Report on
Topographic and Bathymetric Survey of Reservoirs
for Water Resources Department, Govt. of Gujarat
at Saurashtra and Northern Gujarat Region, Gujarat
Machhu-1 Reservoir

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6.	8.8, 33	Table 11 updated
7.	8.11, 37-38	Table 13 & 14, heading updated

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ABBREVIATIONS

AutoCAD	Computer aided design and drafting software application
AM	Ante Meridiem
BM	Benchmark
CAD	Computer Aided Design
COG	Centre of Gravity
Cm	Centimetre
C.M.	Central Meridian
CMG	Course Made Good
Cu.m	Cubic metre
DF	Dual Frequency
DGPS	Differential Global Positioning System
dd-mm-yy	Date-Month-Year
DSL	Dead Storage Level
DTM	Digital Terrain Model
E	Easting
e.g.	Example
FRL	Full Reservoir Level
Ft.	Feet
Govt.	Government
GPS	Global Positioning System
Ha.m	Hectare metre
Horz	Horizontal
HSE	Health, Safety & Environment
ID	Identification name/number
IHO	International Hydrographic Organization
kHz	Kilohertz
km	Kilometre
km2	Square kilometre
KP	Kilometre Post
Lat	Latitude
LBM	Local Benchmark
Long	Longitude
Ltd.	Limited
m	Metre
MDDL	Minimum Drawdown Level
Mm^3	Million cubic metre

Mm^2	Million square metres
MRU	Motion Reference Unit
MSL	Mean Sea Level
MWL	Maximum Water Level
NA	Not Applicable
N	Northing
Nov	November
NU	North Up
NWRWS	Narmada Water Resources Water Supply
OSaS	Ocean Science & Surveying Pvt. Ltd
PM	Post Meridiem
Pvt.	Private
RF	Radio Frequency
R.L.	Reduced Level
RTK	Real-time Kinematic positioning
SBES	Single Beam Echo Sounder
SMB	Survey motor boat
sq. km	Square kilometre
SVP	Sound Velocity Profile
TBM	Temporary Benchmark
TIN	Triangulated irregular network
Th.Cu.m	Thousand cubic metre
UTM	Universal Transverse Mercator projection
USB	Universal Serial Bus
VDU	Video Display Unit
Vert	Vertical
Vs	Versus
w.d.	Water depth
WGS84	World Geodetic System 1984
WRD	Water Resources Department

EXECUTIVE SUMMARY

Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to initially carry out topographic and bathymetric survey of six reservoirs in the Saurashtra region; namely Shetrunji, Brahmani-1, Und 1, Machhu-1, Machhu-2 and Bhadar-1. However, as per instructions received from the client (Via document no: WRIDN/PB/ Bathymetry Survey (Sau) 183/2021, dated 24th February 2021), the survey of Shetrunji reservoir was not to be carried out. Instead, the client provided a list of 8 new reservoirs where bathymetric and topographic survey were to be carried out against the cancelled Shetrunji reservoir. Hence, finally a total of thirteen reservoirs in the Saurashtra and Northern Gujarat region; namely Bhadar-1, Brahmani-1, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Bhadar-2, Nara, Tappar, Rudramata, Mitti and Fatehgadh are to be surveyed as per the project specifications.

This report describes the results of the topographic and bathymetric survey services provided by OSaS to Narmada Water Resources, Water Supply & Kalpsar Department (WRD) for topographic and bathymetric mapping of the **Machhu-1** reservoir, Saurashtra region, Gujarat.

The survey boat SMB Ocean, owned by OSaS, was used for conducting the survey. The survey team started mobilisation of equipment on 02nd February 2021 while the survey boat was near the dam wall walkway of Machhu-1 dam.

To establish TBMs, two points were marked on the dam wall walkway which were spaced 20m apart. DGPS observations were carried out at each of these points for about 2 hours on 02nd February. The levelling of these TBMs was carried out on the same day with respect to the known level of FRL (135.33m above MSL) as provided by the client.

Initial system preparations and equipment checks were completed on 04th February 2021. The bathymetric and topographic survey commenced on 05th February and 07th February respectively at Machhu-1 reservoir. Bathymetric survey was completed on 02nd March 2021 and topographic survey was completed on 05th March. The survey boat was demobilised on 02nd March.

The survey data was processed on the site on a daily basis and reporting and charting was completed in the OSaS data processing centre in Navi-Mumbai after completion of the survey.

All the co-ordinates in the report and charts are referenced to WGS 84 datum, UTM projection, CM 69° east, zone 42, northern hemisphere.

All bathymetric and topographic data has been reduced to Mean Sea Level (M.S.L) using the observed average water level of each day during the survey period. All elevations mentioned in this report and accompanying charts are in metres above MSL.

The survey was carried out in daylight hours keeping in mind the safety of personnel and survey equipment.

From the current (2021) survey results, a minimum elevation of 121.3m above MSL and a maximum elevation of 135.3m above MSL was observed in the northern and north-western portions of the surveyed area respectively within the bathymetric section. A minimum elevation of 130.3m and a maximum elevation of 151.8m above MSL was observed in the south-southwestern and east-northeastern portions of the surveyed area respectively within the topographic section.

The topographic survey extended till the elevation of 141.0m above MSL as instructed by the client. In some areas, this elevation of 141.0m was not achievable, as a level lower than that of 141.0m extended and continued far beyond the limits of the survey area (mainly due to the continuation of flat areas for long distances).

A description of the bathymetric and topographic features observed in the surveyed area have been provided in **Section 7** of this report.

Based on the earlier survey report (Sedimentation Studies in Machhu-1 Irrigation Scheme, Nov 1990) provided by the client, it is understood that two capacity surveys: one in the year 1958 and another in 1989 were conducted using hydrographic and dry bed survey techniques prior to the current survey by OSaS in 2021. Hence, the survey data between 1958 vs 2021 and 1989 vs 2021 have been compared to draw conclusions on loss/increase of reservoir capacity and rate of siltation/erosion that has occurred over the years.

The capacity (volume) and area results obtained from the surveys carried out in 1958 and 1989 (provided by the client) have been tabulated in **Table 7** and **Table 8** respectively.

The capacity and area results obtained from the present survey data (2021) at the particular elevations at which the data is available in 1958 and 1989 are tabulated in **Table 9** and **Table 10** respectively.

The values of areas and capacities at 0.01m intervals of elevation (above MSL) obtained from the current survey data have been provided in Annexure 2.

The elevation area capacity curves showing the comparison between the capacity and area data between the years 1958, 1989 and 2021 are shown in **Figure 7**.

Vertical sediment distribution at particular elevations obtained on comparing the differences in capacities between the results obtained from the surveys carried out in 1958 vs 2021 and 1989 vs 2021 are tabulated in **Table 13** and **Table 14** respectively.

The comparison between the results obtained from the surveys carried out in 1958 and 2021 (63 years) indicates that siltation has occurred in the reservoir over the past 63 years and the rate of siltation is calculated to be 0.3 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity and dead storage capacity are 0.03% and 1.59% respectively. The annual percentage increase in live storage capacity is 0.01%.The details and calculations are provided in **section 8.7**.

The comparison between the results obtained from the surveys carried out in 1989 and 2021 (32 years) indicates that erosion has occurred in the reservoir over the past 32 years and the rate of erosion is calculated to be 2.6 Ha.m/100sq.km./year. Annual percentage increase of gross storage, live storage capacity and dead storage capacity are 0.25%, 0.25% and 0.00% respectively. The details and calculations are provided in **Section 8.9**.

The minimum elevation observed in the reservoir over the years (from 1958 to 2021) has increased, which indicates that sedimentation has occurred over the years. Thus it can be understood that the reservoir was filled with silt between elevations 114.30m and 121.50m from the year 1958 to 2021.

1 INTRODUCTION

The Water Resources Department, Govt. of Gujarat is engaged in developing water reservoirs within the state of Gujarat, under a World Bank funding programme towards National Hydrology Projects of Govt. of India. Towards this end, the Water Resources Department, Govt. of Gujarat requires services for conducting bathymetric survey of reservoirs of Saurashtra and Northern Gujarat regions under National Hydrology Project.

Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to initially carry out topographic and bathymetric survey of six reservoirs in the Saurashtra region; namely Shetrunji, Brahmani-1, Und 1, Machhu-1, Machhu-2 and Bhadar-1. However, as per instructions received from the client (Via document no: WRIDN/PB/ Bathymetry Survey (Sau) 183/2021, dated 24th February 2021), the survey of Shetrunji reservoir was not to be carried out. Instead, the client provided a list of 8 new reservoirs where bathymetric and topographic survey were to be carried out against the cancelled Shetrunji reservoir. Hence, finally a total of thirteen reservoirs in the Saurashtra and Northern Gujarat region; namely Bhadar-1, Brahmani-1, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Bhadar-2, Nara, Tappar, Rudramata, Mitti and Fatehgadh are to be surveyed as per the project specifications.

This report describes the results of the topographic and bathymetric survey services provided by OSaS to Narmada Water Resources, Water Supply & Kalpsar Department (WRD) for topographic and bathymetric mapping of the **Machhu-1** reservoir, Saurashtra region, Gujarat.

1.1 Salient Features of Survey Area

Machhu River rises in the hills of Jasdan near village Khokhara in Chotila taluk of Surendranagar district in Saurashtra region of Gujarat state in India at an elevation of 220m above MSL. This is one of the North-flowing rivers of Saurashtra in Gujarat state. The Machhu basin is situated between 22°10' N – 23°10’ N latitude and 70°40’ E – 71°15’ E longitude. The river Machhu originates from the hill ranges of Jasdan: Sardar and Mandva in Rajkot district and Chotila in Surendranagar district and flows in north westerly direction along with the district boundary of Surendranagar and Rajkot up to village Beti and then flows mainly northwards in Rajkot district and finally disappears near Malia in the little Rann of Kachchh. Machhu along with its tributaries flows 52% in hilly areas and 48% in plain regions. The river fertilizes Malia, Morbi, Wankaner, Jasdan and Rajkot talukas of Rajkot district and part of Chotila taluka in Surendranagar district. Machhu drains an area of 2515 km^2, of which more than 75% lies in Rajkot district.

The first dam on Machhu River, named Machhu-1, was built in 1959, with a catchment area of 730 km^2. The water stored in Machhu-1 reservoir is mainly for irrigation purpose. However, a part of the storage is also utilized to supply drinking water to Wankaner city.

The details of Machhu–1 reservoir from the survey carried out in 1958 are provided below (obtained from a report provided by the client):

a. Location
   - Latitude : 22^0 - 28’ N
   - Longitude : 70^0 - 13’ E

b. Catchment Area : 730 Sq.Km

c. Full Reservoir Level (F.R.L) : 135.33m above MSL

d. Gross Storage : 83.1307 M.Cu.m

e. Dead Storage : 1.7114 M.Cu.m

f. Live Storage : 81.4193 M.Cu.m

g. Area at F.R.L : 19.9093 Sq.Km

1.2 General Location

All the thirteen (13) reservoirs to be surveyed in the Saurashtra and Northern Gujarat region have been digitised on the Google Earth image and are shown in **Figure 1** (in red).

Figure 1: Overview of the thirteen reservoirs of Saurashtra and northern Gujarat region to be surveyed

(Courtesy: Google Earth)

2 SCOPE OF WORK

The scope of work for the survey is:

- To mobilize requisite topographic equipment and personnel at the site as specified by the client.
- To mobilize a suitable vessel along with requisite bathymetric equipment and personnel at the site specified by the client.
- To carry out topographic and single beam echo sounder bathymetric survey in the specified area.
- To estimate and study the sedimentation behaviour of reservoirs in different zones, including horizontal zones throughout the reservoirs as well as vertical zones namely (a) dead storage (b) live storage (c) flood storage, if any.
- The integrated bathymetric system will be used to collect data on depth and bottom topology of the reservoirs and rivers. Primary application is reservoir sedimentation surveying; products will be reservoir capacity figures as a function of depth, depth contours and bottom topology change over time.
- To upgrade elevation-area-capacity tables/ curves of the reservoirs.
- To prepare contour plan, longitudinal profile (L-section), cross section profiles.

2.1 Surveyed Area

The Machhu-1 dam site is situated about 18 km from Wankaner city near village Jalsika, taluka Wakaner of Rajkot district in the Saurashtra peninsula, in the Western state of Gujarat.

The surveyed area boundaries (both topographic and bathymetric) for Machhu-1 reservoir have been overlaid on the Google earth image shown in **Figure 2**.

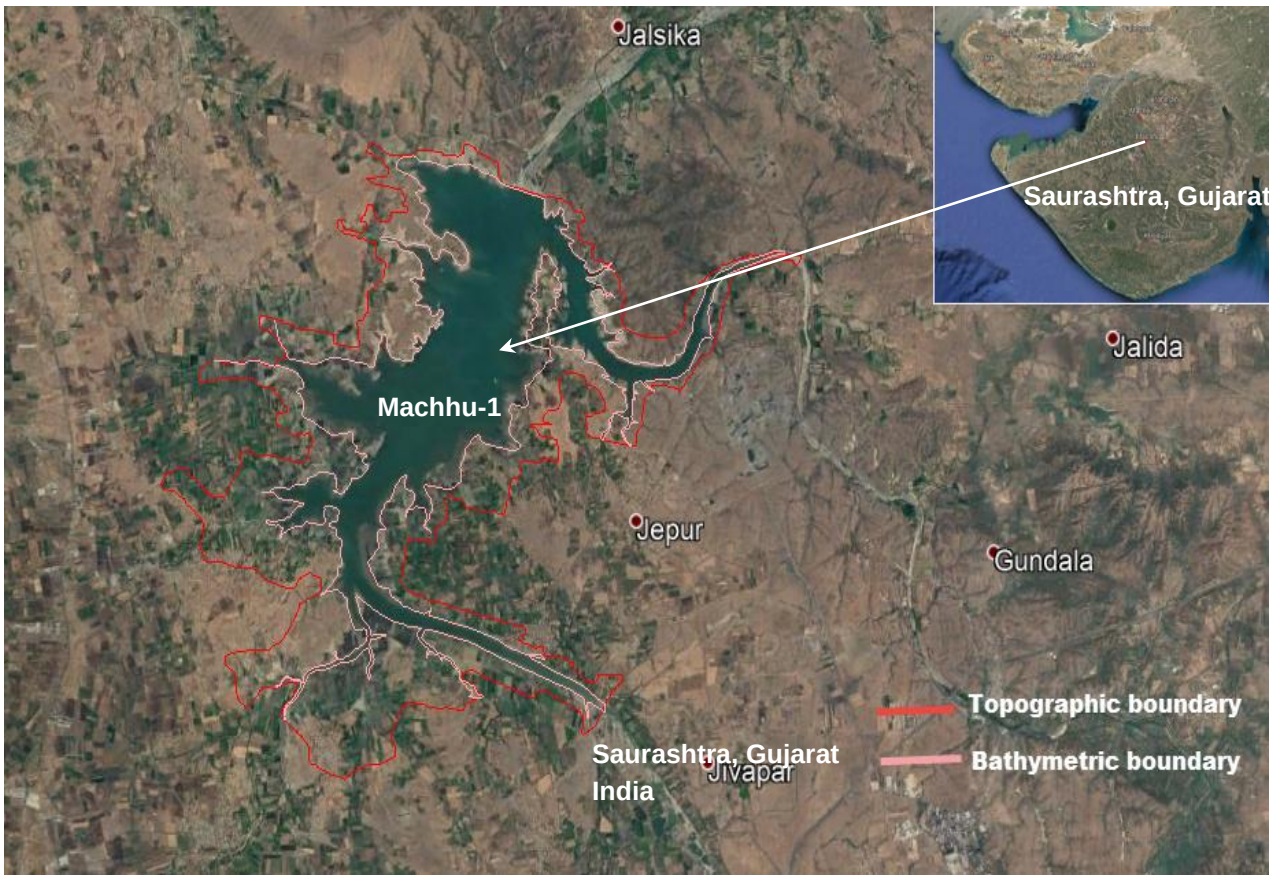


Figure 2: Surveyed areas (Topographic and Bathymetric) – Machhu-1 Reservoir

The topographic and bathymetric surveyed areas (in sq.km) for the Machhu-1 reservoir are provided in **Table 1** below.

Name of Reservoir	Bathymetric area surveyed (Sq. km.)	Topographic area surveyed (Sq.km.)
Machhu-1	7.8	12.7

Table 1: Surveyed areas for Machhu-1 reservoir

2.2 Survey Design

The topographic and bathymetric survey lines were planned and executed at intervals of 25m throughout the area of survey. Topographic survey was conducted using RTK base and rover system. The limit of topographic survey was up to the elevation of 141.0m above MSL, as instructed by the client. In some areas, this elevation of 141.0m was not achievable, as a level lower than that of 141.0m extended and continued far beyond the limits of the survey area (mainly due to the continuation of flat areas for long distances).

3 SURVEY CONTROL

3.1 Geodesy

The survey operations were conducted in WGS 84 Spheroid, Universal Transverse Mercator projection system, based on the geodetic parameters as presented below. All co-ordinates given within this document are with reference to it.

GEODETIC PARAMETERS	
Satellite Datum	
Datum, Spheroid	WGS-84
Semi-Major Axis	6378137.000 m
Semi Minor Axis	6356752.314 m
Inverse Flattening	298.2572
Projection Parameters	
Grid Projection	Universal Transverse Mercator
Latitude of Origin of Projection	0° (Equator)
Longitude of Origin of Projection	69° E, Zone 42 North
Hemisphere	North
False Easting (metres)	500000 E
False Northing (metres)	0
Scale Factor on CM	0.9996
Units	Metres

Table 2: Geodetic Parameters

3.2 Horizontal and vertical Control

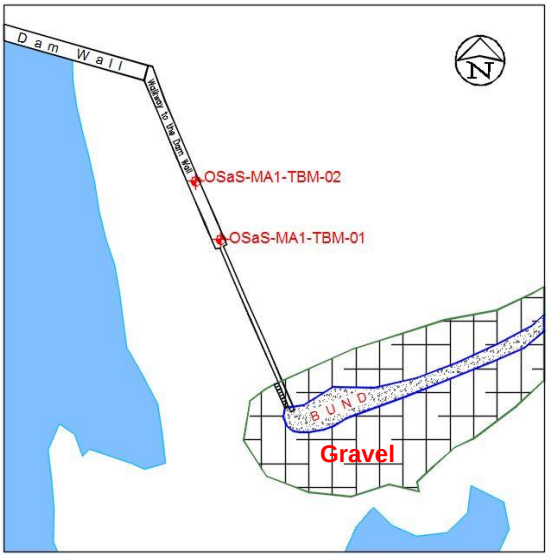
3.2.1 Topographic survey

Two reference stations were established as temporary control points/ temporary benchmarks (TBMs). The levelling of these TBMs was carried out using an auto level with respect to the known level of FRL which is 135.33m above MSL, as provided by the client. The base stations of the RTK system were set up at these positions and two-hour long continuous observations were conducted using a Hemisphere Atlas Link RTK positioning system to fix the consistency of the position for horizontal control. The system provides real time correction signals, providing centimetre level accuracy. Additional TBMs were established at various parts of the survey area to keep the rover in range with respect to the base station.

The details of the reference stations OSaS-MA-TBM-01 and OSaS-MA-TBM-02 are provided in **Figure 3** and **Figure 4** respectively.

Station Number:	OSAS-MA-TBM-01	**Latitude:**	22° 27.988' N
Locality:	Machhu-1, Gujarat	**Longitude:**	70° 58.404' E
Geodetic Datum:	WGS84	**Northing:**	2485795.762 m N
Projection:	Universal Transverse Mercator	**Easting:**	703052.022 m E
Date:	05th February 2021	**Elevation:**	143.04m above MSL
Station Description:	A square with a cross mark drawn inside it and text OSaS-MA-TBM-01 is written with yellow paint on the walkway to dam wall.		
Access:	From the guest house at Machhu-1 dam head south-southeast for about 35m after which turn towards south-west and continue along the bund for about 135m to reach the dam walkway. Head towards north-west on the dam walkway for about 60m to reach the TBM location.		

Sketch:



Map:

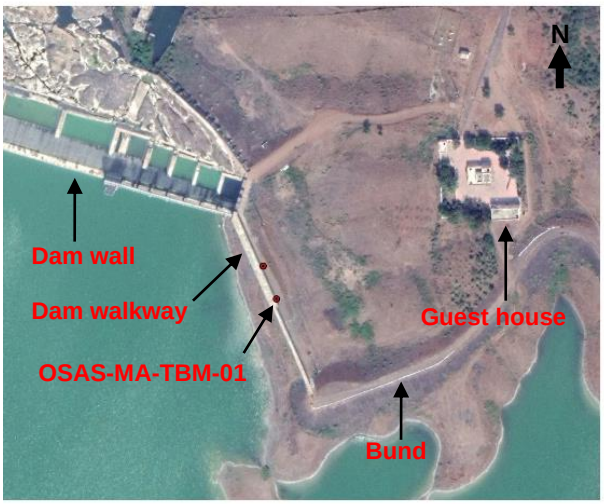
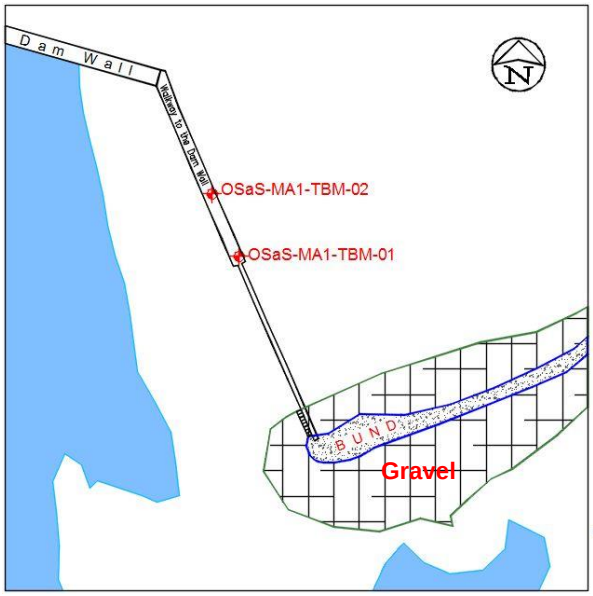


Figure 3: Details of OSaS-MA-TBM-01

Station Number:	OSAS-MA-TBM-02	**Latitude:**	22° 27.998' N
Locality:	Machhu-1, Gujarat	**Longitude:**	70° 58.400' E
Geodetic Datum:	WGS84	**Northing:**	2485814.184 m N
Projection:	Universal Transverse Mercator	**Easting:**	703044.072 m E
Date:	05th February 2021	**Elevation:**	143.02m above MSL
Station Description:	A square with a cross mark drawn inside it and text OSaS-MA-TBM-02 is written with yellow paint on the walkway to dam wall.		
Access:	From the guest house at Machhu-1 dam head south-southeast for about 35m after which turn towards south-west and continue along the bund for about 135m to reach the dam walkway. Head towards north-west on the dam walkway for about 80m to reach the TBM location.		

Sketch:



Map:

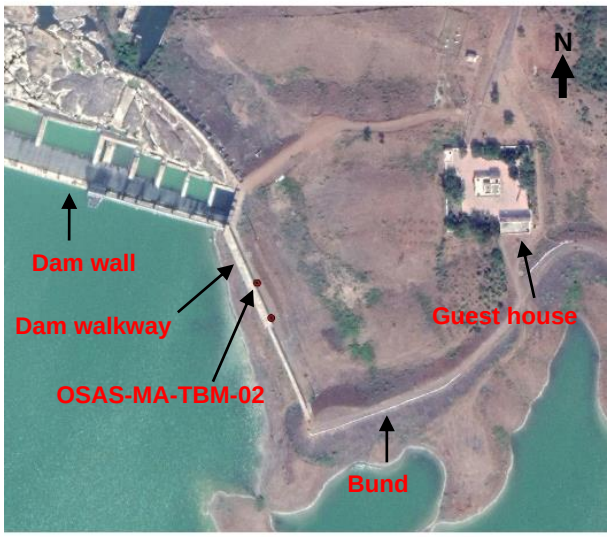


Figure 4: Details of OSaS-MA-TBM-02

Additional temporary control points were established at the site to maintain the moving rover within the range of the base reference point. The following table summarises the details of all the temporary control points (TBMs) established at the site during the survey.

Sr. No.	Station Name	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Elevations (m) w.r.t MSL
1	OSAS-MA1-TBM-01	22° 27′ 59.260″	70° 58′ 24.249″	703052.022	2485795.762	143.04
2	OSAS-MA1-TBM-02	22° 27′ 59.862″	70° 58′ 23.980″	703044.072	2485814.184	143.02
3	OSAS-MA1-TBM-03	22° 26′ 50.134″	70° 58′ 19.665″	702948.932	2483667.669	144.8
4	OSAS-MA1-TBM-04	22° 26′ 53.269″	70° 59′ 14.186″	704506.615	2483784.675	150.62
5	OSAS-MA1-TBM-05	22° 25′ 45.133″	70° 56′ 43.070″	700212.835	2481632.138	141.8

Table 3: Details of TBMs

3.2.2 Bathymetric survey

The two reference stations, established as temporary control points/ temporary benchmark (TBMs) for

topographic survey were used as the base station for RTK positioning during bathymetric survey. The rover fixed in the survey boat can receive calculated X Y Z (Easting, Northing, and Elevation) of its position at any point with centimetre level accuracy with respect to the known base positions. The details of the reference stations are given in **Figure 3** and **Figure 4**.

The water level of the reservoir with respect to the known value of FRL (135.33m above MSL) was measured twice a day during the survey. The mean value of these two readings was taken as the datum for the day's work. The depths recorded by the echo sounder were deducted from these levels to obtain the bed levels with respect to MSL. The observed water levels for each survey day are given in **Table 4.**

Survey date (dd-mm-yy)	Water level				
	Start		End		Average level in metres (above MSL)
	Time (AM)	Level (above MSL, in metres)	Time (PM)	Level (above MSL, in metres)	
05-02-21	10:00	132.63	5:00	132.63	132.63
06-02-21	10:00	132.57	5:00	132.57	132.57
07-02-21	10:00	132.52	5:00	132.52	132.52
08-02-21	10:00	132.47	5:00	132.47	132.47s
09-02-21	10:00	132.41	5:00	132.41	132.41
11-02-21	10:00	132.30	5:00	132.30	132.30
12-02-21	10:00	132.26	5:00	132.24	132.25
13-02-21	10:00	132.21	5:00	132.18	132.20
14-02-21	10:00	132.15	5:00	132.12	132.14
15-02-21	10:00	132.08	5:00	132.05	132.07
16-02-21	10:00	132.02	5:00	132.0	132.01
17-02-21	10:00	131.96	5:00	131.94	131.94
18-02-21	10:00	131.90	5:00	131.88	131.89
19-02-21	10:00	131.84	5:00	131.82	131.83
20-02-21	10:00	131.78	5:00	131.76	131.77

Table 4: Observed water levels at Machhu-1 reservoir

3.3 Survey Boat

A company owned boat, SMB Ocean, was utilised for conducting the survey operations.

Figure 5: Survey boat – SMB Ocean

4 PERSONNEL

The following survey personnel were involved during the survey period.

Name	Designation	Duration
Santokh Chand	Project Manager	Project Duration (In Navi-Mumbai office)
M.I. Mansuri	Party Chief/ AutoCAD Processor	01st February - 12th February 2021
Santosh Wakankar	Party Chief/ AutoCAD Processor	15th February – 06th March 2021
Prasant Panda	Survey Engineer	01st February - 11th February 2021
Pankaj Rabary	Surveyor	01st February - 06th March 2021
Manoj More	Land Surveyor	01st February - 06th March 2021
Nikhil Rane	Land Surveyor	01st February - 06th March 2021
Usha Kadam	AutoCAD Processor	Project duration (data processing in office)

Table 5: Survey Personnel

5 SURVEY EQUIPMENT DETAILS

5.1 General

The equipment used for the survey is described below.

