.54
91.00	37.44	0.00
Total Area		= 2824.56

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.72	0.00
0.00	35.96	0.00
10.00	36.14	360.50
20.00	35.83	359.85
21.00	35.31	35.57
26.00	33.31	171.55
31.00	32.01	163.30
36.00	31.31	158.30
41.00	32.31	159.05
46.00	30.51	157.05
51.00	30.11	151.55
56.00	29.31	148.55
61.00	30.11	148.55
66.00	30.21	150.80
71.00	30.41	151.55
76.00	30.61	152.55
81.00	30.66	153.18
84.00	35.31	98.96
88.00	37.05	144.72
91.00	37.44	111.74
Total Area		= 2977.31

Table A7 Contd. : Section No.54B

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.56	0.00
0.00	36.20	0.00
13.00	36.27	471.06
18.00	35.00	178.18
24.00	32.60	202.80
29.60	31.25	178.78
34.70	29.90	155.93
39.30	29.90	137.54
43.50	29.85	125.48
48.70	29.85	155.22
54.50	29.90	173.28
61.50	30.00	209.65
67.70	30.15	186.47
72.20	30.20	135.79
77.00	32.30	150.00
82.00	35.00	168.25
84.00	35.91	70.91
91.00	36.10	252.04
91.00	36.34	0.00
Total Area =		2951.35

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.56	0.00
0.00	37.43	0.00
4.00	37.53	149.92
8.00	37.77	150.60
12.00	37.98	151.50
15.00	36.49	111.71
19.00	34.90	142.78
25.00	33.10	204.00
30.00	31.95	162.63
35.00	30.65	156.50
40.00	30.95	154.00
45.00	31.20	155.38
50.00	31.25	156.13
55.00	31.30	156.38
60.00	31.70	157.50
65.00	31.95	159.13
70.00	32.98	162.33
74.00	34.90	135.76
78.00	36.74	143.28
81.00	37.34	111.12
85.00	38.08	150.84
86.00	38.07	38.08
89.00	37.62	113.54
91.00	36.34	73.96
Total Area =		3097.03

Table A7 Contd. : Section No. 54C

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.80	0.00
0.00	36.60	0.00
12.00	36.59	439.14
16.60	35.04	164.75
22.80	34.34	215.08
27.50	32.24	156.46
35.10	31.09	240.65
44.90	31.14	304.93
50.30	31.14	168.16
56.90	31.24	205.85
62.00	31.24	159.32
67.40	31.34	168.97
69.80	32.24	76.30
81.70	35.04	400.32
87.00	38.91	195.97
91.00	40.55	158.92
91.00	40.93	0.00
Total Area =		3054.81

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.80	0.00
0.00	37.35	0.00
8.00	37.23	298.32
12.00	37.37	149.20
16.00	34.99	144.72
21.00	32.99	169.95
26.00	30.89	159.70
31.00	31.04	154.83
36.00	30.94	154.95
41.00	30.89	154.58
46.00	30.99	154.70
51.00	30.94	154.83
56.00	30.99	154.83
61.00	30.49	153.70
66.00	30.89	153.45
72.00	31.89	188.34
78.00	34.99	200.64
83.00	37.37	180.90
87.00	39.15	153.04
89.00	40.61	79.76
91.00	40.93	81.54
Total Area =		3041.96

Table A7 Contd. : Section No.55

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.06	0.00
0.00	34.71	0.00
6.00	11.21	137.76
67.00	4.21	470.31
86.00	6.51	101.84
100.00	6.86	93.59
122.00	7.11	153.67
140.00	7.21	128.88
161.00	7.01	149.31
182.00	7.41	151.41
196.00	12.41	138.74
212.00	19.11	252.16
227.00	23.41	318.90
245.00	24.11	427.68
265.00	26.81	509.20
280.00	28.91	417.90
302.00	31.81	667.92
317.00	35.21	502.65
360.00	33.87	1485.22
360.00	34.21	0.00
Total Area	=	6107.14

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	35.06	0.00
0.00	35.23	0.00
1.00	33.68	34.46
5.00	38.43	144.22
18.00	36.88	489.52
33.00	30.68	506.70
48.00	7.62	287.25
60.00	7.06	88.08
74.00	6.88	97.58
87.00	7.68	94.64
99.00	7.78	92.76
110.00	8.62	90.20
122.00	8.98	105.60
136.00	8.24	120.54
151.00	7.45	117.68
164.00	7.34	96.14
178.00	6.59	97.51
199.00	5.64	128.42
210.00	5.30	60.17
220.00	5.63	54.85
230.00	5.83	57.30
234.00	8.97	29.60
252.00	10.68	176.85
268.00	14.65	202.64
279.00	16.62	171.99
290.00	22.16	213.29
301.00	26.58	268.07
315.00	29.43	392.07
324.00	31.42	273.83
335.00	30.67	341.50
348.00	39.97	459.16
352.00	33.68	147.30
360.00	34.65	273.32
360.00	34.21	0.00
Total Area	=	5713.00

Table A7 Contd. : Section No.56

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.43	0.00
0.00	36.15	0.00
4.00	35.56	143.42
13.34	33.56	322.79
22.42	16.36	226.64
29.97	4.76	79.73
39.34	3.91	40.62
49.77	4.71	44.95
76.94	5.96	144.95
100.36	7.51	157.73
111.92	8.96	95.20
121.92	11.56	102.60
139.75	14.36	231.08
156.81	16.56	263.75
168.39	19.46	208.56
181.68	23.06	282.55
194.00	28.66	318.60
211.21	33.96	538.85
229.00	35.56	618.38
235.00	36.42	215.94
235.00	36.59	0.00
Total Area		= 4036.32

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	36.43	0.00
0.00	36.14	0.00
8.00	34.91	284.20
12.00	33.63	137.08
16.00	31.61	130.48
20.00	30.01	123.24
38.00	29.03	531.36
50.00	27.31	338.04
61.00	21.61	269.06
69.00	14.06	142.68
72.00	11.88	38.91
83.00	12.95	136.57
95.00	12.98	155.58
102.00	12.83	90.34
108.00	13.61	79.32
118.00	14.73	141.70
127.00	15.31	135.18
129.00	15.63	30.94
135.00	17.38	99.03
142.00	20.21	131.57
150.00	23.41	174.48
158.00	26.17	198.32
170.00	29.78	335.70
178.00	31.19	243.88
185.00	30.62	216.34
192.00	31.38	217.00
204.00	31.58	377.76
205.00	31.78	31.68
209.00	33.63	130.82
211.00	34.36	67.99
219.00	34.78	276.56
227.00	35.06	279.36
235.00	36.13	284.76
235.00	36.59	0.00
Total Area		= 5829.91

Table A7Contd. : Section No.57

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	39.60	0.00
0.00	39.18	0.00
6.00	38.10	231.84
11.00	35.57	184.18
38.00	30.27	888.84
48.00	30.07	301.70
64.00	30.77	486.72
74.00	30.77	307.70
85.00	30.27	335.72
94.00	29.37	268.38
105.00	27.77	314.27
116.00	25.47	292.82
130.00	22.77	337.68
143.00	20.77	283.01
157.00	17.77	269.78
168.00	16.17	186.67
180.00	13.17	176.04
189.00	13.32	119.21
200.00	14.67	153.95
213.00	16.07	199.81
225.00	18.17	205.44
247.00	22.87	451.44

Year 2000		
L/B Dist. m	Bed R.L. m	L/B Dist. m
0.00	39.60	79.20
0.00	39.20	78.40
8.00	36.85	65.70
10.00	35.77	61.54
12.00	33.67	55.34
20.00	34.00	48.00
30.00	34.41	38.82
50.00	34.44	18.88
60.00	33.73	7.46
64.00	30.84	-2.32
67.00	30.53	-5.94
80.00	29.63	-20.74
91.00	28.88	-33.24
100.00	26.68	-46.64
111.00	23.68	-63.64
120.00	20.54	-78.92
127.00	19.66	-87.68
136.00	19.80	-96.40
146.00	21.34	-103.32
155.00	22.33	-110.34
165.00	22.94	-119.12
174.00	23.28	208.01

Section 57 Contd.