Bathymetry:

Hemisphere Atlas Link RTK Base and Rover System with accessories

Odom MK III dual frequency single beam echo sounder system with accessories

MRU-PD heave sensor

Hypack navigation system

2 x computers with associated accessories

Topography:

Hemisphere Atlas Link RTK Base and Rover System with accessories

Geomax Auto Level complete with all accessories.

Adequate spares and back-ups for critical items were carried on board the survey vessel to ensure that failure of any hardware unit does not adversely affect progress of field work.

5.2 RTK Positioning and Navigation

An RTK system was mobilised at the site to carry out the topographic and bathymetric survey. The system comprises the following:

- Atlas Antenna
- SATEL Modem
- RF Antenna
- Hemisphere Controller with stylus

The base station of the RTK was set up at the temporary benchmark. Real Time Kinematic (RTK) is a technique used to increase the accuracy of GPS signals by using a fixed base station which wirelessly sends out corrections to a moving receiver. By utilising these corrections, the GPS engine can fix the position of the antenna to within 1-2cm. GPS Real-Time Kinematic (RTK) operation provides centimetre-level accuracy by eliminating errors that are present in the GPS system. For obtaining corrected positions, a rover receiver and a source of corrections from a base station were used.

Vessel positioning was carried out by the RTK system and its heading determined using MRU-PD by the course made good method (CMG). Vessel track and offset positions were recorded digitally in the navigation software. The positioning system was interfaced to the Hypack navigation software. RTK positioning accuracy of the moving vessel was within 1-2cm.

The vessel's computed position from the RTK system receiver was interfaced to the navigation computer system. Hypack navigation and data acquisition software was used to provide track guidance information for the survey crew and also output the vessel position to assist the helmsman in maintaining the selected track guidance line. The VDU displays the selected survey line, the vessel position in relation to that line and numerical data to assist the helmsman such as the along-line and off-line distances, vessel speed and course made good, gyro heading, distance and bearing to end of line and water depth. The position of each fix, together with other information such as fix numbers, depths, and down line distances were logged to the hard drive.

Sensor offsets on the survey vessel were accurately measured during mobilisation and are included in Mobilisation report (Annexure 1).

5.3 Single Beam Echo Sounder System

Bathymetry data was acquired using a dual frequency 33/200 kHz Echotrac DF 3200 MK III single beam echo sounder. The SBES transducer assembly was side-mounted on a pole on the port side of the survey boat. A hard copy (paper) record was produced in real-time, annotated with line name, fix number, time and date. The digital output was logged by the navigation computer for post-processing.

Calibration

The echo sounder was calibrated at the survey location by conducting a bar-check. The bar-check is carried out by lowering a horizontal steel plate to known, fixed depths below the water surface directly below the echo sounder transducer. Acoustic reflections from the plate at different depths are then recorded and adjustments made to the settings for sound velocity and draft to get accurate results. A bar-check was carried out before commencing the survey and the average speed of sound obtained was entered into the unit.

5.4 Heave Sensor

A MRU-PD heave sensor was fixed on the deck of the boat about 0.5m ahead of the COG. Its output was given to the SBES unit.

5.5 Auto Level Geomax

A Geomax Auto Level was used to transfer the benchmark as provided by the client to a local benchmark. It was also used to level this local benchmark.

5.6 Real Time Kinematic (RTK) For Topographic Survey

A Hemisphere Atlas Link RTK system with base station and rover was used to conduct the survey. Base stations were established with respect to the FRL value at TMB's and rovers were used to fix the positions. This is a positioning system which can measure and calculate the X Y Z (Easting, Northing and Elevation) of any given point with centimetre level accuracy with respect to the known base positions. An AutoCAD drawing can be generated with the help of the XYZ values obtained from this equipment.

5.7 Hypack Software

Navigation data was processed using the Hypack navigation software. Single beam data from the Echotrac DF 3200 MK III echo sounder was also processed using the Hypack software. Hypack provides all of the tools necessary to complete the hydrographic survey requirements. It provides a tool to design a survey, collect data, apply corrections to soundings, remove outliers, plot field sheets, export data to CAD, compute volume quantities, generate contours and create/modify electronic charts.

6 DATA PROCESSING AND INTERPRETATION

This section explains the established terminology and standards for the project and how they were applied to the survey data.

6.1 Navigation Data

Raw RTK and gyro data were processed and merged to form an edited vessel track file. The final navigation data was reviewed in AutoCAD to confirm the validity of the vessel's position and to aid in the correlation between navigation data and chart location.

The survey track plots were then used for data interpretation and generation of the survey charts.

6.2 Bathymetric Data

Single beam data from the Echotrac DF 3200 MK III echo sounder was processed using the Hypack navigation package. The water level of the reservoir with respect to the known value of FRL (135.33m above MSL) was measured twice a day during the survey. The mean value of these two readings was taken as the datum for the day's work. The depths recorded by the echo sounder were deducted from these levels to obtain the bed levels with respect to MSL.

The vertical datum for all bathymetric measurements was the known value of FRL with respect to the MSL. The depth soundings obtained from the single beam echo sounder were reduced to MSL with the help of the observed water levels in the reservoir.

Recorded depth data was adjusted for transducer draft and changes in water mass acoustic velocity as measured during the bar-check.

Seabed Gradient Classification

The following terms were used to describe the seabed gradients.

CLASSIFICATION	GRADIENT (in terms of Degrees and Slope Interval)	
Very Gentle	<1°	< 1 in 57
Gentle	1° – 4.9°	1 in 57 to 1 in 11.7
Moderate	5° – 9.9°	1 in 11.7 to 1 in 5.7
Steep	10° – 14.9°	1 in 5.7 to 1 in 3.7
Very Steep	>15°	> 1 in 3.7

Table 6: Classification of gradients

Gradients documented in the report should be taken as an indication of general slopes for the area. The localised gradients, particularly near features such as depressions or trenches may occasionally be steeper.

Following the data processing and interpretation phase, the charts were prepared at the OSaS data processing centre, in Navi Mumbai. A team comprising a single beam data processor, CAD processor and geophysicist prepared the report and accompanying charts to WRD's specifications.

6.3 Charting

The results of the survey conducted during February and March 2021 are presented in fifteen charts.

The details of all the charts drafted for Machhu-1 reservoir surveyed area are provided after the List of Tables at the beginning of the report.

7 SURVEY RESULTS

An overview chart and a contour chart of the surveyed area are provided in chart nos.

OSaS_P34320_WRD_Machhu-1_OV_01 and

OSaS_P34320_WRD_Machhu-1_CC_02 respectively

7.1 Bathymetry & Topography

The elevations mentioned in this report and associated charts have been reduced to Mean Sea Level (MSL) using the observed average water level of the Machhu-1 reservoir for the corresponding survey day. Hence, all the bathymetric and topographic values mentioned in this report are with respect to MSL.

The bathymetric and topographic data are plotted in 1:5000 scale in a 25m x 25m grid.

The following observations were obtained after the processing and interpretation of all the bathymetric and topographic data acquired during the entire period of survey.

(Refer to charts: OSaS_P34320_WRD_Machhu-1_03 to OSaS_P34320_WRD_Machhu-1_05).

Bathymetric and topographic survey was limited at some places due to the presence of marshy ground, cultivated land, steep to very steep slopes on land, bushes, hillslopes, small streams and very shallow areas (which were as not accessible by either the survey boat or the survey personnel).

A minimum elevation of 121.3m and a maximum elevation of 135.3m was observed in the northern and north-western portion of the surveyed area respectively within the bathymetric section.

A general range of elevation change between 125.0m and 128.0m.is observed within the bathymetric section for a major part of the reservoir. Moderate to steep slopes are generally observed all along the periphery of the reservoir, with the slopes becoming gentler moving away from the periphery towards the central portion of the reservoir. Occasionally, very steep gradients are observed in the surveyed area, mainly in the vicinity of and to the south of the dam gates.

A minimum elevation of 130.3m and a maximum elevation of 151.8m was observed in the south-southwestern and east-northeastern portions of the surveyed area respectively within the topographic section.

A general range of elevations between 132.0m and 136.0m.is observed for a major part of the topographic surveyed area. The processed topographic data shows that the land is sloping with very gentle gradients from all the sides towards the reservoir area. Moderate to steep gradients are generally observed all along the reservoir banks where the topographic survey ends. Isolated to scattered areas, showing moderate variations in elevations compared to the surrounding topography are observed in the eastern, north-western and southern portions of the topographic surveyed area. Features like temples, houses, an island, cultivated lands, bunds, bushes, trees, ravines, roads and steps were observed within the topographic surveyed area.

Figure 6 shows a 2-dimensional image of the entire Machhu-1 surveyed reservoir area, generated using the gridded bathymetric and topographic data.

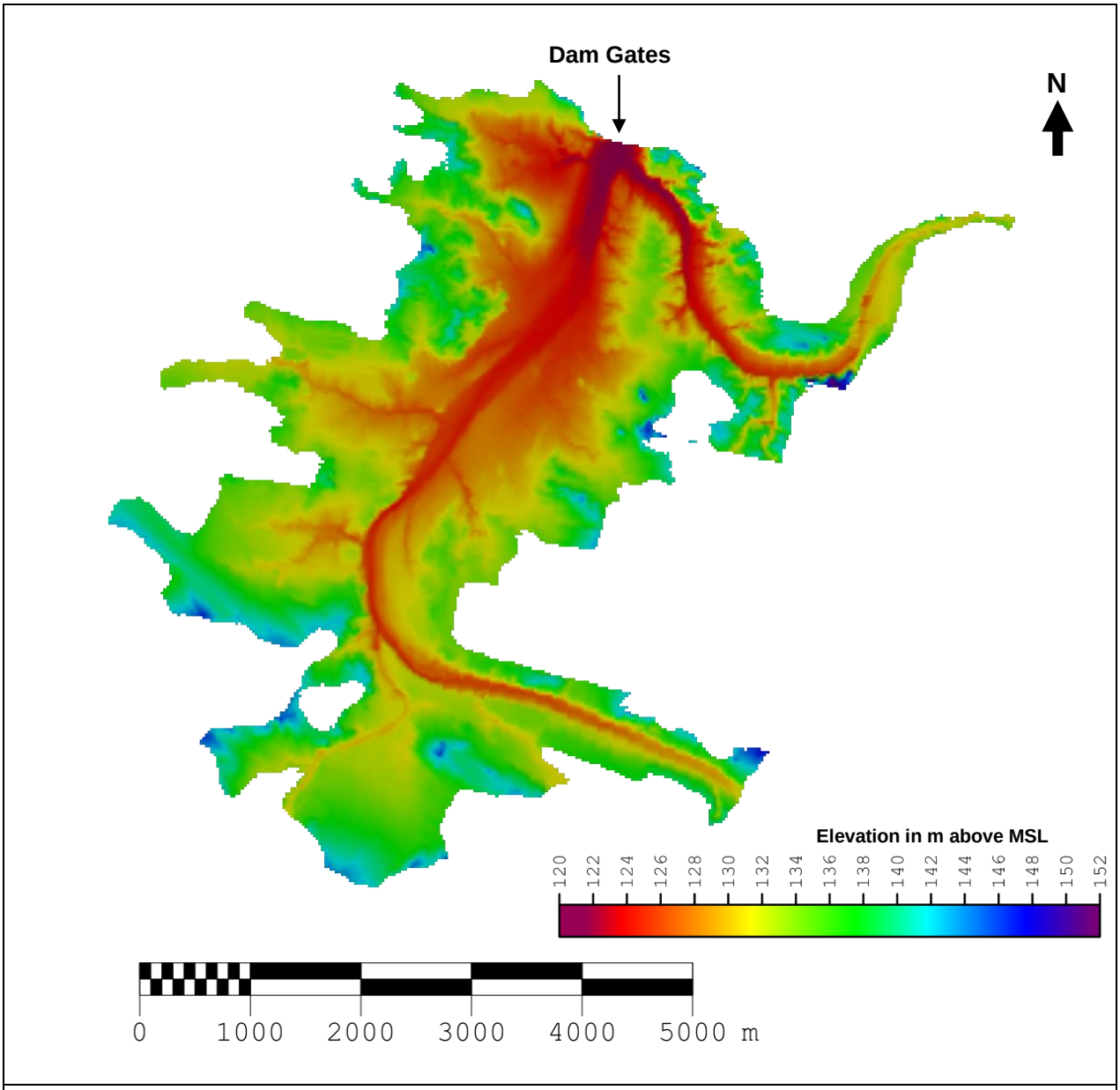


Figure 6: 2D image of Machhu-1 reservoir entire surveyed area

7.2 Longitudinal Profile

A longitudinal profile of the reservoir was generated from the lowest elevation line created by connecting the lowest bed level observed along each survey line. This longitudinal profile is provided in chart: OSaS_P34320_WRD_Machhu-1_LP_06.

7.3 Cross Section Profiles

Cross section profiles consist of the bed levels observed along the survey lines at 100m intervals. The cross-section profiles are presented in nine charts. The details of these charts are provided in charts nos. OSaS_P34320_WRD_Machhu-1_CP_07 to ……CP_15.

8 CAPACITY SURVEY RESULTS

8.1 General

It is natural for lakes and reservoirs to trap a major part of the sediment brought into them by the streams in the catchment. Sedimentation of reservoirs is therefore a natural process resulting from the geologic and geo-morphologic processes of water-borne erosion.

Sedimentation of reservoirs leads to a gradual loss of their storage capacities available for regulation of supplies. Apart from this, it can cause operational problems created by the entry of large volumes of sediments in the canals or in the turbines, as also due to jamming of hydraulic gates. Reservoir sedimentation can also cause ecological problems due to turbidity, and due to gradual delta formation at the upstream end of the reservoirs. Therefore, sedimentation of reservoirs is a matter of vital concern in all water resources development projects.

The two dominant factors which influence the rate of silting in any storage reservoir are: (i) the relationship of capacity to inflow and (ii) the content of sediment in the inflow. The other factors that modify the long-term loss of storage capacities are (a) the trap efficiency of the reservoir, (b) the character of the sediment, and (c) the method of reservoir operation. Basically, these three factors mentioned are modifiers and do not usually have a major effect as compared to the capacity-inflow ratio and the sediment content in the inflow.

It is generally recommended to carry out capacity survey of reservoirs periodically so that the quantity of sedimentation taking place can be assessed and timely remedial measures taken. This also serves as a guide for proper sedimentation planning of future reservoirs to ensure that the reservoir sedimentation does not cause unexpected problems in the useful operation of the reservoir.

The capacity surveys in general, show that the observed rate of sedimentation is higher than the rate of sedimentation adopted in the original designs. However, it is observed that the rate of sedimentation decreases with the passage of time and the useful life of the reservoir may not get unduly reduced in most cases.

8.2 Effect of Sedimentation in Planning of Reservoirs

It is important to note that storage reservoirs built across rivers and streams lose their capacity on account of deposition of sediment. This deposition, which takes place progressively in time, reduces the active capacity of the reservoir to provide the outputs of water through the passage of time. Accumulation of sediment at or near the dam may interfere with the future functioning of water intakes and hence affects decisions regarding location and height of various outlets. It may also result in greater flow of water into canals / water conveyance systems drawing water from the reservoir. Problems of rise in flood levels in the head reaches and unsightly deposition of sediment from a recreation point of view may also crop up in the course of time.

In this regard, the Bureau of Indian Standards code IS: 12182 - 1987 “Guidelines for determination of effects of sedimentation in planning and performance of reservoir” is an important document which discusses some of the aspects of sedimentation that have to be considered while planning reservoirs. Some of the important points from the code are as follows:

While planning a reservoir, the degree of seriousness and the effect of sedimentation at the proposed location have to be judged from studies, which normally consist of a combination of:

1. Performance Assessment (Simulation) Studies with varying rate of sedimentation.
2. Likely effects of sedimentation at the dam face.

In special cases, where the effects of sedimentation on backwater levels are likely to be significant, backwater studies would be useful to understand the size of river water levels. The steps to be followed

for performance assessment studies with varying rates of sedimentation are as follows:

a. Estimation of annual sediment yields into the reservoir or the average annual sediment yield and of trap efficiency expected.

b. Distribution of sediment within the reservoir to obtain a sediment elevation and capacity curve at any appropriate time.

8.3 EARLIER CAPACITY SURVEYS (1958 and 1989)

Based on the survey report (Sedimentation Studies in Machhu-1 Irrigation Scheme, Nov 1990) provided by the client, it is understood that two capacity surveys; one in the year 1958 and another in 1989 were conducted using hydrographic and dry bed survey techniques prior to the current survey by OSaS in the year 2021.

The capacity (volume) and area results obtained from these surveys carried out in 1958 and 1989 have been provided in **Table 7** and **Table 8** respectively (Source: Sedimentation Studies in Machhu-1 Irrigation Scheme, Nov 1990 (report provided by client)).

8.4 ELEVATION-AREA-CAPACITY TABLE (2021)

The water spread area and its corresponding capacity has been calculated from the acquired bathymetry and topographic data. Hypack software's TIN (Triangulated Irregular Network) MODEL package was used to calculate the Area and Capacity of the Machu-1 reservoir at intervals of 0.01m with respect to the corresponding elevation above MSL. Within the surveyed area a few places were not accessible to the survey personnel due to existing marshy ground, small streams and very shallow areas were not accessible (by either the survey boat or the survey personnel). However, these areas were taken into account while calculating the water spread area by assigning interpolated values with respect to the acquired values around these restricted areas (inaccessible areas). The F.R.L is considered at 135.33m according to the information obtained from the client-provided report.

The depths recorded by the echo sounder were reduced to obtain the bed levels (bathymetry data) with respect to MSL for the entire surveyed area. Then, the entire data obtained from RTK (topography data) was merged with the bathymetry data to output a single xyz file for the entire surveyed area. Using the Hypack software a TIN (Triangulated irregular network) model was generated from this single xyz file mentioned above. Then, using the TIN to level option in Hypack software, the required range of levels (minimum and maximum water levels) and the desired interval (in this case 0.01m) at which the capacity/volume and area output is required were input in the software. Finally, a text file was generated by the software which contains all the information on the volume/capacity and area obtained at the specified elevation interval (0.01m) in the reservoir.

For comparing and generating elevation-area-capacity curves with previous surveyed data, the capacity and area data from the present survey (2021) has been extracted at the particular available elevations at which previous surveyed data is also available (1958 and 1989 surveys). The capacity and area results obtained from the present survey data at these particular elevations for the data available in 1958 and 1989 are tabulated in **Table 9** and **Table 10** respectively.

The values of areas and capacities at 0.01m interval obtained from the 2021 survey data have been provided in Annexure 1.

8.5 ELEVATION-AREA-CAPACITY CURVES

One of the most important physical characteristics of dams and their reservoirs are Elevation-area-capacity curves. Elevation-area-capacity curves are important for defining the storage capacity of the reservoir and thereby can be used in reservoir operation, reservoir flood routing, determination of capacity and water spread corresponding to each elevation.

Data for the capacity/volume and area obtained from the surveys carried out in the year 1958 and 1989 are available at particular elevations above MSL. This information has been provided in **Table 7** and

Table 8 ((Source: Sedimentation Studies in Machhu-1 Irrigation Scheme, Nov 1990 (report provided by client)). The capacity data for the survey conducted in 2021 is available at intervals of 0.01m elevation above MSL. However, while generating and comparing the Elevation area capacity curves between two years (e.g. 1958 and 2021) the capacity data at the same elevations for both the years have to be compared. Hence, the capacity and area data at the respective elevations similar to the ones available from the survey data carried out in 1958 and 1989 (**Table 7** and **Table 8** respectively) have been extracted from the 2021 capacity survey data and the same have been provided in **Table 9** and **Table 10**.

Elevation (Above MSL, m)	As per 1958 survey		As per 2021 survey		Remarks
	Gross Capacity (M.Cu.m)	Area (M.Sq.m or Sq.Km)	Gross Capacity (M.Cu.m)	Area (M.Sq.m or Sq.Km)	
114.30	-	0.0147	0.0000	0.0000	
115.82	0.1047	0.1458	0.0000	0.0000	
117.34	0.4190	0.2292	0.0000	0.0000	
118.87	0.8539	0.4161	0.0000	0.0000	
120.39	1.7114	0.6573	0.0000	0.0000	DSL
121.92	2.8897	0.9728	0.0150	0.1009	
123.44	4.7319	1.4131	0.4814	0.5198	
124.96	7.1492	1.7819	1.7870	1.3083	
126.49	10.3211	2.4907	4.8137	2.6580	
128.01	14.9535	3.6587	10.0524	4.3194	
129.54	21.5929	5.1215	18.0866	6.1630	
131.06	31.1307	7.7841	29.0278	8.3743	
132.28	41.9024	9.9175	40.6004	10.6109	
134.11	63.0350	13.2590	63.3473	14.1570	
135.33	83.1307	19.9093	81.7772	15.9321	FRL

Table 7: Comparative statement of Machu-1 reservoir between 1958 and 2021

Elevation (Above MSL, m)	As per 1989 survey		As per 2021 survey		Remarks
	Gross Capacity (M.Cu.m)	Area (M.Sq.m or Sq.Km)	Gross Capacity (M.Cu.m)	Area (M.Sq.m or Sq.Km)	
120.39	-	0.0007	0.0000	0.0000	DSL
121.00	0.0497	0.2444	0.0000	0.0000	
122.00	0.4387	0.3387	0.0239	0.1281	
123.00	0.7604	0.5331	0.2858	0.3851	
124.11	1.9154	1.6500	0.9145	0.7959	
125.00	3.4554	1.8200	1.8399	1.3424	
126.00	5.6254	2.2000	3.6198	2.2282	
127.00	7.8954	2.7000	6.2963	3.1727	
128.00	11.2084	3.7500	10.0092	4.3072	
129.00	15.5624	5.3000	14.9364	5.5179	

Elevation (Above MSL, m)	As per 1989 survey		As per 2021 survey		Remarks
	Gross Capacity (M.Cu.m)	Area (M.Sq.m or Sq.Km)	Gross Capacity (M.Cu.m)	Area (M.Sq.m or Sq.Km)	
130.00	21.7824	6.7820	21.0599	6.7720	
131.00	29.1324	8.2900	28.5285	8.2684	
132.00	38.3634	9.8000	37.7069	10.0431	
133.00	48.6624	11.1000	48.8002	12.0958	
134.00	60.2304	11.4000	61.8014	13.9522	
135.33	75.7894	12.0000	81.7772	15.9321	FRL

Table 8: Comparative statement of Machu-1 reservoir between 1989 and 2021

The above data were used for the preparation of Elevation-Area-Capacity curves. **Figure 7** shows the Elevation-Area-Capacity curves of 2021 superimposed on the 1958 and 1989 Elevation-Area-Capacity curves.

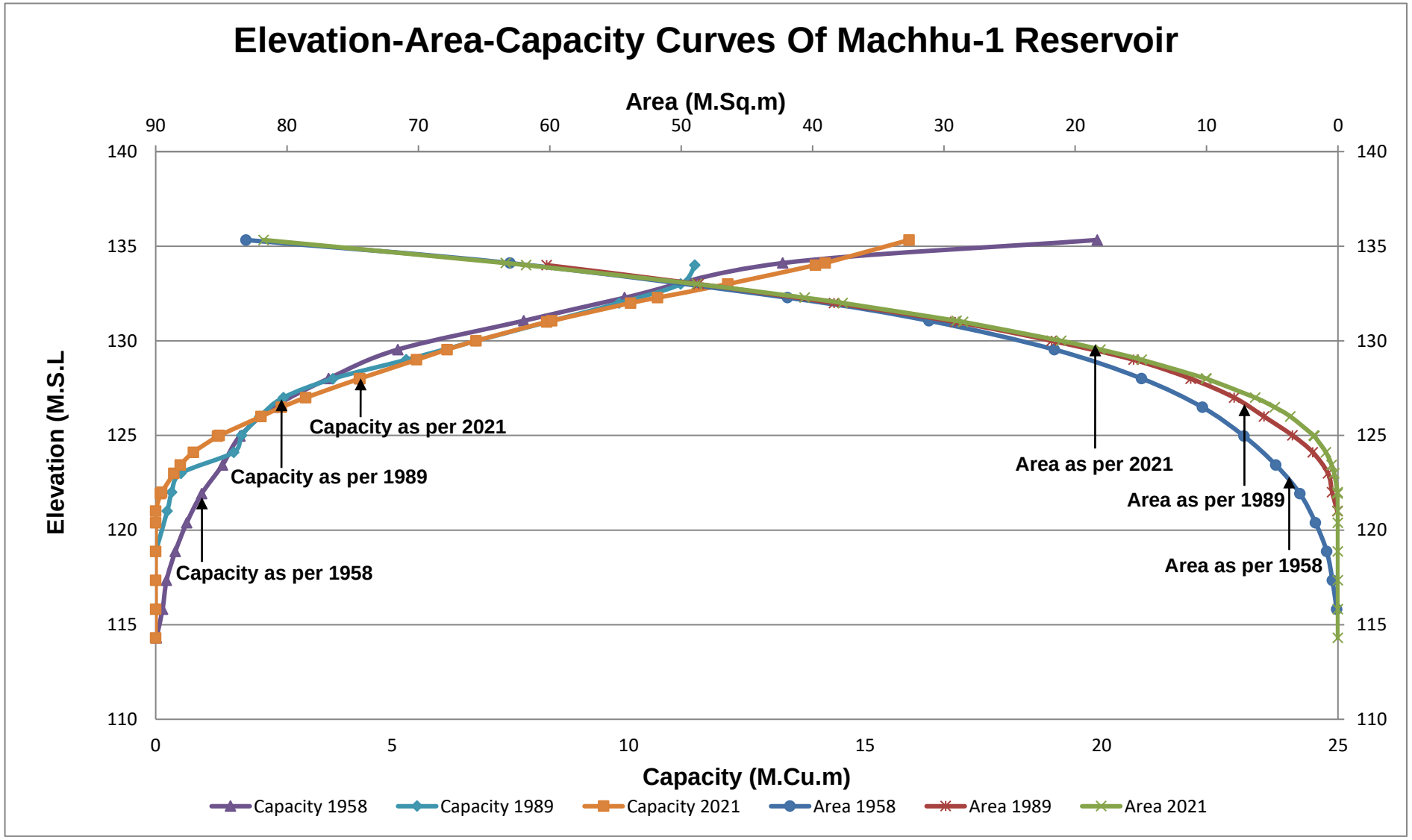


Figure 7: Elevation-Area-Capacity Curves (1958, 1989 and 2021))

8.6 LOSS OF STORAGE

Reservoirs, created by dams on rivers, lose their storage capacity due to sedimentation. A large proportion of the transported silt eventually gets deposited at different levels of a reservoir and causes reduction not only in dead storage but also in live storage capacities. The consequence of loss in storage due to sediment accumulation may even cause operational problems. Periodic capacity survey of a reservoir is thus essential to ascertain the rate of sedimentation and reduction in storage capacity for efficient and productive management of water resources. Reservoir siltation affects the safety of an old reservoir since the sediment in the reservoirs increases the load on the wall of the dam.

The amount of silt present in any reservoir is attributed to the geological nature of the area surrounding the reservoir. If the area is rich in silt, definitely any reservoir located within the area will have a greater proportion of silt in any sediment transported into it. Since erosion sedimentation is a serious problem in different parts of the world today resulting in several reservoirs becoming completely silted over, designers should aim at the following mitigation measures of soil erosion and sediment transport processes:

- Prevention of further land degradation in any catchment to reduce siltation
- Prevention of soil erosion from catchment to reduce siltation of reservoir
- Ensuring adequate irrigation water to the demand area
- Improving land capability moisture regime in the watershed
- Improving land use to match capability
- Maintaining ecological balance in a catchment area
- Educating people in the management of a catchment

Loss of storage/capacity was assessed by comparing the area and capacity values between the surveys conducted in 1958 vs 2021 and 1989 vs 2021.