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
258.00	23.97	257.62
273.00	24.57	364.05
285.00	25.07	297.84
302.00	25.87	432.99
321.00	27.57	507.68
335.00	30.67	407.68
350.00	34.30	487.28
350.00	34.66	0.00
Total Area	=	8750.32

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
185.00	23.59	257.79
195.00	23.73	236.80
204.00	23.88	214.25
215.00	24.21	264.50
226.00	24.47	267.74
234.00	24.66	196.52
247.00	24.93	322.34
259.00	25.10	300.18
270.00	25.46	278.08
283.00	25.92	333.97
296.00	26.18	338.65
305.00	27.50	241.56
311.00	28.69	168.57
320.00	30.22	265.10
327.00	31.14	214.76
334.00	31.65	219.77
338.00	33.73	130.76
342.00	34.35	136.16
350.00	34.85	276.80
350.00	34.66	0.00
Total Area	=	9567.27

Table A7 Contd. : Section No. 58

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.57	0.00
0.00	34.25	0.00
7.32	33.21	246.90
13.28	32.81	196.74
23.86	32.61	346.07
40.45	30.21	521.09
52.44	27.41	345.43
61.87	25.01	247.16
70.94	22.81	216.86
79.77	20.21	189.93
90.50	18.81	209.34
104.72	16.81	253.26
112.97	15.81	134.56
122.72	15.11	150.74
135.48	14.01	185.79
145.78	12.61	137.09
161.39	11.21	185.92
183.41	11.01	244.64
217.20	12.01	388.92
229.47	14.41	162.09
238.85	20.81	165.18
252.28	27.81	326.48
257.90	33.41	172.03
270.00	34.58	411.34
270.00	34.90	0.00
Total Area	=	5437.57

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.57	0.00
0.00	34.73	0.00
14.00	35.10	488.81
22.00	34.12	276.88
26.00	33.73	135.70
30.00	30.38	128.22
42.00	30.27	363.90
51.00	29.73	270.00
58.00	27.91	201.74
63.00	26.84	136.88
70.00	25.07	181.69
74.00	23.68	97.50
78.00	22.01	91.38
82.00	21.77	87.56
88.00	20.91	128.04
92.00	20.21	82.24
95.00	19.51	59.58
102.00	19.06	135.00
107.00	18.25	93.28
111.00	17.48	71.46
115.00	16.93	68.82
117.00	16.61	33.54
121.00	16.20	65.62
123.00	15.73	31.93
127.00	15.46	62.38
133.00	15.88	94.02
138.00	15.63	78.78
143.00	16.54	80.43
149.00	16.71	99.75
155.00	17.08	101.37
160.00	19.59	91.68
166.00	20.36	119.85
173.00	20.47	142.91
180.00	22.20	149.35
186.00	23.54	137.22
194.00	25.41	195.80

Section No.58 Contd.

L/B Dist. m	Year 2000	
	Bed R.L. m	Area m ²
198.00	26.81	104.44
207.00	27.01	242.19
214.00	28.24	193.39
224.00	29.54	288.92
228.00	33.73	126.55
230.00	34.51	68.24
236.00	34.90	208.21
240.00	35.92	141.63
254.00	35.69	501.21
266.00	36.56	433.49
270.00	38.10	149.32
270.00	34.90	0.00
Total Area		= 4583.27

Table A7 Contd. : Section No.59

L/B Dist. m	Year 1983	
	Bed R.L. m	Area m ²
0.00	36.34	0.00
0.00	36.03	0.00
3.00	35.62	107.48
14.94	34.72	419.93
24.47	34.02	327.55
36.40	32.62	397.51
51.39	31.92	483.73
59.62	31.72	261.88
68.99	29.32	285.97
92.80	23.52	629.06
105.61	22.72	296.17
120.32	22.92	335.68
137.20	22.97	387.31
157.56	23.12	469.20
170.76	23.12	305.18
184.09	23.47	310.52
194.83	23.52	252.34
207.72	23.52	303.17
222.42	23.52	345.74
235.48	26.72	328.07
249.76	32.42	422.26
265.00	35.48	517.40
265.00	35.81	0.00
Total Area		= 7186.14

L/B Dist. m	Year 2000	
	Bed R.L. m	Area m ²
0.00	36.34	0.00
0.00	35.91	0.00
15.00	34.98	531.68
30.00	34.46	520.80
40.00	34.09	342.75
55.00	33.58	507.53
65.00	34.12	338.50
70.00	34.15	170.68
74.00	33.68	135.66
78.00	29.42	126.20
88.00	29.11	292.65
99.00	26.94	308.28
105.00	25.91	158.55
113.00	25.40	205.24
123.00	24.83	251.15
130.00	24.54	172.80
135.00	24.02	121.40
141.00	23.68	143.10
147.00	23.25	140.79
155.00	22.91	184.64
161.00	22.54	136.35
167.00	22.54	135.24
173.00	22.60	135.42
182.00	22.45	202.73
190.00	22.51	179.84
197.00	22.54	157.68
204.00	22.48	157.57
210.00	22.52	135.00
218.00	22.65	180.68
225.00	22.54	158.17
231.00	22.83	136.11
239.00	23.40	184.92
244.00	25.11	121.28
250.00	31.25	169.08
254.00	33.68	129.86
258.00	33.92	135.20
262.00	35.83	139.50
265.00	36.05	107.82
265.00	35.81	0.00
Total Area		= 7354.81

Table A7 Contd. : Section No.60

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.46	0.00
0.00	34.21	0.00
23.50	33.16	791.60
26.10	32.98	85.98
41.70	32.48	510.59
52.90	27.81	337.62
62.40	21.88	236.03
83.80	19.26	440.20
109.60	15.71	451.11
123.40	16.26	220.59
133.00	16.06	155.14
150.00	19.98	306.34
158.70	24.01	191.36
163.80	32.26	143.49
173.00	35.66	312.43
177.00	37.15	145.62
177.00	37.68	0.00
Total Area	=	4328.10

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	34.45	0.00
0.00	35.26	0.00
12.00	34.78	420.24
24.00	35.09	419.22
36.00	34.96	420.30
44.00	34.80	279.04
48.00	33.75	137.10
52.00	29.47	126.44
58.00	30.04	178.53
68.00	28.75	293.95
74.00	26.89	166.92
78.00	25.18	104.14
81.00	30.47	83.48
85.00	22.89	106.72
92.00	21.75	156.24
97.00	20.61	105.90
103.00	19.67	120.84
108.00	18.72	95.98
113.00	18.24	92.40
119.00	17.75	107.97
122.00	19.33	55.62
125.00	16.04	53.06
130.00	16.32	80.90
135.00	16.34	81.65
139.00	16.61	65.90
142.00	16.89	50.25
146.00	20.04	73.86
153.00	24.61	156.28
157.00	26.61	102.44
161.00	24.33	101.88
164.00	29.75	81.12
168.00	31.58	122.66
171.00	33.75	98.00
173.00	35.45	69.20
175.00	35.88	71.33
175.50	37.14	18.26
177.00	37.25	55.79
177.00	37.56	0.00
Total Area	=	4753.58

Table A7 Contd. : Section No.61

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	38.34	0.00
0.00	37.96	0.00
9.00	35.67	331.34
16.20	33.17	247.82
28.50	27.77	374.78
40.80	23.27	313.90
54.40	23.17	315.79
68.80	23.37	335.09
86.30	23.37	408.98
100.00	23.27	319.48
112.50	23.07	289.63
123.10	22.77	242.95
133.70	22.27	238.71
145.30	22.77	261.23
156.10	23.27	248.62
163.80	23.27	179.18
175.90	23.52	283.08
184.80	27.27	226.02
191.10	32.02	186.76
208.00	35.67	571.98
212.00	36.69	144.72
212.00	37.06	0.00
Total Area		= 5520.05

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	38.34	0.00
0.00	38.27	0.00
6.00	37.45	227.16
10.00	35.26	145.42
13.00	33.77	103.55
17.00	30.91	129.36
20.00	30.65	92.34
29.00	28.63	266.76
38.00	27.49	252.54
50.00	26.77	325.56
58.00	24.91	206.72
63.00	22.91	119.55
66.00	22.63	68.31
70.00	22.34	89.94
75.00	22.49	112.08
79.00	22.63	90.24
85.00	22.34	134.91
91.00	22.34	134.04
98.00	22.63	157.40
103.00	22.49	112.80
110.00	22.64	157.96
117.00	22.77	158.94
124.00	23.20	160.90
133.00	23.29	209.21
140.00	23.49	163.73
148.00	23.50	187.96
156.00	23.20	186.80
165.00	25.20	217.80
169.00	26.49	103.38
175.00	30.63	171.36
178.00	31.67	93.45
181.00	32.02	95.54
185.00	33.77	131.58
192.00	35.15	241.22
204.00	36.49	429.84
212.00	37.16	294.60
212.00	37.06	0.00
Total Area		= 5772.91