It is observed that a minimum elevation of 114.30m (**Table 9**) and 120.39m (**Table 10**) was observed in the surveys carried out in 1958 and 1989 respectively. Further, in the recent survey conducted in 2021, a minimum elevation of 121.50m was observed. Hence, it can be said that the minimum elevation observed in the reservoir over the years (from 1958 to 2021) has increased, which indicates that sedimentation has occurred over the years. Thus it can be understood that the reservoir is filled with silt alone between elevations 114.30m and 121.50m from the year 1958 to 2021. Hence the cumulative capacity calculated in 2021 between elevations 114.30m and 120.39m is zero as indicated in **Table 9**. The same above given explanation holds good for the zero values of cumulative capacity calculated at elevations 120.39m and 121.0m in **Table 10**.

On comparing the capacity and area data of the survey carried out in 1958 with that of 2021, it is observed that there is loss in reservoir capacity in 2021, except at the elevation 134.11m, where an increase of capacity (0.50%) is observed. The details of the area and capacities for the year 1958 and 2021 and the calculated rate of sedimentation and % loss of capacity at the particular elevations have been provided in **Table 9**. The elevation area capacity curves comparing the results of the surveys carried out in the year 1958, 1989 and 2021 are shown in **Figure 7**.

On comparing the capacity and area data of the survey carried out in 1989 with that of 2021, it is observed that there is a loss in reservoir capacity in 2021 between 121.0m and 132.0m elevations, while an increase of area and capacity has been observed between elevations 133.0m and 135.33m (FRL), (**Table 10**), which may possibly be due to the process of erosion. Though, loss of capacity and sedimentation is observed between 121.0 and 132.0m elevations, on comparing the cumulative capacities for the years 1989 and 2021, an increase of cumulative capacity from 75.7894 M.cu.m (in

1958) to 81.7772 M.cu.m (in 2021) was observed at 135.33m (FRL) elevation. Also, a corresponding increase in water spread area was observed from 12.0000 M.sq.m (in 1958) to 15.9321 M.sq.m (in 2021) at 135.33m elevation. This has ultimately brought us to a conclusion that an erosional phenomenon has occurred in the reservoir from 1989 to 2021, which has resulted in an increase of storage of reservoir capacity rather than an expected siltation and corresponding loss of storage over the years.

Elevation (Above MSL, m)	Survey results – 1958		Survey results – 2021		Loss of capacity (M.cu.m)	% Loss of Capacity
	Area (M.Sq.m or Sq.Km)	Cumulative capacity (M.cu.m)	Area (M.Sq.m or Sq.Km)	Cumulative capacity (M.cu.m)		
114.30	0.0147	0.0000	0.0000	0.0000	0.0000	0.00
115.82	0.1458	0.1047	0.0000	0.0000	0.1047	100.00
117.34	0.2292	0.4190	0.0000	0.0000	0.4190	100.00
118.87	0.4161	0.8539	0.0000	0.0000	0.8539	100.00
120.39	0.6573	1.7114	0.0000	0.0000	1.7114	100.00
121.92	0.9728	2.8897	0.1009	0.0150	2.8747	99.48
123.44	1.4131	4.7319	0.5198	0.4814	4.2505	89.83
124.96	1.7819	7.1492	1.3083	1.7870	5.3622	75.00
126.49	2.4907	10.3211	2.6580	4.8137	5.5074	53.36
128.01	3.6587	14.9535	4.3194	10.0524	4.9011	32.78
129.54	5.1215	21.5929	6.1630	18.0866	3.5063	16.24
131.06	7.7841	31.1307	8.3743	29.0278	2.1029	6.76
132.28	9.9175	41.9024	10.6109	40.6004	1.3020	3.11
134.11	13.2590	63.0350	14.1570	63.3473	-0.3123	-0.50
135.33 (FRL)	19.9093	83.1307	15.9321	81.7772	1.3535	1.63

Table 9: Loss of storage (Comparison between 1958 and 2021 survey data)

Elevation (Above MSL, m)	Survey results – 1989		Survey results – 2021		Loss of capacity (M.cu.m)	% Loss of Capacity
	Area (M.Sq.m or Sq.Km)	Cumulative capacity (M.cu.m)	Area (M.Sq.m or Sq.Km)	Cumulative capacity (M.cu.m)		
120.39	0.0007	0.0000	0.0000	0.0000	0.0000	0.00
121.00	0.2444	0.0497	0.0000	0.0000	0.0497	100.00
122.00	0.3387	0.4387	0.1281	0.0239	0.4148	94.55
123.00	0.5331	0.7604	0.3851	0.2858	0.4746	62.42
124.11	1.6500	1.9154	0.7959	0.9145	1.0009	52.26
125.00	1.8200	3.4554	1.3424	1.8399	1.6155	46.75
126.00	2.2000	5.6254	2.2282	3.6198	2.0056	35.65
127.00	2.7000	7.8954	3.1727	6.2963	1.5991	20.25

128.00	3.7500	11.2084	4.3072	10.0092	1.1992	10.70
129.00	5.3000	15.5624	5.5179	14.9364	0.6260	4.02
130.00	6.7820	21.7824	6.7720	21.0599	0.7225	3.32
131.00	8.2900	29.1324	8.2684	28.5285	0.6039	2.07
132.00	9.8000	38.3634	10.0431	37.7069	0.6565	1.71
133.00	11.1000	48.6624	12.0958	48.8002	-0.1378	-0.28
134.00	11.4000	60.2304	13.9522	61.8014	-1.5710	-2.61
135.33 (FRL)	12.0000	75.7894	15.9321	81.7772	-5.9878	-7.90

Table 10: Loss of storage (Comparison between 1989 and 2021 survey data)

8.7 DATA COMPARISON BETWEEN 1958 AND 2021

Definitions

Full Reservoir Level: Denoted by FRL, this level corresponds to the storage which includes both inactive and active storages and also the flood storage, it is the highest reservoir level that can be maintained without spillway discharge.

Minimum Drawdown Level (M.D.D.L): It is the level below which the water from reservoir will not be drawn down to maintain a minimum head required in power projects.

Maximum Water Level (MWL): This water level that likely to be attained during the passage of the design flood. This level is also called as the highest reservoir level or the highest flood level**.**

Live storage: it is volume of water actually available at any time between the Dead Storage Level and the Full Reservoir Level.

Dead Storage Level (D.S.L): Below this level, there are no outlets to drain the water in the reservoir by gravity.

Dead storage: It is the total storage below the invert level of the lowest discharge outlet from the reservoir. It may be available to contain sedimentation, provided the sediment does not adversely affect the lowest discharge.

8.7.1 Rate of siltation

The loss of storage and rate of sedimentation calculations are based on the following basic data.

i) The catchment area of the reservoir is 730 Sq.Km.
ii) The FRL of the reservoir is given as 135.33m.

The results obtained after comparing the survey data of the year 1958 with that of 2021 are provided below:

Capacity at FRL (135.33m) as per 1958 survey	= 83.1307 Mm^3
Capacity at FRL as per 2021 survey	= 81.7772 Mm^3
Silting in 63 years (1958-2021)	= 83.1307 – 81.7772
	= 1.3535 Mm^3
Annual Siltation	= 1.3535/63= 0.021 Mm^3/year
Rate of Siltation (Silt Index)	= (0.021/730) x 1000
	= 0.029 Th.Cu.m/sq.km/year
	= **0.3 Ha.m/100sq.km./year**

8.7.2 Loss of gross storage capacity at F.R.L

Capacity at FRL (135.33) as per 1958 survey	= 83.1307 Mm^3
Capacity at FRL as per 2021 survey	= 81.7772 Mm^3

Loss of storage in 63 years (1958-2021)	= 83.1307 – 81.7772 = 1.3535 Mm^3
Percentage loss of Gross storage at F.R.L in 63 years	= (1.3535/83.1307) x 100 = 1.63%
Annual percentage loss	= 1.63/63 = **0.03%**

8.7.3 Loss of dead storage capacity

Capacity at D.S.L (120.39m) as per 1958 survey	= 1.7114 Mm^3
Capacity at D.S.L (120.39) as per 2021 survey	= 0.0000 Mm^3
Loss of storage up to D.S.L	= 1.7114 – 0.0000 = 1.7114 Mm^3
Percentage loss of dead storage capacity in 63 years	= (1.7114/1.7114) x 100 = 100%
Annual percentage loss	= 100/63 = **1.59%**

8.7.4 Increase of live storage capacity

Live storage capacity as per 1958 survey	= 83.1307 – 1.7114 = 81.4193 Mm^3
Live storage capacity as per 2021 survey	= 81.7772 – 0.000 = 81.7772 Mm^3
Increase of live storage capacity	= 81.7772 – 81.4193 =0.3579 Mm^3
Percentage increase of live storage capacity in 63 years	= (0.3579/81.7772) x 100 = 0.44%
Annual percentage increase	= 0.44/63 = **0.01%**

8.8 SUMMARY OF CAPACITY SURVEYS (1958 and 2021)

Original Reservoir Data:

Year of impounding : 1959
Year of survey : 1958
Catchment Area : 730.00 Sq.Km
Spread area at F.R.L (135.33m) : 19.9093 Sq.Km
Gross storage at F.R.L (135.33m) : 83.1307 M.Cu.m
Dead storage at D.S.L (120.39m) : 1.7114 M.Cu.m
Live storage at F.R.L (135.33m) : 81.4193 M.Cu.m

Rate of sedimentation (at F.R.L 135.33m) with respect to survey year 1958													
Sr. No	Year of Survey	Capacity in M.Cu.m			Silt Deposited in M.Cu.m	Period in years	Silt Rate in M.Cu.m/Year	Loss/Increase in Capacity in M.Cu.m and percentage			Silt Index ham/100 Sq.Km/Yr	Annual % loss of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1958	1.7114	81.4193	83.1307	-	-	-	-	-	-	-	-	-
2	2021	0	81.7772	81.7772	1.3535	63	0.021	1.7114 100%	0.3579* 0.44%**	1.3535 1.63%	0.3	0.03	**Insignificant Category**

Table 11: Rate of Sedimentation at F.R.L (135.33m)

<u>According to IS-12182 (1987)</u>

Annual % loss - Class of Reservoir

Up to 0.1 - Insignificant
0.1 to 0.5 - Significant
Above 0.5 - Serious

Rate of Silt – Loss in Gross Capacity/No of Years
Silt Index – Silt rate/Catchment area) x 10000
Annual % Loss – Loss in % of Gross Capacity/No. of years

Note:

- *Values highlighted with single asterisks (*) represents the volume of sediment eroded.*
- *Values highlighted with double asterisks (**) represents the percentage (%) increase of storage capacity.*

8.9 DATA COMPARISON BETWEEN 1989 AND 2021

On comparing the data between 1989 and 2021, a significant increase in water spread area was observed from 12.0000 M.sq.m (in 1989) to 15.9321 M.sq.m (2021) at 135.33m elevation. This increase in area may have been due to the erosion of reservoir banks and irregular flood plains into more flattened agricultural land. The increase in area reflects an increase in capacity of the reservoir. This has ultimately brought us to a conclusion that an erosional phenomenon has occurred in the reservoir from 1989 to 2021, which has resulted in an increase of storage of reservoir capacity rather than an expected siltation and corresponding loss of storage over the years.

8.9.1 Rate of erosion

The increase of storage and rate of erosion calculations are based on the following basic data.

iii) The catchment area of the reservoir is 730 Sq.km.

iv) The FRL of the reservoir is given as 135.33m.

The results obtained after comparing the survey data of the year 1989 with that of 2021 are provided below:

Capacity at 135.33m as per the 1989 survey	= 75.7894 Mm^3
Capacity at 135.33 as per 2021 survey	= 81.7772 Mm^3
Erosion in 32 years (1989-2021)	= 81.7772 – 75.7894 = 5.9878 Mm^3
Annual erosion	= 5.9878/32 = 0.187 Mm^3/year
Rate of erosion	= (0.187/730) x 1000 = 0.256 Th.Cu.m/sq.km/year
	= 2.6 Ha.m/100sq.km./year

8.9.2 Increase of Gross storage capacity at 135.33m

Capacity at 135.33m as per 1989 survey	= 75.7894 Mm^3
Capacity at 135.33m as per 2021 survey	= 81.7772 Mm^3
Increase of gross storage in 32 years (1989-2021)	= 81.7772 – 75.7894 = 5.9878 Mm^3
Percentage increase of gross storage at 135.33m (FRL) in 32 years	= (5.9878/75.7894) x 100 = 7.90%
Annual percentage increase	= 7.90/32
	= **0.25%**

8.9.3 Increase of dead storage capacity

Capacity at D.S.L (120.39m) as per 1989 survey	= 0.0000 Mm^3
Capacity at D.S.L (120.39m) as per 2021 survey	= 0.0000 Mm^3
Increase of storage up to D.S.L	= 0.0000 – 0.0000
	= 0.0000 Mm^3
Percentage increase of dead storage capacity in 32 years	=0.00%
Annual percentage increase	= 0.00/32
	= **0.00%**

8.9.4 Increase of live storage capacity

Live storage capacity as per 1989 survey	= 75.7894 – 0.0000
	= 75.7894 Mm^3
Live storage capacity as per 2021 survey	= 81.7772 – 0.0000
	= 81.7772 Mm^3
Increase of live storage capacity	= 81.7772 – 75.7894
	= 5.9878 Mm^3
Percentage increase of live storage capacity in 32 years	= (5.9878 /75.7894) x 100
	= 7.90%
Annual percentage increase	= 7.90/32
	= 0.25%

8.10 SUMMARY OF CAPACITY SURVEYS (1989 and 2021)

Reservoir Data as per 1989 Silt Survey:

Year of impounding : 1959
Year of survey : 1989
Catchment Area : 730.00 Sq.Km
Spread area at F.R.L (135.33m) : 12.0000 Sq.Km
Gross storage at F.R.L (135.33m) : 75.7894 M.Cu.m
Dead storage at D.S.L (120.39m) : 00.0000 M.Cu.m
Live storage at F.R.L (135.33m) : 75.7894 M.Cu.m

Rate of sedimentation (at F.R.L 135.33m) with respect to survey year 1989

Sr. No	Year of Survey	Capacity in M.Cu.m			Erosion in M.Cu.m	Period in years	Erosion Rate in M.Cu.m/Year	Increase in Capacity in M.Cu.m and percentage			Erosion index ham/100 Sq.Km/Yr	Annual % increase of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1989	0	75.7894	75.7894	-	-	-	-	-	-	-	-	-
2	2021	0	81.7772	81.7772	5.9878	32	0.187	5.9878 7.90%	0 0%	5.9878 7.90%	2.6	0.25	-

Table 12: Rate of Erosion at F.R.L (135.33m)

According to IS-12182 (1987)

Annual % loss	-	**Class of Reservoir**
Up to 0.1	-	Insignificant
0.1 to 0.5	-	Significant
Above 0.5	-	Serious

Rate of Erosion – Increase in Gross Capacity/No of Years
Erosion Index – (Erosion rate/Catchment area) x 10000
Annual % Increase – Increase in % of Gross Capacity/No. of years

8.11 VERTICAL SEDIMENT DISTRIBUTION

The distribution pattern in a reservoir depends on many factors, such as slope of the valley, length of the reservoir, constriction in the reservoir, particle sizes in the suspended sediment, capacity-inflow ratio, etc., and these factors exert an important control on reservoir operation.

Vertical sediment distribution (1958 vs 2021):

Vertical sediment distribution at particular elevations (above MSL) obtained on comparing the differences in capacities between the results from the surveys carried out in the year 1958 and 2021 are tabulated in **Table 13**.

From **Table 13**, it is understood that the gross capacity of the reservoir has decreased which may be due to sediment deposition that has occurred at all the mentioned elevations (in **Table 13**), except at elevation 134.11m, where an increase in capacity (0.3123 Mm^3) of the reservoir is observed in 2021 as compared to 1958.

Elevation (Above MSL, m)	Depth (m)	Cumulative Depth %	Area 1958 (M.Sq.m or Sq.Km)	Cumulative Capacity 1958 (M.cu.m)	Area 2021 (M.Sq.m or Sq.Km)	Cumulative Capacity 2021 (M.cu.m)	Sediment Deposit (M.cu.m)
114.30	0	0.00	0.0147	0.0000	0.0000	0.0000	0.0000
115.82	1.52	7.23	0.1458	0.1047	0.0000	0.0000	0.1047
117.34	3.04	14.46	0.2292	0.4190	0.0000	0.0000	0.4190
118.87	4.57	21.73	0.4161	0.8539	0.0000	0.0000	0.8539
120.39	6.09	28.96	0.6573	1.7114	0.0000	0.0000	1.7114
121.92	7.62	36.23	0.9728	2.8897	0.1009	0.0150	2.8747
123.44	9.14	43.46	1.4131	4.7319	0.5198	0.4814	4.2505
124.96	10.66	50.69	1.7819	7.1492	1.3083	1.7870	5.3622
126.49	12.19	57.96	2.4907	10.3211	2.6580	4.8137	5.5074
128.01	13.71	65.19	3.6587	14.9535	4.3194	10.0524	4.9011
129.54	15.24	72.47	5.1215	21.5929	6.1630	18.0866	3.5063
131.06	16.76	79.70	7.7841	31.1307	8.3743	29.0278	2.1029
132.28	17.98	85.50	9.9175	41.9024	10.6109	40.6004	1.3020
134.11	19.81	94.20	13.2590	63.0350	14.1570	63.3473	-0.3123
135.33 (FRL)	21.03	100.00	19.9093	83.1307	15.9321	81.7772	1.3535

Table 13: Vertical sediment distribution (Comparison between 1958 and 2021 survey data)

Note: In **Table 13**, the cumulative capacity calculated from 2021 survey data for elevations between 114.30m and 120.39m is zero. This is mainly because a minimum elevation of 121.50m was observed in the 2021 survey, which indicates that the minimum elevation observed in the reservoir over the years (from 1958 to 2021) has increased mainly due to sedimentation. Thus, it can be understood that the reservoir was filled with silt between elevations 114.30m and 121.50m from the year 1958 to 2021. Hence the cumulative capacity calculated in 2021 between elevations 114.30m and 120.39m is zero.

Vertical sediment distribution (1989 vs 2021):

Vertical sediment distribution at particular elevations obtained on comparing the differences in capacities between the results from the surveys carried out in the year 1989 and 2021 are tabulated in **Table 14**.

From **Table 14**, it is understood that the gross capacity of the reservoir has increased which may be due to sediment erosion that has mainly occurred at elevations 133.0m, 134.0m and 135.33m (refer **Table 14**).

Elevation (Above MSL, m)	Depth (m)	Cumulative Depth %	Area 1989 (M.Sq.m or Sq.Km)	Cumulative Capacity 1989 (M.cu.m)	Area 2021 (M.Sq.m or Sq.Km)	Cumulative Capacity 2021 (M.cu.m)	Sediment Deposit (M.cu.m)
120.39	0.00	0.00	0.0007	0.0000	0.0000	0.0000	0.0000
121.00	0.61	4.08	0.2444	0.0497	0.0000	0.0000	0.0497
122.00	1.61	10.78	0.3387	0.4387	0.1281	0.0239	0.4148
123.00	2.61	17.47	0.5331	0.7604	0.3851	0.2858	0.4746
124.11	3.72	24.90	1.6500	1.9154	0.7959	0.9145	1.0009
125.00	4.61	30.86	1.8200	3.4554	1.3424	1.8399	1.6155
126.00	5.61	37.55	2.2000	5.6254	2.2282	3.6198	2.0056
127.00	6.61	44.24	2.7000	7.8954	3.1727	6.2963	1.5991
128.00	7.61	50.94	3.7500	11.2084	4.3072	10.0092	1.1992
129.00	8.61	57.63	5.3000	15.5624	5.5179	14.9364	0.6260
130.00	9.61	64.32	6.7820	21.7824	6.7720	21.0599	0.7225
131.00	10.61	71.02	8.2900	29.1324	8.2684	28.5285	0.6039
132.00	11.61	77.71	9.8000	38.3634	10.0431	37.7069	0.6565
133.00	12.61	84.40	11.1000	48.6624	12.0958	48.8002	-0.1378
134.00	13.61	91.10	11.4000	60.2304	13.9522	61.8014	-1.5710
135.33 (FRL)	14.94	100.00	12.0000	75.7894	15.9321	81.7772	-5.9878

Table 14: Vertical sediment distribution (Comparison between 1989 and 2021 survey data)

Note: In **Table 14**, the cumulative capacity calculated from 2021 survey data at elevations 120.39m and 121.0m is zero. This is mainly because a minimum elevation of 121.50m was observed in 2021 survey which indicates that the minimum elevation observed in the reservoir over the years (from 1989 to 2021) has increased mainly due to sedimentation. Thus, it can be understood that the reservoir was filled with silt between elevations 120.39m and 121.50m from the year 1989 to 2021. Hence the cumulative capacity calculated in 2021 at elevations 120.39m and 121.0m is zero.

8.12 CONTROL OF SEDIMENTATION IN RESERVOIRS

Sedimentation in a reservoir is a natural process which affects the capacity of the reservoir. Excess deposition of sediment directly affects the useful capacity of the reservoir based on the project requirements like irrigation, hydroelectric power, flood control etc. The rate of deposition of sediment largely depends on the annual sediment load carried by the streams and up to what extent the sediment is retained in the reservoir. This, in turn, depends upon a number of factors such as the area and nature of the catchment, level use pattern (cultivation practices, grazing, logging, construction activities and conservation practices), rainfall pattern, storage capacity, period of storage in relation to the sediment load of the stream, particle size distribution in the suspended sediment, channel hydraulics, location and size of sluices, outlet works, configuration of the reservoir, and the method and purpose of releases through the dam. An appropriate approach to these factors mentioned above is essential for efficient control of sedimentation and therefore to extend the life of the reservoir.

There are numerous techniques developed to control the sedimentation in reservoirs, broadly classified as:

I. Suitable design of reservoir
II. Restrict the sediment inflow
III. Limit the sediment deposition
IV. Regular removal of deposited sediment

8.12.1 Suitable design of reservoir

The volume of discharge directly affects the rate of sedimentation. The rate of sedimentation increases with the volume of discharge. The higher deposition of sediment within a reservoir increases the surface area of the water, thereby resulting in greater loss of water by evaporation. This will ultimately decrease of storage capacity which in turn lowers the trap efficiency of the reservoir.

The capacity of the reservoir and the size and characteristics of the reservoir and its drainage area are the most important factors governing the annual rate of accumulation of sediment. Periodic reservoir sediment surveys provide information about the rate of sediment deposited, hence can enable us to make necessary steps to limit the same. The sedimentation may take place not only in the dead storage area of a reservoir; reservoir studies have revealed significant deposition of sediment in the live storage area of a reservoir as well.

The capacity of reservoirs largely depends on various factors. Hence the following points need to be considered for their optimum design.

- Topographical, geological and geomorphological factors which directly affect the sediment yield
- Sediment delivery characteristics of the channel system
- The efficiency of the reservoir as a sediment trap
- The ratio of capacity of the reservoir to the inflow
- Configuration of the reservoir
- Method of operation of the reservoir
- Provisions for silt exclusion

8.12.2 Restrict the sediment inflow

The sediment inflow to the reservoirs can be controlled by proper watershed management and soil conservation measures to check production and transport of sediment to the catchment area. Also adopt adequate ppreventive measures to check the inflow of sediment into the reservoir. Soil conservation involves the prevention of loss of the topmost layer of the soil from erosion or prevention of reduced fertility caused by over usage, acidification, salinization or other chemical soil contamination. The soil conservation measures are further sub-divided as

- Engineering
- Agronomy
- Forestry

Engineering methods

Check dams

One of the methods of soil conservation is the use of check dams. A check dam is a small dam which can be either temporary or permanent, built across a minor channel, swale, or drainage ditch. They are used to slow the velocity of concentrated water flows, a practice that helps reduce erosion.

Contour trenching and bunding

In the contour trenching method, the surrounding area of the reservoir is ploughed, like contour lines. These contour lines create a water break which reduces the formation of rills and gullies during times of heavy precipitation, allowing more time for the water to settle into the soil. Also, trenches can be artificially dug along the contour lines. Water flowing down the hill is retained by the trenches, and infiltrates the soil below. Manually dug trenches are smaller, machine dug trenches can be deeper. The dimensions and the format of the trenches should correspond to the local climate and soil conditions.

A similar practice is contour bunding where stones are placed around the contours of slopes. Contour bunding or contour bundling, and contour farming involves the placement of lines of stones along the natural rises of a landscape. These techniques help to capture and hold rainfall before it can become runoff. Contour bunds also help to control soil erosion.

Gully Plugging

A gully plug is a small, temporary or permanent dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows. These dams can be constructed using locally available materials. These small dams reduce the speed of water flow and minimise the erosive power of runoff. They also promote the deposition of eroded materials to further stabilise the gullies.

Agronomy methods

Agronomic conservation measures function by reducing the impact of raindrops through interception and thus reducing soil erosion and increasing infiltration rates, and also reducing surface runoff and soil erosion. The major agronomic soil and water conservation practices are strip cropping, mixed cropping, intercropping, fallowing, mulching, contour ploughing, crop rotation, conservation tillage, and agroforestry.

Forestry methods

Forestry measures include forest conservancy, control on grazing, lumbering operations and forest fires along with management and protection of forest plantations.

8.12.3 Limit sediment deposition

The amount of suspended sediment is comparatively large during and just after flood flow. The settlement of sediment in the reservoir can be controlled by adequate operation of outlets in such a manner as to permit selective withdrawals of water having a higher-than-average sediment content. Thus, more water wasted at peak time of inflow will result a low level of sediment to deposit in the reservoir. There are two methods:

Density Current

Water at various levels of a reservoir often contains radically different concentrations of suspended sediment, particularly during and after flood flows and if all waste-water could be withdrawn at those levels where the concentration is highest, a significant amount of sediment might be removed from the reservoir. The density differences between the sediment-laden inflow and the clear water in the reservoir

leads to a turbidity current which plunges beneath the clear water and moves towards the dam as a submerged current. The proper allocation of gates or sluices can remove a significant amount of sediment-saturated water and therefore can reduce the amount of sedimentation.

Waste-Water Release

This method is applicable only when a reservoir is of such a size that a small part of large flood flows will fill it. A series of outlets at various elevations can eject sediment-saturated water. This method, which can remove considerable amount of sediment from the reservoir through proper gate control, will differ greatly with different locations. The drawback of this method is that waste-water release is only possible when water can be or should be wasted.

8.12.4 Regular removal of deposited sediment

Removal of accumulated sediment is considered as the last resort as the operations are very expensive unless the excavated sediment is economically usable. The removal of sediment deposits may be accomplished by a variety of mechanical and hydraulic methods, such as excavation, dredging, draining and flushing, sluicing aided by such measures as hydraulic or mechanical agitation or blasting of the sediment.

Excavation

Excavation is the removal of the sediment by hand or power operated shovel, dragline scraper or other mechanical means after draining most of the water. The excavation of silt and clay which constitute most of the material in larger reservoirs is more difficult than the excavation of sand and gravel. Fine-textured sediment cannot be excavated easily from larger reservoirs unless it is relatively fluid or relatively compact.

Dredging

In this method, the deposit is removed from the bottom of the reservoir irrespective of the level of storage using mechanical or hydraulic equipment. The various types of dredging are mechanical dredging by bucket, suction dredging with floating pipeline and a pump on a barge and siphon dredging with a floating pipe extending over the dam or connected to an opening in the dam and with a pump on a barge.

Draining and flushing

This method, also called flood sluicing, involves a relatively slow release of all stored water in a reservoir through gates or valves located near the bottom of the dam and the maintenance thereafter of open outlets for a shorter or longer period during which normal stream flow cuts into or is directed against the sediment deposits.

Sluicing with Controlled Water

In this method the controlled water supply permits choosing the time of sluicing more advantageously and the water may be directed more effectively against the sediment deposits. While the flood sluicing depends either on the occurrence of flood or on being able to release rapidly all of a full or nearly full supply of water in the main reservoir. The advantage of this method is that generally more sediment can be removed per unit of water used than in flood scouring or draining and flushing.