Table A7 Contd. : Section No.62

Year 1983		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	38.59	0.00
0.00	38.30	0.00
8.00	37.02	301.28
12.00	35.72	145.48
17.00	34.32	175.10
27.00	34.02	341.70
38.00	30.62	355.52
43.00	28.57	147.98
48.00	27.37	139.85
54.00	27.07	163.32
59.00	26.42	133.73
64.00	25.97	130.98
68.00	25.17	102.28
73.00	26.07	128.10
80.00	27.12	186.17
90.00	26.82	269.70
101.00	26.22	291.72
116.00	25.07	384.68
121.00	24.47	123.85

Year 2000		
L/B Dist. m	Bed R.L. m	Area m ²
0.00	38.59	0.00
0.00	38.83	0.00
12.00	37.37	457.20
20.00	38.19	302.24
36.00	36.93	600.96
44.00	36.09	292.08
52.00	35.27	285.44
60.00	33.75	276.08
64.00	28.61	124.72
77.00	27.90	367.32
88.00	27.47	304.54
99.00	27.46	302.12
112.00	27.26	355.68
121.00	26.61	242.42
130.00	26.04	236.93
137.00	25.64	180.88
147.00	24.72	251.80
153.00	24.04	146.28
159.00	23.18	141.66

Section No.62 Contd.

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
127.00	23.92	145.17
134.00	23.62	166.39
143.00	22.82	208.98
159.00	22.67	363.92
179.00	22.52	451.90
180.00	22.42	22.47
188.00	22.37	179.16
201.00	25.12	308.69
211.00	30.12	276.20
218.00	33.02	220.99
224.00	35.72	206.22
227.00	36.01	107.60
227.00	36.40	0.00
Total Area		= 6179.10

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
165.00	22.78	137.88
172.00	22.61	158.87
178.00	22.38	134.97
184.00	22.32	134.10
189.00	22.15	111.18
198.00	22.32	200.12
204.00	22.04	133.08
210.00	23.75	137.37
215.00	26.61	125.90
223.00	30.61	228.88
227.00	33.75	128.72
231.00	37.77	143.04
234.00	39.26	115.55
235.00	39.28	39.27
Total Area		= 6797.24

Table A7 Contd. : Section No.63

Year 1983		
L/B Dist. m	Bed R.L m	Area m ²
0.00	43.27	0.00
0.00	42.68	0.00
5.00	39.65	205.83
13.00	35.76	301.64
20.00	34.96	247.52
26.00	35.01	209.91
35.00	34.96	314.87
42.00	33.56	239.82
47.00	30.71	160.68
51.00	28.61	118.64
56.00	25.01	134.05
62.00	23.26	144.81
67.00	22.56	114.55
72.00	22.41	112.43
78.00	22.11	133.56
83.00	21.11	108.05
88.00	19.76	102.18
95.00	19.81	138.50
102.00	19.16	136.40
109.00	20.96	140.42
114.00	20.26	103.05
123.00	20.86	185.04
128.00	21.76	106.55
133.00	21.86	109.05
137.00	21.61	86.94
142.00	21.21	107.05
150.00	22.96	176.68
156.00	25.91	146.61
161.00	30.36	140.68
165.00	35.76	132.24
170.00	38.43	185.48
170.00	38.71	0.00
Total Area		= 4543.19

Year 2000		
L/B Dist. m	Bed R.L m	Area m ²
0.00	38.04	0.00
0.00	37.62	0.00
12.00	37.20	448.92
20.00	36.03	292.92
32.00	36.03	432.36
37.00	33.83	174.65
41.00	28.39	124.44
44.00	27.80	84.29
48.00	27.01	109.62
54.00	25.45	157.38
60.00	23.63	147.24
67.00	21.96	159.57
72.00	21.18	107.85
77.00	20.60	104.45
82.00	19.87	101.18
85.00	19.39	58.89
87.00	18.92	38.31
89.00	18.78	37.70
94.00	18.73	93.78
96.00	18.63	37.36
99.00	18.69	55.98
110.00	18.69	205.59
120.00	19.14	189.15
129.00	19.51	173.93
138.00	21.51	184.59
145.00	24.52	161.11
157.00	27.54	312.36
165.00	29.63	228.68
177.00	29.26	353.34
183.00	33.83	189.27
187.00	36.40	140.46
189.00	37.25	73.65
193.00	38.87	152.24
201.00	40.30	316.68
201.00	40.68	0.00
Total Area		= 5447.91