Sluicing with Hydraulics and Mechanical Agitation

In this method, stirring up, breaking up or moving deposits of a sediment into a stream current moving through a drained reservoir basin or into a full reservoir will tend to make the removal of sediment from the reservoir more complete. Wherever draining, flushing or sluicing appear to be warranted, the additional use of hydraulic means for stirring up the sediment deposits, or sloughing them off, into a stream flowing through the reservoir basin should be considered.

9 CONCLUSIONS

- The construction of Machhu-1 reservoir was completed in 1959, with an area of 19.91 M.sq.m at FRL – 135.33m above MSL. Machhu-1 reservoir has a catchment area of 730 sq.km. The gross storage at FRL (135.33m) and dead storage at DSL (120.39m) during the 1958 survey were found to be 83.1307 M.cu.m and 1.7114 M.cu.m respectively (Source: Sedimentation Studies in Machhu-1 Irrigation Scheme, Nov 1990).
- Based on the survey report (Sedimentation Studies in Machhu-1 Irrigation Scheme, Nov 1990) provided by the client, it is understood that two capacity surveys: one in the year 1958 and another in 1989 were conducted using hydrographic and dry bed survey techniques prior to the current survey by OSaS in the year 2021. Hence, the survey data between 1958 vs 2021 and 1989 vs 2021 have been compared to draw the conclusions on loss/increase of reservoir capacity and rate of siltation/erosion that has occurred over the years.
- From the 2021 survey results, a minimum elevation of 121.3m and a maximum elevation of 135.3m above MSL was observed in the northern and north-western portion of the survey area respectively within the bathymetric section. A minimum elevation of 130.3m and a maximum elevation of 151.8m was observed in the south-southwestern and east-northeastern portion of the survey area respectively within the topographic section. A description of the bathymetric and topographic features observed in the surveyed area have been provided in section 7.1 of this report.
- The topographic survey was extended till the elevation of 141.0m above MSL as instructed by client. In some areas, this elevation of 141.0m was not achievable, as a level lower than that of 141.0m extended and continued far beyond the limits of the survey area (mainly due to the continuation of flat areas for long distances).
- The elevation area capacity curves showing the comparison between the capacity and area data at particular elevations (above MSL) for the years 1958, 1989 and 2021 are shown in **Figure 7**.
- Vertical sediment distribution at particular elevations (above MSL) obtained on comparing the differences in capacities between the results from the surveys carried out in the years 1958 and 2021 is tabulated in **Table 13** and between the years 1989 and 2021 in **Table 14**.
- The comparison between the results obtained from the surveys carried out in 1958 and 2021 (63 years) indicates that siltation has occurred in the reservoir over the past 63 years and the rate of siltation is calculated to be 0.3 Ha.m/100sq.km./year. Annual percentage loss of gross storage capacity and dead storage capacity are 0.03% and 1.59% respectively. The annual percentage increase in live storage capacity is 0.01%. The details and calculations are provided in section **8.7**.
- The comparison between the results obtained from the surveys carried out in 1989 and 2021 (32 years) indicates that erosion has occurred in the reservoir over the past 32 years and the rate of erosion is calculated to be 2.6 Ha.m/100sq.km./year. Annual percentage increase of gross storage capacity, live storage capacity and dead storage capacity are 0.25%, 0.25% and 0.00% respectively. The details and calculations are provided in section **8.9**.
- It is observed that a minimum elevation of 114.30m (**Table 9**) and 120.39m (**Table 10**) was observed in the surveys carried out in 1958 and 1989 respectively. Further, in the recent survey conducted in 2021, a minimum elevation of 121.50m was observed (negligible/zero value of cumulative capacity observed between 121.30m and 121.50, so a minimum value of 121.50m is considered for capacity calculations) Hence, it can be said that the minimum elevation observed in the reservoir over the years (from 1958 to 2021) has increased, which indicates that sedimentation has occurred over the years. Thus it can be understood that the reservoir was filled with silt between elevations 114.30m and 121.50m from the year 1958 to 2021.

10 REFERENCES

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Annexure - 1

Elevation-Area-Capacity Table (2021)

Machhu-1 Reservoir

Note: In the table below, some values in the column "Volume (M.Cu.m)" under gross capacity and live capacity headings at particular elevation levels are shown as 0.0000. However, there is a negligible value beyond the 4th decimal place which is not seen as the values in the table have been rounded up to 4 decimal places. Hence, during conversion of volume from M.Cu.m to M.Cu.ft, a value is observed in the "Volume (M.Cu.ft)" column even though there is a zero value (0.0000) in the corresponding "Volume (M.Cu.m)" column at that level.

E.g., at elevation level 121.50m a value of 0.0000 is shown in the column "Volume (M.Cu.m)" under gross capacity heading. However, the actual value at that level is 0.000008 which is rounded up to 4 decimal places hence the value 0.0000 is seen in the column. Therefore, a value of 0.0003 is shown in the column "Volume (M.Cu.ft)" under gross capacity at that level, even though a value of 0.0000 (actual value without rounding of decimal places is:0.000008) is present in the column "Volume(M.Cu.m)".

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)		
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)	
394.98	120.39	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**DSL**
398.62	121.50	0.0012	0.0001	0.0003	0.0000	0.0003	0.0000	
398.65	121.51	0.0013	0.0001	0.0003	0.0000	0.0003	0.0000	
398.69	121.52	0.0015	0.0001	0.0004	0.0000	0.0004	0.0000	
398.72	121.53	0.0017	0.0002	0.0004	0.0000	0.0004	0.0000	
398.75	121.54	0.0019	0.0002	0.0005	0.0000	0.0005	0.0000	
398.79	121.55	0.0021	0.0002	0.0005	0.0000	0.0005	0.0000	
398.82	121.56	0.0024	0.0002	0.0006	0.0000	0.0006	0.0000	
398.85	121.57	0.0026	0.0002	0.0007	0.0000	0.0007	0.0000	
398.88	121.58	0.0030	0.0003	0.0008	0.0000	0.0008	0.0000	
398.92	121.59	0.0033	0.0003	0.0009	0.0000	0.0009	0.0000	
398.95	121.60	0.0525	0.0049	0.0010	0.0000	0.0010	0.0000	
398.98	121.61	0.0656	0.0061	0.0029	0.0001	0.0029	0.0001	
399.02	121.62	0.0792	0.0074	0.0053	0.0002	0.0053	0.0002	
399.05	121.63	0.0931	0.0086	0.0081	0.0002	0.0081	0.0002	
399.08	121.64	0.1078	0.0100	0.0114	0.0003	0.0114	0.0003	
399.11	121.65	0.1236	0.0115	0.0152	0.0004	0.0152	0.0004	
399.15	121.66	0.1404	0.0130	0.0196	0.0006	0.0196	0.0006	
399.18	121.67	0.1584	0.0147	0.0245	0.0007	0.0245	0.0007	
399.21	121.68	0.1777	0.0165	0.0300	0.0008	0.0300	0.0008	
399.25	121.69	0.1985	0.0184	0.0361	0.0010	0.0361	0.0010	
399.28	121.70	0.3465	0.0322	0.0430	0.0012	0.0430	0.0012	
399.31	121.71	0.3758	0.0349	0.0549	0.0016	0.0549	0.0016	
399.34	121.72	0.4018	0.0373	0.0676	0.0019	0.0676	0.0019	
399.38	121.73	0.4264	0.0396	0.0812	0.0023	0.0812	0.0023	
399.41	121.74	0.4490	0.0417	0.0956	0.0027	0.0956	0.0027	
399.44	121.75	0.4707	0.0437	0.1107	0.0031	0.1107	0.0031	
399.48	121.76	0.4924	0.0457	0.1265	0.0036	0.1265	0.0036	
399.51	121.77	0.5134	0.0477	0.1430	0.0040	0.1430	0.0040	
399.54	121.78	0.5341	0.0496	0.1601	0.0045	0.1601	0.0045	

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
399.57	121.79	0.5547	0.0515	0.1780	0.0050	0.1780	0.0050
399.61	121.80	0.6594	0.0613	0.1966	0.0056	0.1966	0.0056
399.64	121.81	0.6887	0.0640	0.2187	0.0062	0.2187	0.0062
399.67	121.82	0.7177	0.0667	0.2417	0.0068	0.2417	0.0068
399.70	121.83	0.7466	0.0694	0.2658	0.0075	0.2658	0.0075
399.74	121.84	0.7755	0.0721	0.2907	0.0082	0.2907	0.0082
399.77	121.85	0.8047	0.0748	0.3166	0.0090	0.3166	0.0090
399.80	121.86	0.8340	0.0775	0.3435	0.0097	0.3435	0.0097
399.84	121.87	0.8636	0.0802	0.3714	0.0105	0.3714	0.0105
399.87	121.88	0.8934	0.0830	0.4002	0.0113	0.4002	0.0113
399.90	121.89	0.9235	0.0858	0.4300	0.0122	0.4300	0.0122
399.93	121.90	1.0276	0.0955	0.4608	0.0130	0.4608	0.0130
399.97	121.91	1.0569	0.0982	0.4950	0.0140	0.4950	0.0140
400.00	121.92	1.0857	0.1009	0.5301	0.0150	0.5301	0.0150
400.03	121.93	1.1139	0.1035	0.5662	0.0160	0.5662	0.0160
400.07	121.94	1.1415	0.1061	0.6032	0.0171	0.6032	0.0171
400.10	121.95	1.1686	0.1086	0.6411	0.0182	0.6411	0.0182
400.13	121.96	1.1952	0.1110	0.6799	0.0193	0.6799	0.0193
400.16	121.97	1.2216	0.1135	0.7196	0.0204	0.7196	0.0204
400.20	121.98	1.2476	0.1159	0.7601	0.0215	0.7601	0.0215
400.23	121.99	1.2732	0.1183	0.8014	0.0227	0.8014	0.0227
400.26	122.00	1.3785	0.1281	0.8436	0.0239	0.8436	0.0239
400.30	122.01	1.4064	0.1307	0.8893	0.0252	0.8893	0.0252
400.33	122.02	1.4344	0.1333	0.9359	0.0265	0.9359	0.0265
400.36	122.03	1.4625	0.1359	0.9834	0.0278	0.9834	0.0278
400.39	122.04	1.4907	0.1385	1.0318	0.0292	1.0318	0.0292
400.43	122.05	1.5189	0.1411	1.0812	0.0306	1.0812	0.0306
400.46	122.06	1.5471	0.1437	1.1315	0.0320	1.1315	0.0320
400.49	122.07	1.5753	0.1464	1.1827	0.0335	1.1827	0.0335
400.52	122.08	1.6035	0.1490	1.2349	0.0350	1.2349	0.0350
400.56	122.09	1.6320	0.1516	1.2880	0.0365	1.2880	0.0365
400.59	122.10	1.7043	0.1583	1.3420	0.0380	1.3420	0.0380
400.62	122.11	1.7276	0.1605	1.3983	0.0396	1.3983	0.0396
400.66	122.12	1.7508	0.1627	1.4553	0.0412	1.4553	0.0412
400.69	122.13	1.7735	0.1648	1.5131	0.0428	1.5131	0.0428
400.72	122.14	1.7959	0.1668	1.5717	0.0445	1.5717	0.0445
400.75	122.15	1.8178	0.1689	1.6310	0.0462	1.6310	0.0462
400.79	122.16	1.8394	0.1709	1.6910	0.0479	1.6910	0.0479
400.82	122.17	1.8608	0.1729	1.7517	0.0496	1.7517	0.0496
400.85	122.18	1.8821	0.1748	1.8131	0.0513	1.8131	0.0513
400.89	122.19	1.9034	0.1768	1.8752	0.0531	1.8752	0.0531
400.92	122.20	1.9729	0.1833	1.9380	0.0549	1.9380	0.0549

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
400.95	122.21	1.9965	0.1855	2.0031	0.0567	2.0031	0.0567
400.98	122.22	2.0197	0.1876	2.0690	0.0586	2.0690	0.0586
401.02	122.23	2.0424	0.1897	2.1356	0.0605	2.1356	0.0605
401.05	122.24	2.0648	0.1918	2.2030	0.0624	2.2030	0.0624
401.08	122.25	2.0867	0.1939	2.2711	0.0643	2.2711	0.0643
401.12	122.26	2.1083	0.1959	2.3399	0.0663	2.3399	0.0663
401.15	122.27	2.1297	0.1979	2.4094	0.0682	2.4094	0.0682
401.18	122.28	2.1510	0.1998	2.4796	0.0702	2.4796	0.0702
401.21	122.29	2.1724	0.2018	2.5506	0.0722	2.5506	0.0722
401.25	122.30	2.2557	0.2096	2.6222	0.0743	2.6222	0.0743
401.28	122.31	2.2844	0.2122	2.6967	0.0764	2.6967	0.0764
401.31	122.32	2.3127	0.2149	2.7721	0.0785	2.7721	0.0785
401.35	122.33	2.3411	0.2175	2.8484	0.0807	2.8484	0.0807
401.38	122.34	2.3695	0.2201	2.9257	0.0828	2.9257	0.0828
401.41	122.35	2.3980	0.2228	3.0039	0.0851	3.0039	0.0851
401.44	122.36	2.4265	0.2254	3.0830	0.0873	3.0830	0.0873
401.48	122.37	2.4549	0.2281	3.1631	0.0896	3.1631	0.0896
401.51	122.38	2.4832	0.2307	3.2441	0.0919	3.2441	0.0919
401.54	122.39	2.5111	0.2333	3.3261	0.0942	3.3261	0.0942
401.57	122.40	2.6149	0.2429	3.4089	0.0965	3.4089	0.0965
401.61	122.41	2.6396	0.2452	3.4951	0.0990	3.4951	0.0990
401.64	122.42	2.6643	0.2475	3.5821	0.1014	3.5821	0.1014
401.67	122.43	2.6889	0.2498	3.6699	0.1039	3.6699	0.1039
401.71	122.44	2.7134	0.2521	3.7585	0.1064	3.7585	0.1064
401.74	122.45	2.7379	0.2544	3.8480	0.1090	3.8480	0.1090
401.77	122.46	2.7624	0.2566	3.9382	0.1115	3.9382	0.1115
401.80	122.47	2.7868	0.2589	4.0292	0.1141	4.0292	0.1141
401.84	122.48	2.8111	0.2612	4.1210	0.1167	4.1210	0.1167
401.87	122.49	2.8355	0.2634	4.2137	0.1193	4.2137	0.1193
401.90	122.50	2.9112	0.2705	4.3071	0.1220	4.3071	0.1220
401.94	122.51	2.9361	0.2728	4.4030	0.1247	4.4030	0.1247
401.97	122.52	2.9610	0.2751	4.4998	0.1274	4.4998	0.1274
402.00	122.53	2.9859	0.2774	4.5973	0.1302	4.5973	0.1302
402.03	122.54	3.0107	0.2797	4.6957	0.1330	4.6957	0.1330
402.07	122.55	3.0355	0.2820	4.7949	0.1358	4.7949	0.1358
402.10	122.56	3.0603	0.2843	4.8949	0.1386	4.8949	0.1386
402.13	122.57	3.0851	0.2866	4.9957	0.1415	4.9957	0.1415
402.17	122.58	3.1099	0.2889	5.0973	0.1443	5.0973	0.1443
402.20	122.59	3.1346	0.2912	5.1997	0.1472	5.1997	0.1472
402.23	122.60	3.1809	0.2955	5.3030	0.1502	5.3030	0.1502
402.26	122.61	3.2034	0.2976	5.4077	0.1531	5.4077	0.1531
402.30	122.62	3.2258	0.2997	5.5132	0.1561	5.5132	0.1561

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
402.33	122.63	3.2480	0.3018	5.6194	0.1591	5.6194	0.1591
402.36	122.64	3.2702	0.3038	5.7263	0.1622	5.7263	0.1622
402.40	122.65	3.2921	0.3058	5.8339	0.1652	5.8339	0.1652
402.43	122.66	3.3140	0.3079	5.9423	0.1683	5.9423	0.1683
402.46	122.67	3.3356	0.3099	6.0514	0.1714	6.0514	0.1714
402.49	122.68	3.3572	0.3119	6.1612	0.1745	6.1612	0.1745
402.53	122.69	3.3786	0.3139	6.2717	0.1776	6.2717	0.1776
402.56	122.70	3.4210	0.3178	6.3829	0.1807	6.3829	0.1807
402.59	122.71	3.4423	0.3198	6.4955	0.1839	6.4955	0.1839
402.62	122.72	3.4634	0.3218	6.6088	0.1871	6.6088	0.1871
402.66	122.73	3.4844	0.3237	6.7227	0.1904	6.7227	0.1904
402.69	122.74	3.5053	0.3257	6.8374	0.1936	6.8374	0.1936
402.72	122.75	3.5260	0.3276	6.9527	0.1969	6.9527	0.1969
402.76	122.76	3.5467	0.3295	7.0688	0.2002	7.0688	0.2002
402.79	122.77	3.5672	0.3314	7.1855	0.2035	7.1855	0.2035
402.82	122.78	3.5876	0.3333	7.3028	0.2068	7.3028	0.2068
402.85	122.79	3.6080	0.3352	7.4209	0.2101	7.4209	0.2101
402.89	122.80	3.6530	0.3394	7.5396	0.2135	7.5396	0.2135
402.92	122.81	3.6753	0.3415	7.6598	0.2169	7.6598	0.2169
402.95	122.82	3.6979	0.3435	7.7807	0.2203	7.7807	0.2203
402.99	122.83	3.7207	0.3457	7.9024	0.2238	7.9024	0.2238
403.02	122.84	3.7436	0.3478	8.0249	0.2272	8.0249	0.2272
403.05	122.85	3.7668	0.3500	8.1481	0.2307	8.1481	0.2307
403.08	122.86	3.7903	0.3521	8.2720	0.2342	8.2720	0.2342
403.12	122.87	3.8139	0.3543	8.3968	0.2378	8.3968	0.2378
403.15	122.88	3.8378	0.3565	8.5223	0.2413	8.5223	0.2413
403.18	122.89	3.8618	0.3588	8.6486	0.2449	8.6486	0.2449
403.22	122.90	3.9046	0.3627	8.7757	0.2485	8.7757	0.2485
403.25	122.91	3.9263	0.3648	8.9042	0.2521	8.9042	0.2521
403.28	122.92	3.9480	0.3668	9.0333	0.2558	9.0333	0.2558
403.31	122.93	3.9698	0.3688	9.1632	0.2595	9.1632	0.2595
403.35	122.94	3.9916	0.3708	9.2938	0.2632	9.2938	0.2632
403.38	122.95	4.0134	0.3729	9.4251	0.2669	9.4251	0.2669
403.41	122.96	4.0352	0.3749	9.5572	0.2706	9.5572	0.2706
403.44	122.97	4.0570	0.3769	9.6899	0.2744	9.6899	0.2744
403.48	122.98	4.0789	0.3789	9.8234	0.2782	9.8234	0.2782
403.51	122.99	4.1008	0.3810	9.9576	0.2820	9.9576	0.2820
403.54	123.00	4.1456	0.3851	10.0925	0.2858	10.0925	0.2858
403.58	123.01	4.1679	0.3872	10.2288	0.2896	10.2288	0.2896
403.61	123.02	4.1902	0.3893	10.3659	0.2935	10.3659	0.2935
403.64	123.03	4.2124	0.3913	10.5038	0.2974	10.5038	0.2974
403.67	123.04	4.2346	0.3934	10.6423	0.3014	10.6423	0.3014

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
403.71	123.05	4.2569	0.3955	10.7816	0.3053	10.7816	0.3053
403.74	123.06	4.2791	0.3975	10.9217	0.3093	10.9217	0.3093
403.77	123.07	4.3013	0.3996	11.0624	0.3133	11.0624	0.3133
403.81	123.08	4.3235	0.4017	11.2039	0.3173	11.2039	0.3173
403.84	123.09	4.3456	0.4037	11.3461	0.3213	11.3461	0.3213
403.87	123.10	4.3855	0.4074	11.4891	0.3253	11.4891	0.3253
403.90	123.11	4.4100	0.4097	11.6333	0.3294	11.6333	0.3294
403.94	123.12	4.4349	0.4120	11.7784	0.3335	11.7784	0.3335
403.97	123.13	4.4602	0.4144	11.9243	0.3377	11.9243	0.3377
404.00	123.14	4.4859	0.4168	12.0711	0.3418	12.0711	0.3418
404.04	123.15	4.5121	0.4192	12.2187	0.3460	12.2187	0.3460
404.07	123.16	4.5386	0.4216	12.3672	0.3502	12.3672	0.3502
404.10	123.17	4.5655	0.4242	12.5165	0.3544	12.5165	0.3544
404.13	123.18	4.5929	0.4267	12.6668	0.3587	12.6668	0.3587
404.17	123.19	4.6206	0.4293	12.8179	0.3630	12.8179	0.3630
404.20	123.20	4.6945	0.4361	12.9700	0.3673	12.9700	0.3673
404.23	123.21	4.7226	0.4387	13.1244	0.3716	13.1244	0.3716
404.27	123.22	4.7509	0.4414	13.2798	0.3760	13.2798	0.3760
404.30	123.23	4.7794	0.4440	13.4362	0.3805	13.4362	0.3805
404.33	123.24	4.8081	0.4467	13.5935	0.3849	13.5935	0.3849
404.36	123.25	4.8370	0.4494	13.7517	0.3894	13.7517	0.3894
404.40	123.26	4.8660	0.4521	13.9108	0.3939	13.9108	0.3939
404.43	123.27	4.8953	0.4548	14.0710	0.3984	14.0710	0.3984
404.46	123.28	4.9247	0.4575	14.2321	0.4030	14.2321	0.4030
404.49	123.29	4.9544	0.4603	14.3941	0.4076	14.3941	0.4076
404.53	123.30	5.0511	0.4693	14.5572	0.4122	14.5572	0.4122
404.56	123.31	5.0869	0.4726	14.7235	0.4169	14.7235	0.4169
404.59	123.32	5.1229	0.4759	14.8909	0.4217	14.8909	0.4217
404.63	123.33	5.1590	0.4793	15.0596	0.4264	15.0596	0.4264
404.66	123.34	5.1953	0.4827	15.2295	0.4313	15.2295	0.4313
404.69	123.35	5.2317	0.4860	15.4005	0.4361	15.4005	0.4361
404.72	123.36	5.2683	0.4894	15.5728	0.4410	15.5728	0.4410
404.76	123.37	5.3051	0.4929	15.7462	0.4459	15.7462	0.4459
404.79	123.38	5.3420	0.4963	15.9209	0.4508	15.9209	0.4508
404.82	123.39	5.3790	0.4997	16.0967	0.4558	16.0967	0.4558
404.86	123.40	5.4645	0.5077	16.2738	0.4608	16.2738	0.4608
404.89	123.41	5.4976	0.5107	16.4536	0.4659	16.4536	0.4659
404.92	123.42	5.5305	0.5138	16.6346	0.4710	16.6346	0.4710
404.95	123.43	5.5631	0.5168	16.8165	0.4762	16.8165	0.4762
404.99	123.44	5.5954	0.5198	16.9996	0.4814	16.9996	0.4814
405.02	123.45	5.6275	0.5228	17.1837	0.4866	17.1837	0.4866
405.05	123.46	5.6594	0.5258	17.3688	0.4918	17.3688	0.4918

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
405.09	123.47	5.6910	0.5287	17.5550	0.4971	17.5550	0.4971
405.12	123.48	5.7223	0.5316	17.7423	0.5024	17.7423	0.5024
405.15	123.49	5.7534	0.5345	17.9305	0.5077	17.9305	0.5077
405.18	123.50	5.8197	0.5407	18.1198	0.5131	18.1198	0.5131
405.22	123.51	5.8507	0.5436	18.3112	0.5185	18.3112	0.5185
405.25	123.52	5.8819	0.5464	18.5037	0.5240	18.5037	0.5240
405.28	123.53	5.9131	0.5493	18.6972	0.5294	18.6972	0.5294
405.31	123.54	5.9445	0.5523	18.8917	0.5350	18.8917	0.5350
405.35	123.55	5.9759	0.5552	19.0872	0.5405	19.0872	0.5405
405.38	123.56	6.0074	0.5581	19.2838	0.5461	19.2838	0.5461
405.41	123.57	6.0389	0.5610	19.4814	0.5517	19.4814	0.5517
405.45	123.58	6.0706	0.5640	19.6801	0.5573	19.6801	0.5573
405.48	123.59	6.1023	0.5669	19.8798	0.5629	19.8798	0.5629
405.51	123.60	6.1703	0.5732	20.0805	0.5686	20.0805	0.5686
405.54	123.61	6.2011	0.5761	20.2834	0.5744	20.2834	0.5744
405.58	123.62	6.2320	0.5790	20.4874	0.5801	20.4874	0.5801
405.61	123.63	6.2628	0.5818	20.6923	0.5859	20.6923	0.5859
405.64	123.64	6.2937	0.5847	20.8983	0.5918	20.8983	0.5918
405.68	123.65	6.3246	0.5876	21.1053	0.5976	21.1053	0.5976
405.71	123.66	6.3556	0.5905	21.3133	0.6035	21.3133	0.6035
405.74	123.67	6.3866	0.5933	21.5224	0.6094	21.5224	0.6094
405.77	123.68	6.4176	0.5962	21.7324	0.6154	21.7324	0.6154
405.81	123.69	6.4486	0.5991	21.9435	0.6214	21.9435	0.6214
405.84	123.70	6.5474	0.6083	22.1555	0.6274	22.1555	0.6274
405.87	123.71	6.5872	0.6120	22.3710	0.6335	22.3710	0.6335
405.91	123.72	6.6271	0.6157	22.5878	0.6396	22.5878	0.6396
405.94	123.73	6.6671	0.6194	22.8059	0.6458	22.8059	0.6458
405.97	123.74	6.7071	0.6231	23.0252	0.6520	23.0252	0.6520
406.00	123.75	6.7472	0.6268	23.2460	0.6583	23.2460	0.6583
406.04	123.76	6.7875	0.6306	23.4680	0.6645	23.4680	0.6645
406.07	123.77	6.8278	0.6343	23.6913	0.6709	23.6913	0.6709
406.10	123.78	6.8682	0.6381	23.9160	0.6772	23.9160	0.6772
406.14	123.79	6.9086	0.6418	24.1420	0.6836	24.1420	0.6836
406.17	123.80	7.0219	0.6524	24.3693	0.6901	24.3693	0.6901
406.20	123.81	7.0650	0.6564	24.6004	0.6966	24.6004	0.6966
406.23	123.82	7.1085	0.6604	24.8329	0.7032	24.8329	0.7032
406.27	123.83	7.1522	0.6645	25.0668	0.7098	25.0668	0.7098
406.30	123.84	7.1963	0.6686	25.3022	0.7165	25.3022	0.7165
406.33	123.85	7.2408	0.6727	25.5391	0.7232	25.5391	0.7232
406.36	123.86	7.2855	0.6768	25.7773	0.7299	25.7773	0.7299
406.40	123.87	7.3306	0.6810	26.0171	0.7367	26.0171	0.7367
406.43	123.88	7.3761	0.6853	26.2584	0.7436	26.2584	0.7436

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
406.46	123.89	7.4218	0.6895	26.5011	0.7504	26.5011	0.7504
406.50	123.90	7.5664	0.7029	26.7454	0.7573	26.7454	0.7573
406.53	123.91	7.6085	0.7069	26.9943	0.7644	26.9943	0.7644
406.56	123.92	7.6510	0.7108	27.2446	0.7715	27.2446	0.7715
406.59	123.93	7.6937	0.7148	27.4963	0.7786	27.4963	0.7786
406.63	123.94	7.7367	0.7188	27.7495	0.7858	27.7495	0.7858
406.66	123.95	7.7799	0.7228	28.0040	0.7930	28.0040	0.7930
406.69	123.96	7.8234	0.7268	28.2600	0.8002	28.2600	0.8002
406.73	123.97	7.8672	0.7309	28.5173	0.8075	28.5173	0.8075
406.76	123.98	7.9113	0.7350	28.7762	0.8148	28.7762	0.8148
406.79	123.99	7.9556	0.7391	29.0365	0.8222	29.0365	0.8222
406.82	124.00	8.0598	0.7488	29.2982	0.8296	29.2982	0.8296
406.86	124.01	8.1033	0.7528	29.5633	0.8371	29.5633	0.8371
406.89	124.02	8.1468	0.7569	29.8299	0.8447	29.8299	0.8447
406.92	124.03	8.1902	0.7609	30.0979	0.8523	30.0979	0.8523
406.96	124.04	8.2336	0.7649	30.3673	0.8599	30.3673	0.8599
406.99	124.05	8.2769	0.7690	30.6382	0.8676	30.6382	0.8676
407.02	124.06	8.3203	0.7730	30.9104	0.8753	30.9104	0.8753
407.05	124.07	8.3635	0.7770	31.1841	0.8830	31.1841	0.8830
407.09	124.08	8.4068	0.7810	31.4592	0.8908	31.4592	0.8908
407.12	124.09	8.4500	0.7850	31.7357	0.8987	31.7357	0.8987
407.15	124.10	8.5216	0.7917	32.0137	0.9065	32.0137	0.9065
407.19	124.11	8.5669	0.7959	32.2940	0.9145	32.2940	0.9145
407.22	124.12	8.6123	0.8001	32.5758	0.9224	32.5758	0.9224
407.25	124.13	8.6578	0.8043	32.8591	0.9305	32.8591	0.9305
407.28	124.14	8.7034	0.8086	33.1439	0.9385	33.1439	0.9385
407.32	124.15	8.7491	0.8128	33.4302	0.9466	33.4302	0.9466
407.35	124.16	8.7949	0.8171	33.7180	0.9548	33.7180	0.9548
407.38	124.17	8.8408	0.8213	34.0073	0.9630	34.0073	0.9630
407.41	124.18	8.8869	0.8256	34.2981	0.9712	34.2981	0.9712
407.45	124.19	8.9330	0.8299	34.5904	0.9795	34.5904	0.9795
407.48	124.20	9.0178	0.8378	34.8843	0.9878	34.8843	0.9878
407.51	124.21	9.0686	0.8425	35.1810	0.9962	35.1810	0.9962
407.55	124.22	9.1194	0.8472	35.4793	1.0047	35.4793	1.0047
407.58	124.23	9.1703	0.8519	35.7794	1.0132	35.7794	1.0132
407.61	124.24	9.2212	0.8567	36.0811	1.0217	36.0811	1.0217
407.64	124.25	9.2721	0.8614	36.3844	1.0303	36.3844	1.0303
407.68	124.26	9.3230	0.8661	36.6895	1.0389	36.6895	1.0389
407.71	124.27	9.3739	0.8709	36.9962	1.0476	36.9962	1.0476
407.74	124.28	9.4248	0.8756	37.3045	1.0563	37.3045	1.0563
407.78	124.29	9.4758	0.8803	37.6146	1.0651	37.6146	1.0651
407.81	124.30	9.5683	0.8889	37.9263	1.0740	37.9263	1.0740

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
407.84	124.31	9.6224	0.8940	38.2411	1.0829	38.2411	1.0829
407.87	124.32	9.6764	0.8990	38.5577	1.0918	38.5577	1.0918
407.91	124.33	9.7303	0.9040	38.8761	1.1008	38.8761	1.1008
407.94	124.34	9.7842	0.9090	39.1962	1.1099	39.1962	1.1099
407.97	124.35	9.8380	0.9140	39.5181	1.1190	39.5181	1.1190
408.01	124.36	9.8917	0.9190	39.8417	1.1282	39.8417	1.1282
408.04	124.37	9.9453	0.9240	40.1671	1.1374	40.1671	1.1374
408.07	124.38	9.9989	0.9289	40.4943	1.1467	40.4943	1.1467
408.10	124.39	10.0523	0.9339	40.8232	1.1560	40.8232	1.1560
408.14	124.40	10.1452	0.9425	41.1539	1.1653	41.1539	1.1653
408.17	124.41	10.1992	0.9475	41.4876	1.1748	41.4876	1.1748
408.20	124.42	10.2530	0.9525	41.8231	1.1843	41.8231	1.1843
408.23	124.43	10.3068	0.9575	42.1604	1.1938	42.1604	1.1938
408.27	124.44	10.3606	0.9625	42.4994	1.2034	42.4994	1.2034
408.30	124.45	10.4142	0.9675	42.8402	1.2131	42.8402	1.2131
408.33	124.46	10.4678	0.9725	43.1828	1.2228	43.1828	1.2228
408.37	124.47	10.5214	0.9775	43.5271	1.2325	43.5271	1.2325
408.40	124.48	10.5748	0.9824	43.8732	1.2423	43.8732	1.2423
408.43	124.49	10.6282	0.9874	44.2210	1.2522	44.2210	1.2522
408.46	124.50	10.7342	0.9972	44.5706	1.2621	44.5706	1.2621
408.50	124.51	10.7893	1.0024	44.9236	1.2721	44.9236	1.2721
408.53	124.52	10.8445	1.0075	45.2785	1.2821	45.2785	1.2821
408.56	124.53	10.8999	1.0126	45.6352	1.2922	45.6352	1.2922
408.60	124.54	10.9554	1.0178	45.9937	1.3024	45.9937	1.3024
408.63	124.55	11.0112	1.0230	46.3541	1.3126	46.3541	1.3126
408.66	124.56	11.0672	1.0282	46.7163	1.3229	46.7163	1.3229
408.69	124.57	11.1233	1.0334	47.0803	1.3332	47.0803	1.3332
408.73	124.58	11.1797	1.0386	47.4461	1.3435	47.4461	1.3435
408.76	124.59	11.2362	1.0439	47.8139	1.3539	47.8139	1.3539
408.79	124.60	11.3389	1.0534	48.1834	1.3644	48.1834	1.3644
408.83	124.61	11.4005	1.0591	48.5564	1.3750	48.5564	1.3750
408.86	124.62	11.4623	1.0649	48.9315	1.3856	48.9315	1.3856
408.89	124.63	11.5245	1.0707	49.3086	1.3963	49.3086	1.3963
408.92	124.64	11.5869	1.0765	49.6877	1.4070	49.6877	1.4070
408.96	124.65	11.6495	1.0823	50.0689	1.4178	50.0689	1.4178
408.99	124.66	11.7124	1.0881	50.4521	1.4286	50.4521	1.4286
409.02	124.67	11.7756	1.0940	50.8374	1.4396	50.8374	1.4396
409.06	124.68	11.8390	1.0999	51.2248	1.4505	51.2248	1.4505
409.09	124.69	11.9027	1.1058	51.6142	1.4616	51.6142	1.4616
409.12	124.70	12.0342	1.1180	52.0058	1.4726	52.0058	1.4726
409.15	124.71	12.1005	1.1242	52.4017	1.4838	52.4017	1.4838
409.19	124.72	12.1669	1.1303	52.7998	1.4951	52.7998	1.4951

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
409.22	124.73	12.2333	1.1365	53.2001	1.5065	53.2001	1.5065
409.25	124.74	12.2997	1.1427	53.6025	1.5179	53.6025	1.5179
409.28	124.75	12.3662	1.1489	54.0071	1.5293	54.0071	1.5293
409.32	124.76	12.4327	1.1550	54.4139	1.5408	54.4139	1.5408
409.35	124.77	12.4992	1.1612	54.8229	1.5524	54.8229	1.5524
409.38	124.78	12.5658	1.1674	55.2341	1.5641	55.2341	1.5641
409.42	124.79	12.6324	1.1736	55.6475	1.5758	55.6475	1.5758
409.45	124.80	12.7792	1.1872	56.0630	1.5875	56.0630	1.5875
409.48	124.81	12.8564	1.1944	56.4835	1.5994	56.4835	1.5994
409.51	124.82	12.9333	1.2015	56.9066	1.6114	56.9066	1.6114
409.55	124.83	13.0100	1.2087	57.3322	1.6235	57.3322	1.6235
409.58	124.84	13.0864	1.2158	57.7603	1.6356	57.7603	1.6356
409.61	124.85	13.1626	1.2228	58.1909	1.6478	58.1909	1.6478
409.65	124.86	13.2385	1.2299	58.6240	1.6600	58.6240	1.6600
409.68	124.87	13.3142	1.2369	59.0595	1.6724	59.0595	1.6724
409.71	124.88	13.3896	1.2439	59.4976	1.6848	59.4976	1.6848
409.74	124.89	13.4648	1.2509	59.9381	1.6973	59.9381	1.6973
409.78	124.90	13.6114	1.2645	60.3811	1.7098	60.3811	1.7098
409.81	124.91	13.6902	1.2719	60.8290	1.7225	60.8290	1.7225
409.84	124.92	13.7689	1.2792	61.2794	1.7352	61.2794	1.7352
409.88	124.93	13.8475	1.2865	61.7324	1.7481	61.7324	1.7481
409.91	124.94	13.9260	1.2938	62.1880	1.7610	62.1880	1.7610
409.94	124.95	14.0045	1.3011	62.6462	1.7739	62.6462	1.7739
409.97	124.96	14.0829	1.3083	63.1070	1.7870	63.1070	1.7870
410.01	124.97	14.1612	1.3156	63.5703	1.8001	63.5703	1.8001
410.04	124.98	14.2395	1.3229	64.0362	1.8133	64.0362	1.8133
410.07	124.99	14.3176	1.3302	64.5046	1.8266	64.5046	1.8266
410.11	125.00	14.4498	1.3424	64.9757	1.8399	64.9757	1.8399
410.14	125.01	14.5319	1.3501	65.4511	1.8534	65.4511	1.8534
410.17	125.02	14.6141	1.3577	65.9292	1.8669	65.9292	1.8669
410.20	125.03	14.6964	1.3653	66.4100	1.8805	66.4100	1.8805
410.24	125.04	14.7789	1.3730	66.8935	1.8942	66.8935	1.8942
410.27	125.05	14.8615	1.3807	67.3798	1.9080	67.3798	1.9080
410.30	125.06	14.9442	1.3884	67.8687	1.9218	67.8687	1.9218
410.33	125.07	15.0270	1.3961	68.3604	1.9357	68.3604	1.9357
410.37	125.08	15.1099	1.4038	68.8547	1.9497	68.8547	1.9497
410.40	125.09	15.1930	1.4115	69.3518	1.9638	69.3518	1.9638
410.43	125.10	15.3421	1.4253	69.8516	1.9780	69.8516	1.9780
410.47	125.11	15.4294	1.4334	70.3564	1.9923	70.3564	1.9923
410.50	125.12	15.5165	1.4415	70.8641	2.0066	70.8641	2.0066
410.53	125.13	15.6036	1.4496	71.3746	2.0211	71.3746	2.0211
410.56	125.14	15.6905	1.4577	71.8879	2.0356	71.8879	2.0356

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
410.60	125.15	15.7773	1.4658	72.4041	2.0503	72.4041	2.0503
410.63	125.16	15.8640	1.4738	72.9232	2.0650	72.9232	2.0650
410.66	125.17	15.9506	1.4819	73.4451	2.0797	73.4451	2.0797
410.70	125.18	16.0371	1.4899	73.9698	2.0946	73.9698	2.0946
410.73	125.19	16.1235	1.4979	74.4974	2.1095	74.4974	2.1095
410.76	125.20	16.2675	1.5113	75.0278	2.1245	75.0278	2.1245
410.79	125.21	16.3548	1.5194	75.5629	2.1397	75.5629	2.1397
410.83	125.22	16.4424	1.5276	76.1009	2.1549	76.1009	2.1549
410.86	125.23	16.5303	1.5357	76.6418	2.1703	76.6418	2.1703
410.89	125.24	16.6185	1.5439	77.1856	2.1857	77.1856	2.1857
410.93	125.25	16.7070	1.5521	77.7323	2.2011	77.7323	2.2011
410.96	125.26	16.7959	1.5604	78.2819	2.2167	78.2819	2.2167
410.99	125.27	16.8850	1.5687	78.8344	2.2323	78.8344	2.2323
411.02	125.28	16.9744	1.5770	79.3898	2.2481	79.3898	2.2481
411.06	125.29	17.0642	1.5853	79.9482	2.2639	79.9482	2.2639
411.09	125.30	17.2089	1.5988	80.5095	2.2798	80.5095	2.2798
411.12	125.31	17.3029	1.6075	81.0757	2.2958	81.0757	2.2958
411.15	125.32	17.3966	1.6162	81.6449	2.3119	81.6449	2.3119
411.19	125.33	17.4898	1.6249	82.2172	2.3281	82.2172	2.3281
411.22	125.34	17.5828	1.6335	82.7925	2.3444	82.7925	2.3444
411.25	125.35	17.6754	1.6421	83.3709	2.3608	83.3709	2.3608
411.29	125.36	17.7677	1.6507	83.9523	2.3773	83.9523	2.3773
411.32	125.37	17.8596	1.6592	84.5368	2.3938	84.5368	2.3938
411.35	125.38	17.9511	1.6677	85.1242	2.4104	85.1242	2.4104
411.38	125.39	18.0423	1.6762	85.7147	2.4272	85.7147	2.4272
411.42	125.40	18.2086	1.6916	86.3081	2.4440	86.3081	2.4440
411.45	125.41	18.2964	1.6998	86.9069	2.4609	86.9069	2.4609
411.48	125.42	18.3841	1.7079	87.5086	2.4780	87.5086	2.4780
411.52	125.43	18.4718	1.7161	88.1132	2.4951	88.1132	2.4951
411.55	125.44	18.5594	1.7242	88.7207	2.5123	88.7207	2.5123
411.58	125.45	18.6470	1.7324	89.3310	2.5296	89.3310	2.5296
411.61	125.46	18.7345	1.7405	89.9443	2.5469	89.9443	2.5469
411.65	125.47	18.8221	1.7486	90.5603	2.5644	90.5603	2.5644
411.68	125.48	18.9096	1.7568	91.1793	2.5819	91.1793	2.5819
411.71	125.49	18.9970	1.7649	91.8011	2.5995	91.8011	2.5995
411.75	125.50	19.1704	1.7810	92.4258	2.6172	92.4258	2.6172
411.78	125.51	19.2599	1.7893	93.0562	2.6351	93.0562	2.6351
411.81	125.52	19.3498	1.7977	93.6896	2.6530	93.6896	2.6530
411.84	125.53	19.4404	1.8061	94.3259	2.6710	94.3259	2.6710
411.88	125.54	19.5312	1.8145	94.9652	2.6891	94.9652	2.6891
411.91	125.55	19.6223	1.8230	95.6075	2.7073	95.6075	2.7073
411.94	125.56	19.7136	1.8315	96.2528	2.7256	96.2528	2.7256

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
411.98	125.57	19.8053	1.8400	96.9011	2.7439	96.9011	2.7439
412.01	125.58	19.8973	1.8485	97.5523	2.7624	97.5523	2.7624
412.04	125.59	19.9899	1.8571	98.2067	2.7809	98.2067	2.7809
412.07	125.60	20.1898	1.8757	98.8640	2.7995	98.8640	2.7995
412.11	125.61	20.2847	1.8845	99.5280	2.8183	99.5280	2.8183
412.14	125.62	20.3792	1.8933	100.1951	2.8372	100.1951	2.8372
412.17	125.63	20.4732	1.9020	100.8652	2.8562	100.8652	2.8562
412.20	125.64	20.5668	1.9107	101.5384	2.8752	101.5384	2.8752
412.24	125.65	20.6601	1.9194	102.2147	2.8944	102.2147	2.8944
412.27	125.66	20.7530	1.9280	102.8941	2.9136	102.8941	2.9136
412.30	125.67	20.8456	1.9366	103.5765	2.9330	103.5765	2.9330
412.34	125.68	20.9377	1.9452	104.2619	2.9524	104.2619	2.9524
412.37	125.69	21.0294	1.9537	104.9503	2.9719	104.9503	2.9719
412.40	125.70	21.1757	1.9673	105.6418	2.9914	105.6418	2.9914
412.43	125.71	21.2614	1.9753	106.3379	3.0112	106.3379	3.0112
412.47	125.72	21.3474	1.9832	107.0369	3.0309	107.0369	3.0309
412.50	125.73	21.4337	1.9913	107.7387	3.0508	107.7387	3.0508
412.53	125.74	21.5202	1.9993	108.4433	3.0708	108.4433	3.0708
412.57	125.75	21.6070	2.0074	109.1508	3.0908	109.1508	3.0908
412.60	125.76	21.6940	2.0154	109.8611	3.1109	109.8611	3.1109
412.63	125.77	21.7812	2.0235	110.5743	3.1311	110.5743	3.1311
412.66	125.78	21.8687	2.0317	111.2903	3.1514	111.2903	3.1514
412.70	125.79	21.9565	2.0398	112.0092	3.1717	112.0092	3.1717
412.73	125.80	22.1058	2.0537	112.7310	3.1922	112.7310	3.1922
412.76	125.81	22.1937	2.0619	113.4577	3.2128	113.4577	3.2128
412.80	125.82	22.2815	2.0700	114.1873	3.2334	114.1873	3.2334
412.83	125.83	22.3692	2.0782	114.9198	3.2542	114.9198	3.2542
412.86	125.84	22.4568	2.0863	115.6551	3.2750	115.6551	3.2750
412.89	125.85	22.5443	2.0944	116.3933	3.2959	116.3933	3.2959
412.93	125.86	22.6317	2.1026	117.1344	3.3169	117.1344	3.3169
412.96	125.87	22.7191	2.1107	117.8783	3.3379	117.8783	3.3379
412.99	125.88	22.8063	2.1188	118.6252	3.3591	118.6252	3.3591
413.02	125.89	22.8936	2.1269	119.3748	3.3803	119.3748	3.3803
413.06	125.90	23.0481	2.1412	120.1274	3.4016	120.1274	3.4016
413.09	125.91	23.1348	2.1493	120.8850	3.4231	120.8850	3.4231
413.12	125.92	23.2215	2.1573	121.6454	3.4446	121.6454	3.4446
413.16	125.93	23.3082	2.1654	122.4087	3.4662	122.4087	3.4662
413.19	125.94	23.3950	2.1735	123.1748	3.4879	123.1748	3.4879
413.22	125.95	23.4817	2.1815	123.9438	3.5097	123.9438	3.5097
413.25	125.96	23.5685	2.1896	124.7156	3.5315	124.7156	3.5315
413.29	125.97	23.6553	2.1976	125.4903	3.5535	125.4903	3.5535
413.32	125.98	23.7420	2.2057	126.2678	3.5755	126.2678	3.5755

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
413.35	125.99	23.8287	2.2138	127.0482	3.5976	127.0482	3.5976
413.39	126.00	23.9836	2.2282	127.8314	3.6198	127.8314	3.6198
413.42	126.01	24.0697	2.2361	128.6196	3.6421	128.6196	3.6421
413.45	126.02	24.1557	2.2441	129.4107	3.6645	129.4107	3.6645
413.48	126.03	24.2416	2.2521	130.2047	3.6870	130.2047	3.6870
413.52	126.04	24.3274	2.2601	131.0014	3.7095	131.0014	3.7095
413.55	126.05	24.4131	2.2680	131.8009	3.7322	131.8009	3.7322
413.58	126.06	24.4987	2.2760	132.6033	3.7549	132.6033	3.7549
413.62	126.07	24.5842	2.2839	133.4085	3.7777	133.4085	3.7777
413.65	126.08	24.6695	2.2919	134.2164	3.8006	134.2164	3.8006
413.68	126.09	24.7548	2.2998	135.0272	3.8235	135.0272	3.8235
413.71	126.10	24.8819	2.3116	135.8408	3.8466	135.8408	3.8466
413.75	126.11	24.9680	2.3196	136.6585	3.8697	136.6585	3.8697
413.78	126.12	25.0541	2.3276	137.4791	3.8930	137.4791	3.8930
413.81	126.13	25.1401	2.3356	138.3025	3.9163	138.3025	3.9163
413.85	126.14	25.2261	2.3436	139.1287	3.9397	139.1287	3.9397
413.88	126.15	25.3121	2.3516	139.9578	3.9632	139.9578	3.9632
413.91	126.16	25.3980	2.3596	140.7896	3.9867	140.7896	3.9867
413.94	126.17	25.4839	2.3675	141.6243	4.0103	141.6243	4.0103
413.98	126.18	25.5698	2.3755	142.4618	4.0341	142.4618	4.0341
414.01	126.19	25.6556	2.3835	143.3021	4.0579	143.3021	4.0579
414.04	126.20	25.7818	2.3952	144.1452	4.0817	144.1452	4.0817
414.07	126.21	25.8702	2.4034	144.9925	4.1057	144.9925	4.1057
414.11	126.22	25.9587	2.4116	145.8428	4.1298	145.8428	4.1298
414.14	126.23	26.0476	2.4199	146.6959	4.1540	146.6959	4.1540
414.17	126.24	26.1368	2.4282	147.5519	4.1782	147.5519	4.1782
414.21	126.25	26.2262	2.4365	148.4109	4.2025	148.4109	4.2025
414.24	126.26	26.3159	2.4448	149.2728	4.2269	149.2728	4.2269
414.27	126.27	26.4059	2.4532	150.1377	4.2514	150.1377	4.2514
414.30	126.28	26.4961	2.4616	151.0055	4.2760	151.0055	4.2760
414.34	126.29	26.5866	2.4700	151.8763	4.3007	151.8763	4.3007
414.37	126.30	26.7334	2.4836	152.7500	4.3254	152.7500	4.3254
414.40	126.31	26.8276	2.4924	153.6287	4.3503	153.6287	4.3503
414.44	126.32	26.9220	2.5011	154.5104	4.3752	154.5104	4.3752
414.47	126.33	27.0167	2.5099	155.3952	4.4003	155.3952	4.4003
414.50	126.34	27.1116	2.5187	156.2831	4.4254	156.2831	4.4254
414.53	126.35	27.2067	2.5276	157.1742	4.4507	157.1742	4.4507
414.57	126.36	27.3021	2.5364	158.0683	4.4760	158.0683	4.4760
414.60	126.37	27.3976	2.5453	158.9657	4.5014	158.9657	4.5014
414.63	126.38	27.4935	2.5542	159.8661	4.5269	159.8661	4.5269
414.67	126.39	27.5895	2.5632	160.7697	4.5525	160.7697	4.5525
414.70	126.40	27.7357	2.5767	161.6764	4.5782	161.6764	4.5782

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
414.73	126.41	27.8327	2.5857	162.5880	4.6040	162.5880	4.6040
414.76	126.42	27.9298	2.5948	163.5027	4.6299	163.5027	4.6299
414.80	126.43	28.0269	2.6038	164.4207	4.6559	164.4207	4.6559
414.83	126.44	28.1240	2.6128	165.3418	4.6820	165.3418	4.6820
414.86	126.45	28.2211	2.6218	166.2661	4.7081	166.2661	4.7081
414.90	126.46	28.3184	2.6309	167.1936	4.7344	167.1936	4.7344
414.93	126.47	28.4157	2.6399	168.1242	4.7607	168.1242	4.7607
414.96	126.48	28.5132	2.6490	169.0581	4.7872	169.0581	4.7872
414.99	126.49	28.6107	2.6580	169.9952	4.8137	169.9952	4.8137
415.03	126.50	28.7373	2.6698	170.9355	4.8403	170.9355	4.8403
415.06	126.51	28.8319	2.6786	171.8798	4.8671	171.8798	4.8671
415.09	126.52	28.9270	2.6874	172.8273	4.8939	172.8273	4.8939
415.12	126.53	29.0228	2.6963	173.7779	4.9208	173.7779	4.9208
415.16	126.54	29.1191	2.7053	174.7317	4.9478	174.7317	4.9478
415.19	126.55	29.2161	2.7143	175.6887	4.9749	175.6887	4.9749
415.22	126.56	29.3136	2.7233	176.6488	5.0021	176.6488	5.0021
415.26	126.57	29.4117	2.7324	177.6121	5.0294	177.6121	5.0294
415.29	126.58	29.5104	2.7416	178.5787	5.0568	178.5787	5.0568
415.32	126.59	29.6097	2.7508	179.5485	5.0842	179.5485	5.0842
415.35	126.60	29.7442	2.7633	180.5216	5.1118	180.5216	5.1118
415.39	126.61	29.8442	2.7726	181.4991	5.1395	181.4991	5.1395
415.42	126.62	29.9443	2.7819	182.4799	5.1673	182.4799	5.1673
415.45	126.63	30.0445	2.7912	183.4640	5.1951	183.4640	5.1951
415.49	126.64	30.1448	2.8006	184.4513	5.2231	184.4513	5.2231
415.52	126.65	30.2453	2.8099	185.4420	5.2511	185.4420	5.2511
415.55	126.66	30.3460	2.8192	186.4359	5.2793	186.4359	5.2793
415.58	126.67	30.4469	2.8286	187.4332	5.3075	187.4332	5.3075
415.62	126.68	30.5480	2.8380	188.4338	5.3358	188.4338	5.3358
415.65	126.69	30.6492	2.8474	189.4377	5.3643	189.4377	5.3643
415.68	126.70	30.7991	2.8613	190.4449	5.3928	190.4449	5.3928
415.72	126.71	30.9009	2.8708	191.4570	5.4215	191.4570	5.4215
415.75	126.72	31.0031	2.8803	192.4725	5.4502	192.4725	5.4502
415.78	126.73	31.1055	2.8898	193.4913	5.4791	193.4913	5.4791
415.81	126.74	31.2080	2.8993	194.5136	5.5080	194.5136	5.5080
415.85	126.75	31.3106	2.9089	195.5391	5.5370	195.5391	5.5370
415.88	126.76	31.4134	2.9184	196.5681	5.5662	196.5681	5.5662
415.91	126.77	31.5164	2.9280	197.6004	5.5954	197.6004	5.5954
415.94	126.78	31.6196	2.9376	198.6361	5.6247	198.6361	5.6247
415.98	126.79	31.7230	2.9472	199.6752	5.6542	199.6752	5.6542
416.01	126.80	31.8765	2.9614	200.7176	5.6837	200.7176	5.6837
416.04	126.81	31.9835	2.9714	201.7652	5.7133	201.7652	5.7133
416.08	126.82	32.0905	2.9813	202.8163	5.7431	202.8163	5.7431

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
416.11	126.83	32.1973	2.9912	203.8709	5.7730	203.8709	5.7730
416.14	126.84	32.3041	3.0012	204.9290	5.8029	204.9290	5.8029
416.17	126.85	32.4108	3.0111	205.9906	5.8330	205.9906	5.8330
416.21	126.86	32.5173	3.0210	207.0557	5.8632	207.0557	5.8632
416.24	126.87	32.6237	3.0308	208.1243	5.8934	208.1243	5.8934
416.27	126.88	32.7302	3.0407	209.1964	5.9238	209.1964	5.9238
416.31	126.89	32.8366	3.0506	210.2719	5.9542	210.2719	5.9542
416.34	126.90	32.9877	3.0647	211.3510	5.9848	211.3510	5.9848
416.37	126.91	33.0952	3.0746	212.4350	6.0155	212.4350	6.0155
416.40	126.92	33.2027	3.0846	213.5226	6.0463	213.5226	6.0463
416.44	126.93	33.3102	3.0946	214.6137	6.0772	214.6137	6.0772
416.47	126.94	33.4177	3.1046	215.7083	6.1082	215.7083	6.1082
416.50	126.95	33.5253	3.1146	216.8065	6.1393	216.8065	6.1393
416.54	126.96	33.6330	3.1246	217.9081	6.1705	217.9081	6.1705
416.57	126.97	33.7410	3.1346	219.0134	6.2018	219.0134	6.2018
416.60	126.98	33.8494	3.1447	220.1221	6.2332	220.1221	6.2332
416.63	126.99	33.9582	3.1548	221.2345	6.2647	221.2345	6.2647
416.67	127.00	34.1508	3.1727	222.3504	6.2963	222.3504	6.2963
416.70	127.01	34.2590	3.1828	223.4726	6.3280	223.4726	6.3280
416.73	127.02	34.3668	3.1928	224.5983	6.3599	224.5983	6.3599
416.77	127.03	34.4743	3.2028	225.7276	6.3919	225.7276	6.3919
416.80	127.04	34.5817	3.2127	226.8604	6.4240	226.8604	6.4240
416.83	127.05	34.6893	3.2227	227.9968	6.4561	227.9968	6.4561
416.86	127.06	34.7966	3.2327	229.1366	6.4884	229.1366	6.4884
416.90	127.07	34.9031	3.2426	230.2800	6.5208	230.2800	6.5208
416.93	127.08	35.0090	3.2524	231.4269	6.5533	231.4269	6.5533
416.96	127.09	35.1146	3.2623	232.5772	6.5858	232.5772	6.5858
416.99	127.10	35.2644	3.2762	233.7310	6.6185	233.7310	6.6185
417.03	127.11	35.3691	3.2859	234.8897	6.6513	234.8897	6.6513
417.06	127.12	35.4740	3.2956	236.0518	6.6842	236.0518	6.6842
417.09	127.13	35.5791	3.3054	237.2174	6.7172	237.2174	6.7172
417.13	127.14	35.6843	3.3152	238.3864	6.7503	238.3864	6.7503
417.16	127.15	35.7898	3.3250	239.5589	6.7835	239.5589	6.7835
417.19	127.16	35.8955	3.3348	240.7348	6.8168	240.7348	6.8168
417.22	127.17	36.0014	3.3446	241.9142	6.8502	241.9142	6.8502
417.26	127.18	36.1075	3.3545	243.0971	6.8837	243.0971	6.8837
417.29	127.19	36.2141	3.3644	244.2835	6.9173	244.2835	6.9173
417.32	127.20	36.3536	3.3774	245.4734	6.9510	245.4734	6.9510
417.36	127.21	36.4658	3.3878	246.6679	6.9849	246.6679	6.9849
417.39	127.22	36.5782	3.3982	247.8661	7.0188	247.8661	7.0188
417.42	127.23	36.6908	3.4087	249.0681	7.0528	249.0681	7.0528
417.45	127.24	36.8037	3.4192	250.2737	7.0870	250.2737	7.0870

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
417.49	127.25	36.9168	3.4297	251.4830	7.1212	251.4830	7.1212
417.52	127.26	37.0304	3.4402	252.6960	7.1555	252.6960	7.1555
417.55	127.27	37.1445	3.4508	253.9128	7.1900	253.9128	7.1900
417.59	127.28	37.2590	3.4615	255.1334	7.2246	255.1334	7.2246
417.62	127.29	37.3745	3.4722	256.3577	7.2592	256.3577	7.2592
417.65	127.30	37.5317	3.4868	257.5858	7.2940	257.5858	7.2940
417.68	127.31	37.6499	3.4978	258.8191	7.3289	258.8191	7.3289
417.72	127.32	37.7677	3.5087	260.0562	7.3640	260.0562	7.3640
417.75	127.33	37.8851	3.5196	261.2973	7.3991	261.2973	7.3991
417.78	127.34	38.0021	3.5305	262.5421	7.4344	262.5421	7.4344
417.81	127.35	38.1186	3.5413	263.7908	7.4697	263.7908	7.4697
417.85	127.36	38.2347	3.5521	265.0434	7.5052	265.0434	7.5052
417.88	127.37	38.3503	3.5629	266.2997	7.5408	266.2997	7.5408
417.91	127.38	38.4655	3.5736	267.5598	7.5764	267.5598	7.5764
417.95	127.39	38.5803	3.5842	268.8237	7.6122	268.8237	7.6122
417.98	127.40	38.7380	3.5989	270.0913	7.6481	270.0913	7.6481
418.01	127.41	38.8515	3.6094	271.3641	7.6842	271.3641	7.6842
418.04	127.42	38.9650	3.6200	272.6406	7.7203	272.6406	7.7203
418.08	127.43	39.0787	3.6305	273.9209	7.7566	273.9209	7.7566
418.11	127.44	39.1924	3.6411	275.2048	7.7929	275.2048	7.7929
418.14	127.45	39.3061	3.6517	276.4925	7.8294	276.4925	7.8294
418.18	127.46	39.4198	3.6622	277.7840	7.8660	277.7840	7.8660
418.21	127.47	39.5337	3.6728	279.0792	7.9026	279.0792	7.9026
418.24	127.48	39.6475	3.6834	280.3781	7.9394	280.3781	7.9394
418.27	127.49	39.7611	3.6939	281.6807	7.9763	281.6807	7.9763
418.31	127.50	39.9273	3.7094	282.9871	8.0133	282.9871	8.0133
418.34	127.51	40.0372	3.7196	284.2988	8.0504	284.2988	8.0504
418.37	127.52	40.1473	3.7298	285.6142	8.0877	285.6142	8.0877
418.41	127.53	40.2575	3.7400	286.9332	8.1250	286.9332	8.1250
418.44	127.54	40.3677	3.7503	288.2558	8.1625	288.2558	8.1625
418.47	127.55	40.4780	3.7605	289.5820	8.2000	289.5820	8.2000
418.50	127.56	40.5885	3.7708	290.9118	8.2377	290.9118	8.2377
418.54	127.57	40.6991	3.7811	292.2453	8.2755	292.2453	8.2755
418.57	127.58	40.8098	3.7914	293.5823	8.3133	293.5823	8.3133
418.60	127.59	40.9209	3.8017	294.9231	8.3513	294.9231	8.3513
418.64	127.60	41.0790	3.8164	296.2675	8.3894	296.2675	8.3894
418.67	127.61	41.1932	3.8270	297.6171	8.4276	297.6171	8.4276
418.70	127.62	41.3078	3.8376	298.9704	8.4659	298.9704	8.4659
418.73	127.63	41.4229	3.8483	300.3276	8.5043	300.3276	8.5043
418.77	127.64	41.5384	3.8590	301.6885	8.5429	301.6885	8.5429
418.80	127.65	41.6542	3.8698	303.0532	8.5815	303.0532	8.5815
418.83	127.66	41.7705	3.8806	304.4217	8.6203	304.4217	8.6203

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
418.86	127.67	41.8871	3.8914	305.7940	8.6591	305.7940	8.6591
418.90	127.68	42.0042	3.9023	307.1702	8.6981	307.1702	8.6981
418.93	127.69	42.1215	3.9132	308.5502	8.7372	308.5502	8.7372
418.96	127.70	42.2943	3.9293	309.9341	8.7763	309.9341	8.7763
419.00	127.71	42.4143	3.9404	311.3237	8.8157	311.3237	8.8157
419.03	127.72	42.5347	3.9516	312.7172	8.8552	312.7172	8.8552
419.06	127.73	42.6556	3.9628	314.1147	8.8947	314.1147	8.8947
419.09	127.74	42.7772	3.9741	315.5161	8.9344	315.5161	8.9344
419.13	127.75	42.8995	3.9855	316.9216	8.9742	316.9216	8.9742
419.16	127.76	43.0225	3.9969	318.3311	9.0141	318.3311	9.0141
419.19	127.77	43.1462	4.0084	319.7446	9.0542	319.7446	9.0542
419.23	127.78	43.2707	4.0200	321.1622	9.0943	321.1622	9.0943
419.26	127.79	43.3958	4.0316	322.5839	9.1346	322.5839	9.1346
419.29	127.80	43.6033	4.0509	324.0097	9.1749	324.0097	9.1749
419.32	127.81	43.7276	4.0624	325.4423	9.2155	325.4423	9.2155
419.36	127.82	43.8519	4.0740	326.8790	9.2562	326.8790	9.2562
419.39	127.83	43.9763	4.0855	328.3197	9.2970	328.3197	9.2970
419.42	127.84	44.1007	4.0971	329.7646	9.3379	329.7646	9.3379
419.46	127.85	44.2252	4.1087	331.2135	9.3789	331.2135	9.3789
419.49	127.86	44.3499	4.1202	332.6665	9.4201	332.6665	9.4201
419.52	127.87	44.4746	4.1318	334.1236	9.4613	334.1236	9.4613
419.55	127.88	44.5992	4.1434	335.5848	9.5027	335.5848	9.5027
419.59	127.89	44.7237	4.1550	337.0501	9.5442	337.0501	9.5442
419.62	127.90	44.9340	4.1745	338.5194	9.5858	338.5194	9.5858
419.65	127.91	45.0644	4.1866	339.9958	9.6276	339.9958	9.6276
419.69	127.92	45.1944	4.1987	341.4764	9.6695	341.4764	9.6695
419.72	127.93	45.3239	4.2107	342.9613	9.7116	342.9613	9.7116
419.75	127.94	45.4530	4.2227	344.4504	9.7537	344.4504	9.7537
419.78	127.95	45.5816	4.2347	345.9438	9.7960	345.9438	9.7960
419.82	127.96	45.7099	4.2466	347.4413	9.8384	347.4413	9.8384
419.85	127.97	45.8378	4.2585	348.9431	9.8810	348.9431	9.8810
419.88	127.98	45.9654	4.2703	350.4491	9.9236	350.4491	9.9236
419.91	127.99	46.0926	4.2821	351.9592	9.9664	351.9592	9.9664
419.95	128.00	46.3624	4.3072	353.4735	10.0092	353.4735	10.0092
419.98	128.01	46.4931	4.3194	354.9968	10.0524	354.9968	10.0524
420.01	128.02	46.6233	4.3315	356.5243	10.0956	356.5243	10.0956
420.05	128.03	46.7532	4.3435	358.0560	10.1390	358.0560	10.1390
420.08	128.04	46.8828	4.3556	359.5921	10.1825	359.5921	10.1825
420.11	128.05	47.0120	4.3676	361.1323	10.2261	361.1323	10.2261
420.14	128.06	47.1410	4.3795	362.6768	10.2699	362.6768	10.2699
420.18	128.07	47.2696	4.3915	364.2256	10.3137	364.2256	10.3137
420.21	128.08	47.3979	4.4034	365.7785	10.3577	365.7785	10.3577

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
420.24	128.09	47.5260	4.4153	367.3357	10.4018	367.3357	10.4018
420.28	128.10	47.7742	4.4384	368.8970	10.4460	368.8970	10.4460
420.31	128.11	47.9026	4.4503	370.4665	10.4904	370.4665	10.4904
420.34	128.12	48.0309	4.4622	372.0402	10.5350	372.0402	10.5350
420.37	128.13	48.1593	4.4741	373.6182	10.5797	373.6182	10.5797
420.41	128.14	48.2875	4.4861	375.2003	10.6245	375.2003	10.6245
420.44	128.15	48.4158	4.4980	376.7867	10.6694	376.7867	10.6694
420.47	128.16	48.5441	4.5099	378.3772	10.7144	378.3772	10.7144
420.51	128.17	48.6723	4.5218	379.9720	10.7596	379.9720	10.7596
420.54	128.18	48.8005	4.5337	381.5709	10.8049	381.5709	10.8049
420.57	128.19	48.9288	4.5456	383.1741	10.8503	383.1741	10.8503
420.60	128.20	49.2224	4.5729	384.7815	10.8958	384.7815	10.8958
420.64	128.21	49.3498	4.5848	386.3985	10.9416	386.3985	10.9416
420.67	128.22	49.4771	4.5966	388.0197	10.9875	388.0197	10.9875
420.70	128.23	49.6043	4.6084	389.6450	11.0335	389.6450	11.0335
420.73	128.24	49.7313	4.6202	391.2745	11.0797	391.2745	11.0797
420.77	128.25	49.8583	4.6320	392.9082	11.1259	392.9082	11.1259
420.80	128.26	49.9852	4.6438	394.5461	11.1723	394.5461	11.1723
420.83	128.27	50.1120	4.6556	396.1881	11.2188	396.1881	11.2188
420.87	128.28	50.2387	4.6673	397.8343	11.2654	397.8343	11.2654
420.90	128.29	50.3653	4.6791	399.4846	11.3121	399.4846	11.3121
420.93	128.30	50.6432	4.7049	401.1391	11.3590	401.1391	11.3590
420.96	128.31	50.7676	4.7165	402.8027	11.4061	402.8027	11.4061
421.00	128.32	50.8910	4.7279	404.4703	11.4533	404.4703	11.4533
421.03	128.33	51.0136	4.7393	406.1420	11.5006	406.1420	11.5006
421.06	128.34	51.1355	4.7507	407.8177	11.5481	407.8177	11.5481
421.10	128.35	51.2568	4.7619	409.4973	11.5957	409.4973	11.5957
421.13	128.36	51.3775	4.7731	411.1810	11.6433	411.1810	11.6433
421.16	128.37	51.4975	4.7843	412.8686	11.6911	412.8686	11.6911
421.19	128.38	51.6167	4.7954	414.5601	11.7390	414.5601	11.7390
421.23	128.39	51.7352	4.8064	416.2555	11.7870	416.2555	11.7870
421.26	128.40	51.9577	4.8270	417.9548	11.8351	417.9548	11.8351
421.29	128.41	52.0815	4.8385	419.6614	11.8835	419.6614	11.8835
421.33	128.42	52.2050	4.8500	421.3722	11.9319	421.3722	11.9319
421.36	128.43	52.3281	4.8614	423.0870	11.9805	423.0870	11.9805
421.39	128.44	52.4509	4.8729	424.8058	12.0291	424.8058	12.0291
421.42	128.45	52.5732	4.8842	426.5286	12.0779	426.5286	12.0779
421.46	128.46	52.6952	4.8956	428.2555	12.1268	428.2555	12.1268
421.49	128.47	52.8169	4.9069	429.9863	12.1758	429.9863	12.1758
421.52	128.48	52.9383	4.9181	431.7212	12.2250	431.7212	12.2250
421.56	128.49	53.0594	4.9294	433.4600	12.2742	433.4600	12.2742
421.59	128.50	53.2267	4.9449	435.2028	12.3236	435.2028	12.3236

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
421.62	128.51	53.3426	4.9557	436.9509	12.3731	436.9509	12.3731
421.65	128.52	53.4579	4.9664	438.7029	12.4227	438.7029	12.4227
421.69	128.53	53.5728	4.9771	440.4587	12.4724	440.4587	12.4724
421.72	128.54	53.6875	4.9877	442.2182	12.5222	442.2182	12.5222
421.75	128.55	53.8018	4.9984	443.9815	12.5721	443.9815	12.5721
421.78	128.56	53.9159	5.0090	445.7485	12.6222	445.7485	12.6222
421.82	128.57	54.0298	5.0195	447.5193	12.6723	447.5193	12.6723
421.85	128.58	54.1435	5.0301	449.2938	12.7226	449.2938	12.7226
421.88	128.59	54.2570	5.0406	451.0720	12.7729	451.0720	12.7729
421.92	128.60	54.4060	5.0545	452.8539	12.8234	452.8539	12.8234
421.95	128.61	54.5214	5.0652	454.6408	12.8740	454.6408	12.8740
421.98	128.62	54.6370	5.0760	456.4315	12.9247	456.4315	12.9247
422.01	128.63	54.7527	5.0867	458.2259	12.9755	458.2259	12.9755
422.05	128.64	54.8683	5.0974	460.0242	13.0264	460.0242	13.0264
422.08	128.65	54.9838	5.1082	461.8262	13.0774	461.8262	13.0774
422.11	128.66	55.0994	5.1189	463.6320	13.1286	463.6320	13.1286
422.15	128.67	55.2149	5.1296	465.4417	13.1798	465.4417	13.1798
422.18	128.68	55.3304	5.1404	467.2551	13.2312	467.2551	13.2312
422.21	128.69	55.4458	5.1511	469.0723	13.2826	469.0723	13.2826
422.24	128.70	55.6133	5.1667	470.8933	13.3342	470.8933	13.3342
422.28	128.71	55.7314	5.1776	472.7198	13.3859	472.7198	13.3859
422.31	128.72	55.8498	5.1886	474.5502	13.4378	474.5502	13.4378
422.34	128.73	55.9685	5.1996	476.3845	13.4897	476.3845	13.4897
422.38	128.74	56.0874	5.2107	478.2227	13.5417	478.2227	13.5417
422.41	128.75	56.2067	5.2218	480.0648	13.5939	480.0648	13.5939
422.44	128.76	56.3264	5.2329	481.9108	13.6462	481.9108	13.6462
422.47	128.77	56.4464	5.2440	483.7607	13.6986	483.7607	13.6986
422.51	128.78	56.5668	5.2552	485.6146	13.7511	485.6146	13.7511
422.54	128.79	56.6877	5.2665	487.4725	13.8037	487.4725	13.8037
422.57	128.80	56.8784	5.2842	489.3343	13.8564	489.3343	13.8564
422.61	128.81	57.0007	5.2955	491.2024	13.9093	491.2024	13.9093
422.64	128.82	57.1231	5.3069	493.0745	13.9623	493.0745	13.9623
422.67	128.83	57.2456	5.3183	494.9506	14.0154	494.9506	14.0154
422.70	128.84	57.3683	5.3297	496.8308	14.0687	496.8308	14.0687
422.74	128.85	57.4911	5.3411	498.7150	14.1220	498.7150	14.1220
422.77	128.86	57.6141	5.3525	500.6032	14.1755	500.6032	14.1755
422.80	128.87	57.7372	5.3640	502.4954	14.2291	502.4954	14.2291
422.83	128.88	57.8604	5.3754	504.3917	14.2828	504.3917	14.2828
422.87	128.89	57.9839	5.3869	506.2921	14.3366	506.2921	14.3366
422.90	128.90	58.1489	5.4022	508.1964	14.3905	508.1964	14.3905
422.93	128.91	58.2698	5.4135	510.1062	14.4446	510.1062	14.4446
422.97	128.92	58.3909	5.4247	512.0199	14.4988	512.0199	14.4988

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
423.00	128.93	58.5124	5.4360	513.9376	14.5531	513.9376	14.5531
423.03	128.94	58.6341	5.4473	515.8593	14.6075	515.8593	14.6075
423.06	128.95	58.7555	5.4586	517.7850	14.6620	517.7850	14.6620
423.10	128.96	58.8768	5.4698	519.7147	14.7167	519.7147	14.7167
423.13	128.97	58.9981	5.4811	521.6483	14.7714	521.6483	14.7714
423.16	128.98	59.1193	5.4924	523.5860	14.8263	523.5860	14.8263
423.20	128.99	59.2404	5.5036	525.5276	14.8813	525.5276	14.8813
423.23	129.00	59.3940	5.5179	527.4731	14.9364	527.4731	14.9364
423.26	129.01	59.5157	5.5292	529.4238	14.9916	529.4238	14.9916
423.29	129.02	59.6374	5.5405	531.3784	15.0469	531.3784	15.0469
423.33	129.03	59.7593	5.5518	533.3370	15.1024	533.3370	15.1024
423.36	129.04	59.8812	5.5631	535.2996	15.1580	535.2996	15.1580
423.39	129.05	60.0032	5.5745	537.2662	15.2137	537.2662	15.2137
423.43	129.06	60.1252	5.5858	539.2368	15.2695	539.2368	15.2695
423.46	129.07	60.2474	5.5972	541.2114	15.3254	541.2114	15.3254
423.49	129.08	60.3697	5.6085	543.1901	15.3814	543.1901	15.3814
423.52	129.09	60.4921	5.6199	545.1727	15.4376	545.1727	15.4376
423.56	129.10	60.6548	5.6350	547.1594	15.4938	547.1594	15.4938
423.59	129.11	60.7756	5.6462	549.1514	15.5502	549.1514	15.5502
423.62	129.12	60.8965	5.6575	551.1473	15.6067	551.1473	15.6067
423.65	129.13	61.0172	5.6687	553.1472	15.6634	553.1472	15.6634
423.69	129.14	61.1379	5.6799	555.1511	15.7201	555.1511	15.7201
423.72	129.15	61.2585	5.6911	557.1589	15.7770	557.1589	15.7770
423.75	129.16	61.3791	5.7023	559.1707	15.8339	559.1707	15.8339
423.79	129.17	61.4996	5.7135	561.1864	15.8910	561.1864	15.8910
423.82	129.18	61.6200	5.7247	563.2061	15.9482	563.2061	15.9482
423.85	129.19	61.7404	5.7359	565.2297	16.0055	565.2297	16.0055
423.88	129.20	61.9048	5.7511	567.2573	16.0629	567.2573	16.0629
423.92	129.21	62.0249	5.7623	569.2903	16.1205	569.2903	16.1205
423.95	129.22	62.1453	5.7735	571.3272	16.1782	571.3272	16.1782
423.98	129.23	62.2660	5.7847	573.3680	16.2360	573.3680	16.2360
424.02	129.24	62.3871	5.7960	575.4129	16.2939	575.4129	16.2939
424.05	129.25	62.5085	5.8072	577.4617	16.3519	577.4617	16.3519
424.08	129.26	62.6302	5.8185	579.5145	16.4100	579.5145	16.4100
424.11	129.27	62.7523	5.8299	581.5713	16.4682	581.5713	16.4682
424.15	129.28	62.8747	5.8413	583.6321	16.5266	583.6321	16.5266
424.18	129.29	62.9974	5.8527	585.6969	16.5851	585.6969	16.5851
424.21	129.30	63.1605	5.8678	587.7658	16.6437	587.7658	16.6437
424.25	129.31	63.2853	5.8794	589.8401	16.7024	589.8401	16.7024
424.28	129.32	63.4103	5.8910	591.9184	16.7612	591.9184	16.7612
424.31	129.33	63.5355	5.9027	594.0008	16.8202	594.0008	16.8202
424.34	129.34	63.6610	5.9143	596.0874	16.8793	596.0874	16.8793

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
424.38	129.35	63.7867	5.9260	598.1781	16.9385	598.1781	16.9385
424.41	129.36	63.9126	5.9377	600.2729	16.9978	600.2729	16.9978
424.44	129.37	64.0388	5.9494	602.3718	17.0573	602.3718	17.0573
424.48	129.38	64.1652	5.9611	604.4749	17.1168	604.4749	17.1168
424.51	129.39	64.2918	5.9729	606.5822	17.1765	606.5822	17.1765
424.54	129.40	64.4490	5.9875	608.6936	17.2363	608.6936	17.2363
424.57	129.41	64.5794	5.9996	610.8102	17.2962	610.8102	17.2962
424.61	129.42	64.7099	6.0118	612.9311	17.3563	612.9311	17.3563
424.64	129.43	64.8406	6.0239	615.0562	17.4164	615.0562	17.4164
424.67	129.44	64.9715	6.0361	617.1857	17.4767	617.1857	17.4767
424.70	129.45	65.1026	6.0482	619.3195	17.5372	619.3195	17.5372
424.74	129.46	65.2339	6.0604	621.4575	17.5977	621.4575	17.5977
424.77	129.47	65.3654	6.0727	623.5999	17.6584	623.5999	17.6584
424.80	129.48	65.4971	6.0849	625.7466	17.7192	625.7466	17.7192
424.84	129.49	65.6291	6.0971	627.8976	17.7801	627.8976	17.7801
424.87	129.50	65.8022	6.1132	630.0530	17.8411	630.0530	17.8411
424.90	129.51	65.9360	6.1257	632.2141	17.9023	632.2141	17.9023
424.93	129.52	66.0698	6.1381	634.3795	17.9636	634.3795	17.9636
424.97	129.53	66.2036	6.1505	636.5494	18.0251	636.5494	18.0251
425.00	129.54	66.3376	6.1630	638.7236	18.0866	638.7236	18.0866
425.03	129.55	66.4716	6.1754	640.9022	18.1483	640.9022	18.1483
425.07	129.56	66.6057	6.1879	643.0853	18.2101	643.0853	18.2101
425.10	129.57	66.7400	6.2004	645.2727	18.2721	645.2727	18.2721
425.13	129.58	66.8743	6.2128	647.4645	18.3341	647.4645	18.3341
425.16	129.59	67.0086	6.2253	649.6608	18.3963	649.6608	18.3963
425.20	129.60	67.1982	6.2429	651.8614	18.4586	651.8614	18.4586
425.23	129.61	67.3325	6.2554	654.0683	18.5211	654.0683	18.5211
425.26	129.62	67.4670	6.2679	656.2796	18.5838	656.2796	18.5838
425.30	129.63	67.6018	6.2804	658.4953	18.6465	658.4953	18.6465
425.33	129.64	67.7369	6.2930	660.7154	18.7094	660.7154	18.7094
425.36	129.65	67.8721	6.3055	662.9400	18.7724	662.9400	18.7724
425.39	129.66	68.0077	6.3181	665.1690	18.8355	665.1690	18.8355
425.43	129.67	68.1434	6.3307	667.4024	18.8987	667.4024	18.8987
425.46	129.68	68.2795	6.3434	669.6403	18.9621	669.6403	18.9621
425.49	129.69	68.4157	6.3560	671.8827	19.0256	671.8827	19.0256
425.52	129.70	68.6035	6.3735	674.1296	19.0892	674.1296	19.0892
425.56	129.71	68.7381	6.3860	676.3826	19.1530	676.3826	19.1530
425.59	129.72	68.8726	6.3985	678.6400	19.2169	678.6400	19.2169
425.62	129.73	69.0072	6.4110	680.9018	19.2810	680.9018	19.2810
425.66	129.74	69.1418	6.4235	683.1680	19.3451	683.1680	19.3451
425.69	129.75	69.2765	6.4360	685.4386	19.4094	685.4386	19.4094
425.72	129.76	69.4112	6.4485	687.7137	19.4739	687.7137	19.4739

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
425.75	129.77	69.5460	6.4610	689.9932	19.5384	689.9932	19.5384
425.79	129.78	69.6808	6.4736	692.2771	19.6031	692.2771	19.6031
425.82	129.79	69.8157	6.4861	694.5654	19.6679	694.5654	19.6679
425.85	129.80	70.0267	6.5057	696.8582	19.7328	696.8582	19.7328
425.89	129.81	70.1635	6.5184	699.1579	19.7979	699.1579	19.7979
425.92	129.82	70.3003	6.5311	701.4621	19.8632	701.4621	19.8632
425.95	129.83	70.4370	6.5438	703.7708	19.9286	703.7708	19.9286
425.98	129.84	70.5738	6.5565	706.0840	19.9941	706.0840	19.9941
426.02	129.85	70.7105	6.5692	708.4016	20.0597	708.4016	20.0597
426.05	129.86	70.8474	6.5819	710.7238	20.1254	710.7238	20.1254
426.08	129.87	70.9842	6.5947	713.0504	20.1913	713.0504	20.1913
426.12	129.88	71.1211	6.6074	715.3815	20.2573	715.3815	20.2573
426.15	129.89	71.2580	6.6201	717.7172	20.3235	717.7172	20.3235
426.18	129.90	71.4445	6.6374	720.0573	20.3897	720.0573	20.3897
426.21	129.91	71.5838	6.6504	722.4035	20.4562	722.4035	20.4562
426.25	129.92	71.7230	6.6633	724.7544	20.5227	724.7544	20.5227
426.28	129.93	71.8623	6.6762	727.1098	20.5894	727.1098	20.5894
426.31	129.94	72.0015	6.6892	729.4698	20.6563	729.4698	20.6563
426.35	129.95	72.1407	6.7021	731.8343	20.7232	731.8343	20.7232
426.38	129.96	72.2800	6.7150	734.2034	20.7903	734.2034	20.7903
426.41	129.97	72.4193	6.7280	736.5771	20.8575	736.5771	20.8575
426.44	129.98	72.5586	6.7409	738.9553	20.9249	738.9553	20.9249
426.48	129.99	72.6992	6.7540	741.3382	20.9923	741.3382	20.9923
426.51	130.00	72.8936	6.7720	743.7256	21.0599	743.7256	21.0599
426.54	130.01	73.0375	6.7854	746.1195	21.1277	746.1195	21.1277
426.57	130.02	73.1811	6.7987	748.5181	21.1957	748.5181	21.1957
426.61	130.03	73.3245	6.8121	750.9214	21.2637	750.9214	21.2637
426.64	130.04	73.4679	6.8254	753.3295	21.3319	753.3295	21.3319
426.67	130.05	73.6113	6.8387	755.7422	21.4002	755.7422	21.4002
426.71	130.06	73.7547	6.8520	758.1596	21.4687	758.1596	21.4687
426.74	130.07	73.8981	6.8654	760.5817	21.5373	760.5817	21.5373
426.77	130.08	74.0416	6.8787	763.0086	21.6060	763.0086	21.6060
426.80	130.09	74.1851	6.8920	765.4401	21.6748	765.4401	21.6748
426.84	130.10	74.3810	6.9102	767.8764	21.7438	767.8764	21.7438
426.87	130.11	74.5222	6.9233	770.3190	21.8130	770.3190	21.8130
426.90	130.12	74.6630	6.9364	772.7663	21.8823	772.7663	21.8823
426.94	130.13	74.8037	6.9495	775.2182	21.9517	775.2182	21.9517
426.97	130.14	74.9445	6.9626	777.6747	22.0213	777.6747	22.0213
427.00	130.15	75.0853	6.9757	780.1358	22.0910	780.1358	22.0910
427.03	130.16	75.2261	6.9887	782.6015	22.1608	782.6015	22.1608
427.07	130.17	75.3669	7.0018	785.0719	22.2307	785.0719	22.2307
427.10	130.18	75.5077	7.0149	787.5469	22.3008	787.5469	22.3008

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
427.13	130.19	75.6485	7.0280	790.0265	22.3710	790.0265	22.3710
427.17	130.20	75.8350	7.0453	792.5107	22.4414	792.5107	22.4414
427.20	130.21	75.9731	7.0581	795.0010	22.5119	795.0010	22.5119
427.23	130.22	76.1113	7.0710	797.4958	22.5825	797.4958	22.5825
427.26	130.23	76.2493	7.0838	799.9952	22.6533	799.9952	22.6533
427.30	130.24	76.3873	7.0966	802.4991	22.7242	802.4991	22.7242
427.33	130.25	76.5253	7.1094	805.0075	22.7953	805.0075	22.7953
427.36	130.26	76.6633	7.1223	807.5204	22.8664	807.5204	22.8664
427.40	130.27	76.8013	7.1351	810.0379	22.9377	810.0379	22.9377
427.43	130.28	76.9394	7.1479	812.5599	23.0091	812.5599	23.0091
427.46	130.29	77.0774	7.1607	815.0864	23.0807	815.0864	23.0807
427.49	130.30	77.2509	7.1768	817.6175	23.1523	817.6175	23.1523
427.53	130.31	77.3882	7.1896	820.1542	23.2242	820.1542	23.2242
427.56	130.32	77.5256	7.2024	822.6955	23.2961	822.6955	23.2961
427.59	130.33	77.6632	7.2152	825.2412	23.3682	825.2412	23.3682
427.62	130.34	77.8009	7.2280	827.7915	23.4404	827.7915	23.4404
427.66	130.35	77.9390	7.2408	830.3463	23.5128	830.3463	23.5128
427.69	130.36	78.0773	7.2536	832.9056	23.5852	832.9056	23.5852
427.72	130.37	78.2160	7.2665	835.4695	23.6578	835.4695	23.6578
427.76	130.38	78.3549	7.2794	838.0379	23.7306	838.0379	23.7306
427.79	130.39	78.4942	7.2924	840.6109	23.8034	840.6109	23.8034
427.82	130.40	78.6938	7.3109	843.1884	23.8764	843.1884	23.8764
427.85	130.41	78.8341	7.3239	845.7726	23.9496	845.7726	23.9496
427.89	130.42	78.9747	7.3370	848.3613	24.0229	848.3613	24.0229
427.92	130.43	79.1157	7.3501	850.9546	24.0963	850.9546	24.0963
427.95	130.44	79.2572	7.3632	853.5526	24.1699	853.5526	24.1699
427.99	130.45	79.3992	7.3764	856.1553	24.2436	856.1553	24.2436
428.02	130.46	79.5417	7.3897	858.7626	24.3174	858.7626	24.3174
428.05	130.47	79.6847	7.4030	861.3745	24.3914	861.3745	24.3914
428.08	130.48	79.8282	7.4163	863.9912	24.4655	863.9912	24.4655
428.12	130.49	79.9722	7.4297	866.6126	24.5397	866.6126	24.5397
428.15	130.50	80.1943	7.4503	869.2388	24.6141	869.2388	24.6141
428.18	130.51	80.3415	7.4640	871.8723	24.6886	871.8723	24.6886
428.22	130.52	80.4874	7.4775	874.5105	24.7634	874.5105	24.7634
428.25	130.53	80.6331	7.4911	877.1536	24.8382	877.1536	24.8382
428.28	130.54	80.7787	7.5046	879.8014	24.9132	879.8014	24.9132
428.31	130.55	80.9245	7.5181	882.4540	24.9883	882.4540	24.9883
428.35	130.56	81.0705	7.5317	885.1114	25.0635	885.1114	25.0635
428.38	130.57	81.2170	7.5453	887.7737	25.1389	887.7737	25.1389
428.41	130.58	81.3642	7.5590	890.4407	25.2144	890.4407	25.2144
428.44	130.59	81.5125	7.5728	893.1125	25.2901	893.1125	25.2901
428.48	130.60	81.7268	7.5927	895.7893	25.3659	895.7893	25.3659

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
428.51	130.61	81.8761	7.6065	898.4731	25.4419	898.4731	25.4419
428.54	130.62	82.0244	7.6203	901.1617	25.5180	901.1617	25.5180
428.58	130.63	82.1737	7.6342	903.8553	25.5943	903.8553	25.5943
428.61	130.64	82.3234	7.6481	906.5537	25.6707	906.5537	25.6707
428.64	130.65	82.4733	7.6620	909.2571	25.7473	909.2571	25.7473
428.67	130.66	82.6231	7.6759	911.9654	25.8240	911.9654	25.8240
428.71	130.67	82.7729	7.6899	914.6786	25.9008	914.6786	25.9008
428.74	130.68	82.9229	7.7038	917.3967	25.9778	917.3967	25.9778
428.77	130.69	83.0733	7.7178	920.1197	26.0549	920.1197	26.0549
428.81	130.70	83.2808	7.7370	922.8477	26.1321	922.8477	26.1321
428.84	130.71	83.4359	7.7515	925.5825	26.2096	925.5825	26.2096
428.87	130.72	83.5915	7.7659	928.3225	26.2871	928.3225	26.2871
428.90	130.73	83.7487	7.7805	931.0676	26.3649	931.0676	26.3649
428.94	130.74	83.9083	7.7953	933.8179	26.4428	933.8179	26.4428
428.97	130.75	84.0734	7.8107	936.5734	26.5208	936.5734	26.5208
429.00	130.76	84.2403	7.8262	939.3345	26.5990	939.3345	26.5990
429.04	130.77	84.4089	7.8419	942.1010	26.6773	942.1010	26.6773
429.07	130.78	84.5794	7.8577	944.8732	26.7558	944.8732	26.7558
429.10	130.79	84.7536	7.8739	947.6509	26.8345	947.6509	26.8345
429.13	130.80	84.9732	7.8943	950.4345	26.9133	950.4345	26.9133
429.17	130.81	85.1630	7.9119	953.2254	26.9923	953.2254	26.9923
429.20	130.82	85.3579	7.9300	956.0227	27.0715	956.0227	27.0715
429.23	130.83	85.5574	7.9485	958.8264	27.1509	958.8264	27.1509
429.27	130.84	85.7509	7.9665	961.6366	27.2305	961.6366	27.2305
429.30	130.85	85.9396	7.9841	964.4530	27.3102	964.4530	27.3102
429.33	130.86	86.1279	8.0016	967.2757	27.3902	967.2757	27.3902
429.36	130.87	86.3155	8.0190	970.1045	27.4703	970.1045	27.4703
429.40	130.88	86.5008	8.0362	972.9394	27.5505	972.9394	27.5505
429.43	130.89	86.6873	8.0535	975.7804	27.6310	975.7804	27.6310
429.46	130.90	86.9410	8.0771	978.6276	27.7116	978.6276	27.7116
429.49	130.91	87.1464	8.0962	981.4834	27.7925	981.4834	27.7925
429.53	130.92	87.3459	8.1147	984.3458	27.8735	984.3458	27.8735
429.56	130.93	87.5418	8.1329	987.2147	27.9548	987.2147	27.9548
429.59	130.94	87.7358	8.1509	990.0900	28.0362	990.0900	28.0362
429.63	130.95	87.9277	8.1688	992.9716	28.1178	992.9716	28.1178
429.66	130.96	88.1216	8.1868	995.8596	28.1996	995.8596	28.1996
429.69	130.97	88.3186	8.2051	998.7539	28.2815	998.7539	28.2815
429.72	130.98	88.5202	8.2238	1001.6548	28.3637	1001.6548	28.3637
429.76	130.99	88.7295	8.2432	1004.5624	28.4460	1004.5624	28.4460
429.79	131.00	88.9997	8.2684	1007.4769	28.5285	1007.4769	28.5285
429.82	131.01	89.1911	8.2861	1010.4000	28.6113	1010.4000	28.6113
429.86	131.02	89.3784	8.3035	1013.3293	28.6943	1013.3293	28.6943

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
429.89	131.03	89.5658	8.3209	1016.2648	28.7774	1016.2648	28.7774
429.92	131.04	89.7555	8.3386	1019.2064	28.8607	1019.2064	28.8607
429.95	131.05	89.9469	8.3564	1022.1543	28.9442	1022.1543	28.9442
429.99	131.06	90.1402	8.3743	1025.1085	29.0278	1025.1085	29.0278
430.02	131.07	90.3327	8.3922	1028.0690	29.1116	1028.0690	29.1116
430.05	131.08	90.5271	8.4102	1031.0358	29.1957	1031.0358	29.1957
430.09	131.09	90.7237	8.4285	1034.0091	29.2798	1034.0091	29.2798
430.12	131.10	90.9480	8.4494	1036.9890	29.3642	1036.9890	29.3642
430.15	131.11	91.1721	8.4702	1039.9766	29.4488	1039.9766	29.4488
430.18	131.12	91.3927	8.4907	1042.9714	29.5336	1042.9714	29.5336
430.22	131.13	91.6120	8.5110	1045.9734	29.6186	1045.9734	29.6186
430.25	131.14	91.8319	8.5315	1048.9827	29.7039	1048.9827	29.7039
430.28	131.15	92.0455	8.5513	1051.9991	29.7893	1051.9991	29.7893
430.31	131.16	92.2531	8.5706	1055.0224	29.8749	1055.0224	29.8749
430.35	131.17	92.4573	8.5896	1058.0524	29.9607	1058.0524	29.9607
430.38	131.18	92.6611	8.6085	1061.0891	30.0467	1061.0891	30.0467
430.41	131.19	92.8663	8.6276	1064.1326	30.1329	1064.1326	30.1329
430.45	131.20	93.0843	8.6478	1067.1828	30.2192	1067.1828	30.2192
430.48	131.21	93.3086	8.6687	1070.2405	30.3058	1070.2405	30.3058
430.51	131.22	93.5244	8.6887	1073.3054	30.3926	1073.3054	30.3926
430.54	131.23	93.7257	8.7074	1076.3771	30.4796	1076.3771	30.4796
430.58	131.24	93.9247	8.7259	1079.4553	30.5667	1079.4553	30.5667
430.61	131.25	94.1211	8.7441	1082.5401	30.6541	1082.5401	30.6541
430.64	131.26	94.3171	8.7624	1085.6313	30.7416	1085.6313	30.7416
430.68	131.27	94.5127	8.7805	1088.7289	30.8293	1088.7289	30.8293
430.71	131.28	94.7090	8.7988	1091.8329	30.9172	1091.8329	30.9172
430.74	131.29	94.9057	8.8170	1094.9434	31.0053	1094.9434	31.0053
430.77	131.30	95.1051	8.8356	1098.0604	31.0936	1098.0604	31.0936
430.81	131.31	95.3051	8.8541	1101.1839	31.1820	1101.1839	31.1820
430.84	131.32	95.5054	8.8728	1104.3140	31.2707	1104.3140	31.2707
430.87	131.33	95.7018	8.8910	1107.4506	31.3595	1107.4506	31.3595
430.91	131.34	95.8965	8.9091	1110.5936	31.4485	1110.5936	31.4485
430.94	131.35	96.0914	8.9272	1113.7430	31.5377	1113.7430	31.5377
430.97	131.36	96.2852	8.9452	1116.8988	31.6270	1116.8988	31.6270
431.00	131.37	96.4795	8.9633	1120.0610	31.7166	1120.0610	31.7166
431.04	131.38	96.6721	8.9811	1123.2295	31.8063	1123.2295	31.8063
431.07	131.39	96.8840	9.0008	1126.4046	31.8962	1126.4046	31.8962
431.10	131.40	97.0937	9.0203	1129.5867	31.9863	1129.5867	31.9863
431.14	131.41	97.2979	9.0393	1132.7755	32.0766	1132.7755	32.0766
431.17	131.42	97.4990	9.0580	1135.9710	32.1671	1135.9710	32.1671
431.20	131.43	97.7103	9.0776	1139.1732	32.2578	1139.1732	32.2578
431.23	131.44	97.9161	9.0967	1142.3823	32.3486	1142.3823	32.3486

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
431.27	131.45	98.1219	9.1158	1145.5981	32.4397	1145.5981	32.4397
431.30	131.46	98.3237	9.1346	1148.8207	32.5309	1148.8207	32.5309
431.33	131.47	98.5190	9.1527	1152.0498	32.6224	1152.0498	32.6224
431.36	131.48	98.7055	9.1700	1155.2851	32.7140	1155.2851	32.7140
431.40	131.49	98.8916	9.1873	1158.5265	32.8058	1158.5265	32.8058
431.43	131.50	99.0791	9.2048	1161.7741	32.8977	1161.7741	32.8977
431.46	131.51	99.2685	9.2224	1165.0278	32.9899	1165.0278	32.9899
431.50	131.52	99.4553	9.2397	1168.2877	33.0822	1168.2877	33.0822
431.53	131.53	99.6384	9.2567	1171.5537	33.1747	1171.5537	33.1747
431.56	131.54	99.8198	9.2736	1174.8257	33.2673	1174.8257	33.2673
431.59	131.55	100.0018	9.2905	1178.1036	33.3601	1178.1036	33.3601
431.63	131.56	100.1870	9.3077	1181.3875	33.4531	1181.3875	33.4531
431.66	131.57	100.3815	9.3258	1184.6776	33.5463	1184.6776	33.5463
431.69	131.58	100.5689	9.3432	1187.9741	33.6396	1187.9741	33.6396
431.73	131.59	100.7495	9.3599	1191.2766	33.7332	1191.2766	33.7332
431.76	131.60	100.9251	9.3763	1194.5849	33.8268	1194.5849	33.8268
431.79	131.61	101.0983	9.3923	1197.8990	33.9207	1197.8990	33.9207
431.82	131.62	101.2715	9.4084	1201.2187	34.0147	1201.2187	34.0147
431.86	131.63	101.4452	9.4246	1204.5441	34.1089	1204.5441	34.1089
431.89	131.64	101.6195	9.4408	1207.8752	34.2032	1207.8752	34.2032
431.92	131.65	101.7903	9.4566	1211.2120	34.2977	1211.2120	34.2977
431.96	131.66	101.9602	9.4724	1214.5544	34.3923	1214.5544	34.3923
431.99	131.67	102.1357	9.4887	1217.9024	34.4871	1217.9024	34.4871
432.02	131.68	102.3200	9.5059	1221.2563	34.5821	1221.2563	34.5821
432.05	131.69	102.4960	9.5222	1224.6162	34.6772	1224.6162	34.6772
432.09	131.70	102.6672	9.5381	1227.9817	34.7725	1227.9817	34.7725
432.12	131.71	102.8371	9.5539	1231.3528	34.8680	1231.3528	34.8680
432.15	131.72	103.0034	9.5693	1234.7295	34.9636	1234.7295	34.9636
432.19	131.73	103.1683	9.5847	1238.1116	35.0594	1238.1116	35.0594
432.22	131.74	103.3329	9.6000	1241.4991	35.1553	1241.4991	35.1553
432.25	131.75	103.4975	9.6152	1244.8920	35.2514	1244.8920	35.2514
432.28	131.76	103.6625	9.6306	1248.2903	35.3476	1248.2903	35.3476
432.32	131.77	103.8284	9.6460	1251.6940	35.4440	1251.6940	35.4440
432.35	131.78	103.9960	9.6616	1255.1032	35.5405	1255.1032	35.5405
432.38	131.79	104.1645	9.6772	1258.5179	35.6372	1258.5179	35.6372
432.41	131.80	104.3327	9.6928	1261.9382	35.7341	1261.9382	35.7341
432.45	131.81	104.5046	9.7088	1265.3640	35.8311	1265.3640	35.8311
432.48	131.82	104.6786	9.7250	1268.7954	35.9283	1268.7954	35.9283
432.51	131.83	104.8592	9.7418	1272.2327	36.0256	1272.2327	36.0256
432.55	131.84	105.0468	9.7592	1275.6761	36.1231	1275.6761	36.1231
432.58	131.85	105.2314	9.7763	1279.1256	36.2208	1279.1256	36.2208
432.61	131.86	105.4180	9.7937	1282.5811	36.3186	1282.5811	36.3186

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
432.64	131.87	105.6079	9.8113	1286.0428	36.4166	1286.0428	36.4166
432.68	131.88	105.7957	9.8288	1289.5107	36.5148	1289.5107	36.5148
432.71	131.89	105.9819	9.8460	1292.9848	36.6132	1292.9848	36.6132
432.74	131.90	106.1680	9.8633	1296.4649	36.7118	1296.4649	36.7118
432.78	131.91	106.3550	9.8807	1299.9512	36.8105	1299.9512	36.8105
432.81	131.92	106.5438	9.8983	1303.4436	36.9094	1303.4436	36.9094
432.84	131.93	106.7323	9.9158	1306.9423	37.0084	1306.9423	37.0084
432.87	131.94	106.9208	9.9333	1310.4471	37.1077	1310.4471	37.1077
432.91	131.95	107.1094	9.9508	1313.9581	37.2071	1313.9581	37.2071
432.94	131.96	107.2982	9.9683	1317.4753	37.3067	1317.4753	37.3067
432.97	131.97	107.4895	9.9861	1320.9987	37.4065	1320.9987	37.4065
433.01	131.98	107.6806	10.0039	1324.5284	37.5064	1324.5284	37.5064
433.04	131.99	107.8805	10.0224	1328.0645	37.6066	1328.0645	37.6066
433.07	132.00	108.1032	10.0431	1331.6077	37.7069	1331.6077	37.7069
433.10	132.01	108.3335	10.0645	1335.1582	37.8074	1335.1582	37.8074
433.14	132.02	108.5707	10.0866	1338.7164	37.9082	1338.7164	37.9082
433.17	132.03	108.8016	10.1080	1342.2822	38.0092	1342.2822	38.0092
433.20	132.04	109.0208	10.1284	1345.8555	38.1103	1345.8555	38.1103
433.23	132.05	109.2400	10.1487	1349.4359	38.2117	1349.4359	38.2117
433.27	132.06	109.4570	10.1689	1353.0234	38.3133	1353.0234	38.3133
433.30	132.07	109.6817	10.1898	1356.6182	38.4151	1356.6182	38.4151
433.33	132.08	109.9150	10.2114	1360.2206	38.5171	1360.2206	38.5171
433.37	132.09	110.1364	10.2320	1363.8304	38.6193	1363.8304	38.6193
433.40	132.10	110.3535	10.2522	1367.4474	38.7218	1367.4474	38.7218
433.43	132.11	110.5669	10.2720	1371.0715	38.8244	1371.0715	38.8244
433.46	132.12	110.7902	10.2928	1374.7027	38.9272	1374.7027	38.9272
433.50	132.13	111.0291	10.3150	1378.3415	39.0302	1378.3415	39.0302
433.53	132.14	111.3067	10.3407	1381.9891	39.1335	1381.9891	39.1335
433.56	132.15	111.5627	10.3645	1385.6454	39.2371	1385.6454	39.2371
433.60	132.16	111.7794	10.3847	1389.3093	39.3408	1389.3093	39.3408
433.63	132.17	111.9858	10.4038	1392.9800	39.4448	1392.9800	39.4448
433.66	132.18	112.1870	10.4225	1396.6574	39.5489	1396.6574	39.5489
433.69	132.19	112.3862	10.4410	1400.3413	39.6532	1400.3413	39.6532
433.73	132.20	112.5852	10.4595	1404.0318	39.7577	1404.0318	39.7577
433.76	132.21	112.7834	10.4779	1407.7288	39.8624	1407.7288	39.8624
433.79	132.22	112.9813	10.4963	1411.4323	39.9673	1411.4323	39.9673
433.83	132.23	113.1796	10.5147	1415.1423	40.0723	1415.1423	40.0723
433.86	132.24	113.3787	10.5332	1418.8588	40.1776	1418.8588	40.1776
433.89	132.25	113.5791	10.5519	1422.5819	40.2830	1422.5819	40.2830
433.92	132.26	113.7896	10.5714	1426.3117	40.3886	1426.3117	40.3886
433.96	132.27	113.9972	10.5907	1430.0484	40.4944	1430.0484	40.4944
433.99	132.28	114.2148	10.6109	1433.7920	40.6004	1433.7920	40.6004

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
434.02	132.29	114.4395	10.6318	1437.5429	40.7066	1437.5429	40.7066
434.06	132.30	114.6761	10.6538	1441.3014	40.8131	1441.3014	40.8131
434.09	132.31	114.9557	10.6797	1445.0686	40.9197	1445.0686	40.9197
434.12	132.32	115.2828	10.7101	1448.8461	41.0267	1448.8461	41.0267
434.15	132.33	115.6566	10.7449	1452.6356	41.1340	1452.6356	41.1340
434.19	132.34	116.0287	10.7794	1456.4376	41.2417	1456.4376	41.2417
434.22	132.35	116.3314	10.8076	1460.2499	41.3496	1460.2499	41.3496
434.25	132.36	116.5925	10.8318	1464.0711	41.4578	1464.0711	41.4578
434.28	132.37	116.8065	10.8517	1467.8999	41.5663	1467.8999	41.5663
434.32	132.38	117.0195	10.8715	1471.7356	41.6749	1471.7356	41.6749
434.35	132.39	117.2398	10.8919	1475.5785	41.7837	1475.5785	41.7837
434.38	132.40	117.4687	10.9132	1479.4287	41.8927	1479.4287	41.8927
434.42	132.41	117.7059	10.9352	1483.2866	42.0020	1483.2866	42.0020
434.45	132.42	117.9311	10.9562	1487.1521	42.1114	1487.1521	42.1114
434.48	132.43	118.1524	10.9767	1491.0249	42.2211	1491.0249	42.2211
434.51	132.44	118.3757	10.9975	1494.9049	42.3310	1494.9049	42.3310
434.55	132.45	118.5969	11.0180	1498.7923	42.4410	1498.7923	42.4410
434.58	132.46	118.8150	11.0383	1502.6869	42.5513	1502.6869	42.5513
434.61	132.47	119.0320	11.0584	1506.5886	42.6618	1506.5886	42.6618
434.65	132.48	119.2439	11.0781	1510.4973	42.7725	1510.4973	42.7725
434.68	132.49	119.4602	11.0982	1514.4131	42.8834	1514.4131	42.8834
434.71	132.50	119.6808	11.1187	1518.3361	42.9944	1518.3361	42.9944
434.74	132.51	119.8935	11.1385	1522.2661	43.1057	1522.2661	43.1057
434.78	132.52	120.1071	11.1583	1526.2032	43.2172	1526.2032	43.2172
434.81	132.53	120.3121	11.1774	1530.1471	43.3289	1530.1471	43.3289
434.84	132.54	120.5140	11.1961	1534.0976	43.4408	1534.0976	43.4408
434.88	132.55	120.7134	11.2147	1538.0548	43.5528	1538.0548	43.5528
434.91	132.56	120.9116	11.2331	1542.0185	43.6651	1542.0185	43.6651
434.94	132.57	121.1136	11.2518	1545.9887	43.7775	1545.9887	43.7775
434.97	132.58	121.3163	11.2707	1549.9656	43.8901	1549.9656	43.8901
435.01	132.59	121.5213	11.2897	1553.9491	44.0029	1553.9491	44.0029
435.04	132.60	121.7307	11.3092	1557.9395	44.1159	1557.9395	44.1159
435.07	132.61	121.9460	11.3292	1561.9368	44.2291	1561.9368	44.2291
435.11	132.62	122.1653	11.3495	1565.9412	44.3425	1565.9412	44.3425
435.14	132.63	122.3842	11.3699	1569.9529	44.4561	1569.9529	44.4561
435.17	132.64	122.6000	11.3899	1573.9717	44.5699	1573.9717	44.5699
435.20	132.65	122.8137	11.4098	1577.9975	44.6839	1577.9975	44.6839
435.24	132.66	123.0270	11.4296	1582.0303	44.7981	1582.0303	44.7981
435.27	132.67	123.2426	11.4496	1586.0702	44.9125	1586.0702	44.9125
435.30	132.68	123.4585	11.4697	1590.1172	45.0271	1590.1172	45.0271
435.33	132.69	123.6811	11.4904	1594.1713	45.1419	1594.1713	45.1419
435.37	132.70	123.9132	11.5119	1598.2329	45.2569	1598.2329	45.2569

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
435.40	132.71	124.1367	11.5327	1602.3020	45.3721	1602.3020	45.3721
435.43	132.72	124.3581	11.5533	1606.3784	45.4875	1606.3784	45.4875
435.47	132.73	124.5807	11.5739	1610.4620	45.6032	1610.4620	45.6032
435.50	132.74	124.8081	11.5951	1614.5530	45.7190	1614.5530	45.7190
435.53	132.75	125.0305	11.6157	1618.6515	45.8351	1618.6515	45.8351
435.56	132.76	125.2535	11.6364	1622.7572	45.9513	1622.7572	45.9513
435.60	132.77	125.4779	11.6573	1626.8703	46.0678	1626.8703	46.0678
435.63	132.78	125.6922	11.6772	1630.9906	46.1845	1630.9906	46.1845
435.66	132.79	125.9109	11.6975	1635.1179	46.3013	1635.1179	46.3013
435.70	132.80	126.1315	11.7180	1639.2525	46.4184	1639.2525	46.4184
435.73	132.81	126.3462	11.7380	1643.3942	46.5357	1643.3942	46.5357
435.76	132.82	126.5525	11.7571	1647.5428	46.6532	1647.5428	46.6532
435.79	132.83	126.7585	11.7763	1651.6982	46.7708	1651.6982	46.7708
435.83	132.84	126.9646	11.7954	1655.8603	46.8887	1655.8603	46.8887
435.86	132.85	127.1710	11.8146	1660.0292	47.0067	1660.0292	47.0067
435.89	132.86	127.3777	11.8338	1664.2049	47.1250	1664.2049	47.1250
435.93	132.87	127.5843	11.8530	1668.3874	47.2434	1668.3874	47.2434
435.96	132.88	127.7905	11.8721	1672.5766	47.3621	1672.5766	47.3621
435.99	132.89	127.9962	11.8913	1676.7726	47.4809	1676.7726	47.4809
436.02	132.90	128.2018	11.9103	1680.9753	47.5999	1680.9753	47.5999
436.06	132.91	128.4058	11.9293	1685.1848	47.7191	1685.1848	47.7191
436.09	132.92	128.6079	11.9481	1689.4009	47.8385	1689.4009	47.8385
436.12	132.93	128.8087	11.9667	1693.6236	47.9580	1693.6236	47.9580
436.15	132.94	129.0086	11.9853	1697.8529	48.0778	1697.8529	48.0778
436.19	132.95	129.2089	12.0039	1702.0888	48.1977	1702.0888	48.1977
436.22	132.96	129.4090	12.0225	1706.3312	48.3179	1706.3312	48.3179
436.25	132.97	129.6083	12.0410	1710.5802	48.4382	1710.5802	48.4382
436.29	132.98	129.8063	12.0594	1714.8357	48.5587	1714.8357	48.5587
436.32	132.99	130.0028	12.0777	1719.0976	48.6794	1719.0976	48.6794
436.35	133.00	130.1976	12.0958	1723.3660	48.8002	1723.3660	48.8002
436.38	133.01	130.3927	12.1139	1727.6409	48.9213	1727.6409	48.9213
436.42	133.02	130.5833	12.1316	1731.9220	49.0425	1731.9220	49.0425
436.45	133.03	130.7732	12.1492	1736.2093	49.1639	1736.2093	49.1639
436.48	133.04	130.9620	12.1668	1740.5029	49.2855	1740.5029	49.2855
436.52	133.05	131.1499	12.1842	1744.8027	49.4073	1744.8027	49.4073
436.55	133.06	131.3374	12.2017	1749.1086	49.5292	1749.1086	49.5292
436.58	133.07	131.5247	12.2191	1753.4206	49.6513	1753.4206	49.6513
436.61	133.08	131.7117	12.2364	1757.7388	49.7736	1757.7388	49.7736
436.65	133.09	131.9009	12.2540	1762.0632	49.8960	1762.0632	49.8960
436.68	133.10	132.0869	12.2713	1766.3937	50.0187	1766.3937	50.0187
436.71	133.11	132.2720	12.2885	1770.7303	50.1415	1770.7303	50.1415
436.75	133.12	132.4569	12.3057	1775.0730	50.2644	1775.0730	50.2644

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
436.78	133.13	132.6417	12.3228	1779.4217	50.3876	1779.4217	50.3876
436.81	133.14	132.8262	12.3400	1783.7765	50.5109	1783.7765	50.5109
436.84	133.15	133.0109	12.3571	1788.1374	50.6344	1788.1374	50.6344
436.88	133.16	133.1954	12.3743	1792.5043	50.7580	1792.5043	50.7580
436.91	133.17	133.3791	12.3913	1796.8772	50.8818	1796.8772	50.8818
436.94	133.18	133.5619	12.4083	1801.2562	51.0058	1801.2562	51.0058
436.98	133.19	133.7440	12.4252	1805.6411	51.1300	1805.6411	51.1300
437.01	133.20	133.9267	12.4422	1810.0321	51.2544	1810.0321	51.2544
437.04	133.21	134.1099	12.4592	1814.4290	51.3789	1814.4290	51.3789
437.07	133.22	134.2947	12.4764	1818.8320	51.5035	1818.8320	51.5035
437.11	133.23	134.4794	12.4936	1823.2410	51.6284	1823.2410	51.6284
437.14	133.24	134.6643	12.5107	1827.6561	51.7534	1827.6561	51.7534
437.17	133.25	134.8496	12.5280	1832.0773	51.8786	1832.0773	51.8786
437.20	133.26	135.0355	12.5452	1836.5045	52.0040	1836.5045	52.0040
437.24	133.27	135.2220	12.5625	1840.9379	52.1295	1840.9379	52.1295
437.27	133.28	135.4089	12.5799	1845.3774	52.2552	1845.3774	52.2552
437.30	133.29	135.5964	12.5973	1849.8230	52.3811	1849.8230	52.3811
437.34	133.30	135.7844	12.6148	1854.2748	52.5072	1854.2748	52.5072
437.37	133.31	135.9759	12.6326	1858.7328	52.6334	1858.7328	52.6334
437.40	133.32	136.1702	12.6506	1863.1972	52.7598	1863.1972	52.7598
437.43	133.33	136.3655	12.6688	1867.6679	52.8864	1867.6679	52.8864
437.47	133.34	136.5617	12.6870	1872.1451	53.0132	1872.1451	53.0132
437.50	133.35	136.7599	12.7054	1876.6287	53.1402	1876.6287	53.1402
437.53	133.36	136.9612	12.7241	1881.1188	53.2673	1881.1188	53.2673
437.57	133.37	137.1623	12.7428	1885.6156	53.3946	1885.6156	53.3946
437.60	133.38	137.3624	12.7614	1890.1190	53.5222	1890.1190	53.5222
437.63	133.39	137.5630	12.7800	1894.6289	53.6499	1894.6289	53.6499
437.66	133.40	137.7646	12.7988	1899.1455	53.7778	1899.1455	53.7778
437.70	133.41	137.9678	12.8176	1903.6687	53.9058	1903.6687	53.9058
437.73	133.42	138.1732	12.8367	1908.1985	54.0341	1908.1985	54.0341
437.76	133.43	138.3819	12.8561	1912.7352	54.1626	1912.7352	54.1626
437.80	133.44	138.5883	12.8753	1917.2787	54.2912	1917.2787	54.2912
437.83	133.45	138.7922	12.8942	1921.8289	54.4201	1921.8289	54.4201
437.86	133.46	138.9926	12.9128	1926.3858	54.5491	1926.3858	54.5491
437.89	133.47	139.1910	12.9313	1930.9491	54.6783	1930.9491	54.6783
437.93	133.48	139.3888	12.9497	1935.5190	54.8077	1935.5190	54.8077
437.96	133.49	139.5867	12.9680	1940.0954	54.9373	1940.0954	54.9373
437.99	133.50	139.7860	12.9866	1944.6783	55.0671	1944.6783	55.0671
438.02	133.51	139.9848	13.0050	1949.2677	55.1971	1949.2677	55.1971
438.06	133.52	140.1828	13.0234	1953.8637	55.3272	1953.8637	55.3272
438.09	133.53	140.3827	13.0420	1958.4661	55.4575	1958.4661	55.4575
438.12	133.54	140.5820	13.0605	1963.0751	55.5880	1963.0751	55.5880

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
438.16	133.55	140.7811	13.0790	1967.6907	55.7187	1967.6907	55.7187
438.19	133.56	140.9845	13.0979	1972.3128	55.8496	1972.3128	55.8496
438.22	133.57	141.1878	13.1168	1976.9416	55.9807	1976.9416	55.9807
438.25	133.58	141.3922	13.1358	1981.5772	56.1120	1981.5772	56.1120
438.29	133.59	141.5980	13.1549	1986.2194	56.2434	1986.2194	56.2434
438.32	133.60	141.8054	13.1742	1990.8684	56.3751	1990.8684	56.3751
438.35	133.61	142.0181	13.1939	1995.5244	56.5069	1995.5244	56.5069
438.39	133.62	142.2276	13.2134	2000.1872	56.6389	2000.1872	56.6389
438.42	133.63	142.4376	13.2329	2004.8569	56.7712	2004.8569	56.7712
438.45	133.64	142.6483	13.2525	2009.5335	56.9036	2009.5335	56.9036
438.48	133.65	142.8600	13.2721	2014.2171	57.0362	2014.2171	57.0362
438.52	133.66	143.0721	13.2919	2018.9076	57.1690	2018.9076	57.1690
438.55	133.67	143.2850	13.3116	2023.6050	57.3021	2023.6050	57.3021
438.58	133.68	143.5038	13.3320	2028.3096	57.4353	2028.3096	57.4353
438.62	133.69	143.7210	13.3521	2033.0213	57.5687	2033.0213	57.5687
438.65	133.70	143.9356	13.3721	2037.7401	57.7023	2037.7401	57.7023
438.68	133.71	144.1468	13.3917	2042.4658	57.8361	2042.4658	57.8361
438.71	133.72	144.3560	13.4111	2047.1985	57.9702	2047.1985	57.9702
438.75	133.73	144.5633	13.4304	2051.9380	58.1044	2051.9380	58.1044
438.78	133.74	144.7703	13.4496	2056.6843	58.2388	2056.6843	58.2388
438.81	133.75	144.9777	13.4689	2061.4374	58.3734	2061.4374	58.3734
438.85	133.76	145.1853	13.4882	2066.1973	58.5081	2066.1973	58.5081
438.88	133.77	145.3934	13.5075	2070.9640	58.6431	2070.9640	58.6431
438.91	133.78	145.6012	13.5268	2075.7376	58.7783	2075.7376	58.7783
438.94	133.79	145.8086	13.5461	2080.5179	58.9137	2080.5179	58.9137
438.98	133.80	146.0155	13.5653	2085.3051	59.0492	2085.3051	59.0492
439.01	133.81	146.2297	13.5852	2090.0992	59.1850	2090.0992	59.1850
439.04	133.82	146.4380	13.6046	2094.9002	59.3209	2094.9002	59.3209
439.07	133.83	146.6476	13.6240	2099.7080	59.4571	2099.7080	59.4571
439.11	133.84	146.8570	13.6435	2104.5228	59.5934	2104.5228	59.5934
439.14	133.85	147.0690	13.6632	2109.3444	59.7299	2109.3444	59.7299
439.17	133.86	147.2804	13.6828	2114.1730	59.8667	2114.1730	59.8667
439.21	133.87	147.4907	13.7024	2119.0085	60.0036	2119.0085	60.0036
439.24	133.88	147.7005	13.7218	2123.8509	60.1407	2123.8509	60.1407
439.27	133.89	147.9134	13.7416	2128.7002	60.2780	2128.7002	60.2780
439.30	133.90	148.1302	13.7618	2133.5565	60.4155	2133.5565	60.4155
439.34	133.91	148.3561	13.7827	2138.4203	60.5533	2138.4203	60.5533
439.37	133.92	148.5661	13.8023	2143.2911	60.6912	2143.2911	60.6912
439.40	133.93	148.7696	13.8212	2148.1687	60.8293	2148.1687	60.8293
439.44	133.94	148.9711	13.8399	2153.0529	60.9676	2153.0529	60.9676
439.47	133.95	149.1722	13.8586	2157.9437	61.1061	2157.9437	61.1061
439.50	133.96	149.3738	13.8773	2162.8411	61.2448	2162.8411	61.2448

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
439.53	133.97	149.5773	13.8962	2167.7452	61.3837	2167.7452	61.3837
439.57	133.98	149.7780	13.9148	2172.6559	61.5227	2172.6559	61.5227
439.60	133.99	149.9788	13.9335	2177.5732	61.6619	2177.5732	61.6619
439.63	134.00	150.1800	13.9522	2182.4971	61.8014	2182.4971	61.8014
439.67	134.01	150.3805	13.9708	2187.4275	61.9410	2187.4275	61.9410
439.70	134.02	150.5802	13.9894	2192.3646	62.0808	2192.3646	62.0808
439.73	134.03	150.7789	14.0078	2197.3081	62.2208	2197.3081	62.2208
439.76	134.04	150.9775	14.0263	2202.2582	62.3609	2202.2582	62.3609
439.80	134.05	151.1774	14.0448	2207.2148	62.5013	2207.2148	62.5013
439.83	134.06	151.3785	14.0635	2212.1780	62.6418	2212.1780	62.6418
439.86	134.07	151.5779	14.0821	2217.1478	62.7826	2217.1478	62.7826
439.90	134.08	151.7779	14.1006	2222.1241	62.9235	2222.1241	62.9235
439.93	134.09	151.9788	14.1193	2227.1070	63.0646	2227.1070	63.0646
439.96	134.10	152.1793	14.1379	2232.0965	63.2059	2232.0965	63.2059
439.99	134.11	152.3842	14.1570	2237.0926	63.3473	2237.0926	63.3473
440.03	134.12	152.5827	14.1754	2242.0954	63.4890	2242.0954	63.4890
440.06	134.13	152.7801	14.1938	2247.1046	63.6309	2247.1046	63.6309
440.09	134.14	152.9783	14.2122	2252.1203	63.7729	2252.1203	63.7729
440.12	134.15	153.1772	14.2306	2257.1426	63.9151	2257.1426	63.9151
440.16	134.16	153.3769	14.2492	2262.1714	64.0575	2262.1714	64.0575
440.19	134.17	153.5770	14.2678	2267.2067	64.2001	2267.2067	64.2001
440.22	134.18	153.7778	14.2864	2272.2486	64.3429	2272.2486	64.3429
440.26	134.19	153.9778	14.3050	2277.2971	64.4858	2277.2971	64.4858
440.29	134.20	154.1753	14.3234	2282.3522	64.6290	2282.3522	64.6290
440.32	134.21	154.3709	14.3415	2287.4136	64.7723	2287.4136	64.7723
440.35	134.22	154.5638	14.3595	2292.4815	64.9158	2292.4815	64.9158
440.39	134.23	154.7544	14.3772	2297.5556	65.0595	2297.5556	65.0595
440.42	134.24	154.9428	14.3947	2302.6359	65.2033	2302.6359	65.2033
440.45	134.25	155.1293	14.4120	2307.7224	65.3474	2307.7224	65.3474
440.49	134.26	155.3146	14.4292	2312.8150	65.4916	2312.8150	65.4916
440.52	134.27	155.4995	14.4464	2317.9137	65.6359	2317.9137	65.6359
440.55	134.28	155.6843	14.4636	2323.0184	65.7805	2323.0184	65.7805
440.58	134.29	155.8690	14.4807	2328.1292	65.9252	2328.1292	65.9252
440.62	134.30	156.0535	14.4979	2333.2461	66.0701	2333.2461	66.0701
440.65	134.31	156.2375	14.5150	2338.3690	66.2152	2338.3690	66.2152
440.68	134.32	156.4211	14.5320	2343.4979	66.3604	2343.4979	66.3604
440.72	134.33	156.6013	14.5488	2348.6328	66.5058	2348.6328	66.5058
440.75	134.34	156.7779	14.5652	2353.7736	66.6514	2353.7736	66.6514
440.78	134.35	156.9532	14.5814	2358.9201	66.7971	2358.9201	66.7971
440.81	134.36	157.1276	14.5976	2364.0723	66.9430	2364.0723	66.9430
440.85	134.37	157.3018	14.6138	2369.2303	67.0891	2369.2303	67.0891
440.88	134.38	157.4777	14.6302	2374.3940	67.2353	2374.3940	67.2353

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
440.91	134.39	157.6522	14.6464	2379.5635	67.3817	2379.5635	67.3817
440.94	134.40	157.8227	14.6622	2384.7386	67.5282	2384.7386	67.5282
440.98	134.41	157.9900	14.6778	2389.9193	67.6749	2389.9193	67.6749
441.01	134.42	158.1563	14.6932	2395.1054	67.8218	2395.1054	67.8218
441.04	134.43	158.3215	14.7086	2400.2970	67.9688	2400.2970	67.9688
441.08	134.44	158.4859	14.7238	2405.4940	68.1159	2405.4940	68.1159
441.11	134.45	158.6500	14.7391	2410.6964	68.2633	2410.6964	68.2633
441.14	134.46	158.8175	14.7546	2415.9042	68.4107	2415.9042	68.4107
441.17	134.47	158.9823	14.7700	2421.1175	68.5583	2421.1175	68.5583
441.21	134.48	159.1435	14.7849	2426.3361	68.7061	2426.3361	68.7061
441.24	134.49	159.3048	14.7999	2431.5600	68.8540	2431.5600	68.8540
441.27	134.50	159.4665	14.8149	2436.7892	69.0021	2436.7892	69.0021
441.31	134.51	159.6285	14.8300	2442.0237	69.1503	2442.0237	69.1503
441.34	134.52	159.7904	14.8450	2447.2635	69.2987	2447.2635	69.2987
441.37	134.53	159.9538	14.8602	2452.5087	69.4472	2452.5087	69.4472
441.40	134.54	160.1158	14.8753	2457.7591	69.5959	2457.7591	69.5959
441.44	134.55	160.2768	14.8902	2463.0149	69.7448	2463.0149	69.7448
441.47	134.56	160.4375	14.9051	2468.2760	69.8937	2468.2760	69.8937
441.50	134.57	160.5979	14.9200	2473.5424	70.0429	2473.5424	70.0429
441.54	134.58	160.7578	14.9349	2478.8140	70.1921	2478.8140	70.1921
441.57	134.59	160.9176	14.9498	2484.0908	70.3416	2484.0908	70.3416
441.60	134.60	161.0764	14.9645	2489.3729	70.4911	2489.3729	70.4911
441.63	134.61	161.2343	14.9792	2494.6601	70.6408	2494.6601	70.6408
441.67	134.62	161.3909	14.9937	2499.9526	70.7907	2499.9526	70.7907
441.70	134.63	161.5469	15.0082	2505.2501	70.9407	2505.2501	70.9407
441.73	134.64	161.7026	15.0227	2510.5528	71.0909	2510.5528	71.0909
441.77	134.65	161.8579	15.0371	2515.8605	71.2412	2515.8605	71.2412
441.80	134.66	162.0153	15.0517	2521.1734	71.3916	2521.1734	71.3916
441.83	134.67	162.1709	15.0662	2526.4914	71.5422	2526.4914	71.5422
441.86	134.68	162.3257	15.0806	2531.8146	71.6929	2531.8146	71.6929
441.90	134.69	162.4796	15.0949	2537.1427	71.8438	2537.1427	71.8438
441.93	134.70	162.6340	15.1092	2542.4760	71.9948	2542.4760	71.9948
441.96	134.71	162.7864	15.1234	2547.8143	72.1460	2547.8143	72.1460
441.99	134.72	162.9366	15.1373	2553.1575	72.2973	2553.1575	72.2973
442.03	134.73	163.0848	15.1511	2558.5056	72.4487	2558.5056	72.4487
442.06	134.74	163.2322	15.1648	2563.8586	72.6003	2563.8586	72.6003
442.09	134.75	163.3788	15.1784	2569.2164	72.7520	2569.2164	72.7520
442.13	134.76	163.5245	15.1919	2574.5790	72.9039	2574.5790	72.9039
442.16	134.77	163.6693	15.2054	2579.9464	73.0559	2579.9464	73.0559
442.19	134.78	163.8134	15.2188	2585.3185	73.2080	2585.3185	73.2080
442.22	134.79	163.9572	15.2321	2590.6953	73.3603	2590.6953	73.3603
442.26	134.80	164.1006	15.2455	2596.0769	73.5126	2596.0769	73.5126

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)	
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)
442.29	134.81	164.2436	15.2587	2601.4631	73.6652	2601.4631	73.6652
442.32	134.82	164.3863	15.2720	2606.8540	73.8178	2606.8540	73.8178
442.36	134.83	164.5279	15.2852	2612.2496	73.9706	2612.2496	73.9706
442.39	134.84	164.6683	15.2982	2617.6498	74.1235	2617.6498	74.1235
442.42	134.85	164.8088	15.3113	2623.0546	74.2766	2623.0546	74.2766
442.45	134.86	164.9493	15.3243	2628.4641	74.4297	2628.4641	74.4297
442.49	134.87	165.0901	15.3374	2633.8781	74.5831	2633.8781	74.5831
442.52	134.88	165.2316	15.3505	2639.2968	74.7365	2639.2968	74.7365
442.55	134.89	165.3736	15.3637	2644.7201	74.8901	2644.7201	74.8901
442.59	134.90	165.5156	15.3769	2650.1481	75.0438	2650.1481	75.0438
442.62	134.91	165.6586	15.3902	2655.5807	75.1976	2655.5807	75.1976
442.65	134.92	165.8038	15.4037	2661.0181	75.3516	2661.0181	75.3516
442.68	134.93	165.9478	15.4171	2666.4603	75.5057	2666.4603	75.5057
442.72	134.94	166.0889	15.4302	2671.9071	75.6599	2671.9071	75.6599
442.75	134.95	166.2315	15.4434	2677.3585	75.8143	2677.3585	75.8143
442.78	134.96	166.3739	15.4567	2682.8147	75.9688	2682.8147	75.9688
442.81	134.97	166.5144	15.4697	2688.2754	76.1234	2688.2754	76.1234
442.85	134.98	166.6551	15.4828	2693.7408	76.2782	2693.7408	76.2782
442.88	134.99	166.7959	15.4959	2699.2108	76.4331	2699.2108	76.4331
442.91	135.00	166.9368	15.5089	2704.6855	76.5881	2704.6855	76.5881
442.95	135.01	167.0778	15.5221	2710.1647	76.7432	2710.1647	76.7432
442.98	135.02	167.2207	15.5353	2715.6486	76.8985	2715.6486	76.8985
443.01	135.03	167.3652	15.5488	2721.1372	77.0540	2721.1372	77.0540
443.04	135.04	167.5122	15.5624	2726.6306	77.2095	2726.6306	77.2095
443.08	135.05	167.6601	15.5761	2732.1289	77.3652	2732.1289	77.3652
443.11	135.06	167.8052	15.5896	2737.6319	77.5210	2737.6319	77.5210
443.14	135.07	167.9486	15.6030	2743.1397	77.6770	2743.1397	77.6770
443.18	135.08	168.0911	15.6162	2748.6522	77.8331	2748.6522	77.8331
443.21	135.09	168.2327	15.6293	2754.1693	77.9893	2754.1693	77.9893
443.24	135.10	168.3737	15.6424	2759.6911	78.1457	2759.6911	78.1457
443.27	135.11	168.5139	15.6555	2765.2175	78.3022	2765.2175	78.3022
443.31	135.12	168.6541	15.6685	2770.7485	78.4588	2770.7485	78.4588
443.34	135.13	168.7940	15.6815	2776.2841	78.6155	2776.2841	78.6155
443.37	135.14	168.9338	15.6945	2781.8242	78.7724	2781.8242	78.7724
443.41	135.15	169.0726	15.7074	2787.3690	78.9294	2787.3690	78.9294
443.44	135.16	169.2107	15.7202	2792.9182	79.0866	2792.9182	79.0866
443.47	135.17	169.3480	15.7330	2798.4720	79.2438	2798.4720	79.2438
443.50	135.18	169.4853	15.7457	2804.0303	79.4012	2804.0303	79.4012
443.54	135.19	169.6237	15.7586	2809.5932	79.5587	2809.5932	79.5587
443.57	135.20	169.7623	15.7714	2815.1605	79.7164	2815.1605	79.7164
443.60	135.21	169.8996	15.7842	2820.7324	79.8742	2820.7324	79.8742
443.64	135.22	170.0378	15.7970	2826.3088	80.0321	2826.3088	80.0321

Elevation (MSL, ft)	Elevation (MSL, m)	Area (M.Sq.ft)	Area (M.Sq.m)	Live Capacity		Gross Capacity (Live + Dead)		
				Volume (M.Cu.ft)	Volume (M.Cu.m)	Volume (M.Cu.ft)	Volume (M.Cu.m)	
443.67	135.23	170.1732	15.8096	2831.8897	80.1901	2831.8897	80.1901	
443.70	135.24	170.3079	15.8221	2837.4751	80.3483	2837.4751	80.3483	
443.73	135.25	170.4417	15.8346	2843.0648	80.5066	2843.0648	80.5066	
443.77	135.26	170.5747	15.8469	2848.6589	80.6650	2848.6589	80.6650	
443.80	135.27	170.7071	15.8592	2854.2574	80.8235	2854.2574	80.8235	
443.83	135.28	170.8392	15.8715	2859.8602	80.9821	2859.8602	80.9821	
443.86	135.29	170.9735	15.8840	2865.4673	81.1409	2865.4673	81.1409	
443.90	135.30	171.1036	15.8961	2871.0789	81.2998	2871.0789	81.2998	
443.93	135.31	171.2325	15.9080	2876.6946	81.4588	2876.6946	81.4588	
443.96	135.32	171.3613	15.9200	2882.3146	81.6180	2882.3146	81.6180	
444.00	135.33	171.4911	15.9321	2887.9388	81.7772	2887.9388	81.7772	**FRL**
444.03	135.34	171.6214	15.9442	2893.5673	81.9366	2893.5673	81.9366	
444.06	135.35	171.7538	15.9565	2899.2001	82.0961	2899.2001	82.0961	
444.09	135.36	171.8881	15.9689	2904.8373	82.2558	2904.8373	82.2558	
444.13	135.37	172.0217	15.9814	2910.4789	82.4155	2910.4789	82.4155	
444.16	135.38	172.1547	15.9937	2916.1248	82.5754	2916.1248	82.5754	
444.19	135.39	172.2869	16.0060	2921.7751	82.7354	2921.7751	82.7354	
444.23	135.40	172.4168	16.0181	2927.4297	82.8955	2927.4297	82.8955	
444.26	135.41	172.5445	16.0299	2933.0886	83.0557	2933.0886	83.0557	
444.29	135.42	172.6714	16.0417	2938.7516	83.2161	2938.7516	83.2161	
444.32	135.43	172.7980	16.0535	2944.4187	83.3766	2944.4187	83.3766	
444.36	135.44	172.9251	16.0653	2950.0901	83.5372	2950.0901	83.5372	
444.39	135.45	173.0521	16.0771	2955.7655	83.6979	2955.7655	83.6979	
444.42	135.46	173.1786	16.0888	2961.4452	83.8587	2961.4452	83.8587	
444.46	135.47	173.3044	16.1005	2967.1290	84.0197	2967.1290	84.0197	
444.49	135.48	173.4297	16.1122	2972.8169	84.1807	2972.8169	84.1807	
444.52	135.49	173.5548	16.1238	2978.5089	84.3419	2978.5089	84.3419	
444.55	135.50	173.6790	16.1353	2984.2050	84.5032	2984.2050	84.5032	

Annexure - 2

Mobilisation and Calibration Report

Machhu 1 Reservoir

1 MOBILISATION

1.1 Introduction

Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to carry out topographic and bathymetric survey of six reservoirs in the Saurashtra region; namely Shetrunji, Brahmani-1, Und 1, Machhu-1, Machhu-2 and Bhadar-1. However, as per instructions received from client (Document no: WRIDN/PB/ Bathymetry Suvey (Sau) 183/2021, dated 24th February 2021), the survey of Shetrunji reservoir was not to be carried out. Instead, the client provided a list of 8 new reservoirs where bathymetry and topographic survey were to be carried out against the cancelled Shetrunji reservoir.

This report documents the mobilisation and calibrations carried out by OSaS on board SMB Ocean for bathymetric and topographic survey of Machhu-1 reservoir at Saurashtra region, Gujarat.

The survey team arrived at the survey site on 01st February 2021. The survey team started mobilisation of equipment on 02nd February 2021 while the survey boat SMB Ocean was near the dam wall walkway of Machhu-1 dam.

To establish TBMs, two points were marked on the dam wall walkway which were spaced 20m apart. DGPS observations were carried out at each of these points for about 2 hours on the 02nd of February 2021. The levelling of these TBMs was carried out on the same day with respect to the known level of FRL provided by the client.

Initial system preparation and equipment checks were completed on 04th February 2021. Bar check was carried out every day before commencing the bathymetric survey.

The bathymetric and topographic survey commenced on 05th February and 07th February respectively at Machhu-1 reservoir. Bathymetric survey was completed on 02nd March 2021 and topographic survey was completed on 05th March 2021. The survey boat was demobilised on 02nd March 2021.

1.2 HSE Checks

A safety induction was given by the Party Chief prior to survey, detailing personnel responsibilities in the event of an emergency, life jacket locations, safety gear locations and procedures and signals for emergencies.

Back deck procedures were explained and enforced with no single man operations and all non-essential personnel keeping clear of operations. PPE included safety boots, hard hats and cover-all's for all personnel involved in back deck operations.

1.3 Survey Equipment list on SMB Ocean

1.3.1 *Navigation and Positioning*

Item	Quantity
Hemisphere DGPS system with cables	1
Navigation computer with Hypack software	1
Moxa 8-port cable	4
Hemisphere Atlas Link RTK system with all accessories	3

1.3.2 *Single beam Echo sounder*

Item	Quantity
Odom MK III Single beam echo sounder	2
Dual frequency transducer and mounting pole	2
Bar check	1

MRU-PD	2

1.3.3 *Levelling equipment*

Item	Quantity
Geomax auto level complete with all accessories	1 set

1.3.4 *Power Systems*

Item	Quantity
2KVA Stabilizer	2
1 KVA generator	2
24V power supply	4
Exide battery 100Ah	1
Invertor	1
12V External battery	3
12V External battery charger	3

1.3.5 *Miscellaneous*

Item	Quantity
LCD monitors	8
Laptop	2
Helmets / life jackets	8
Tool box	1
Tripod and Tri batch	4 & 3
Ranging Rod	3
Antenna T-Section	2 Sets
RF Antenna	3
10m RF antenna cable	3
Echo Rolls	52 nos
HP Printer	1 nos
UPS	2 Sets
Switch Board	8 Sets
Drill Machine	1 Set

1.4 Vessel Offset Diagram

The equipment offsets in the survey motor boat (SMB) Ocean are shown in the figure below:

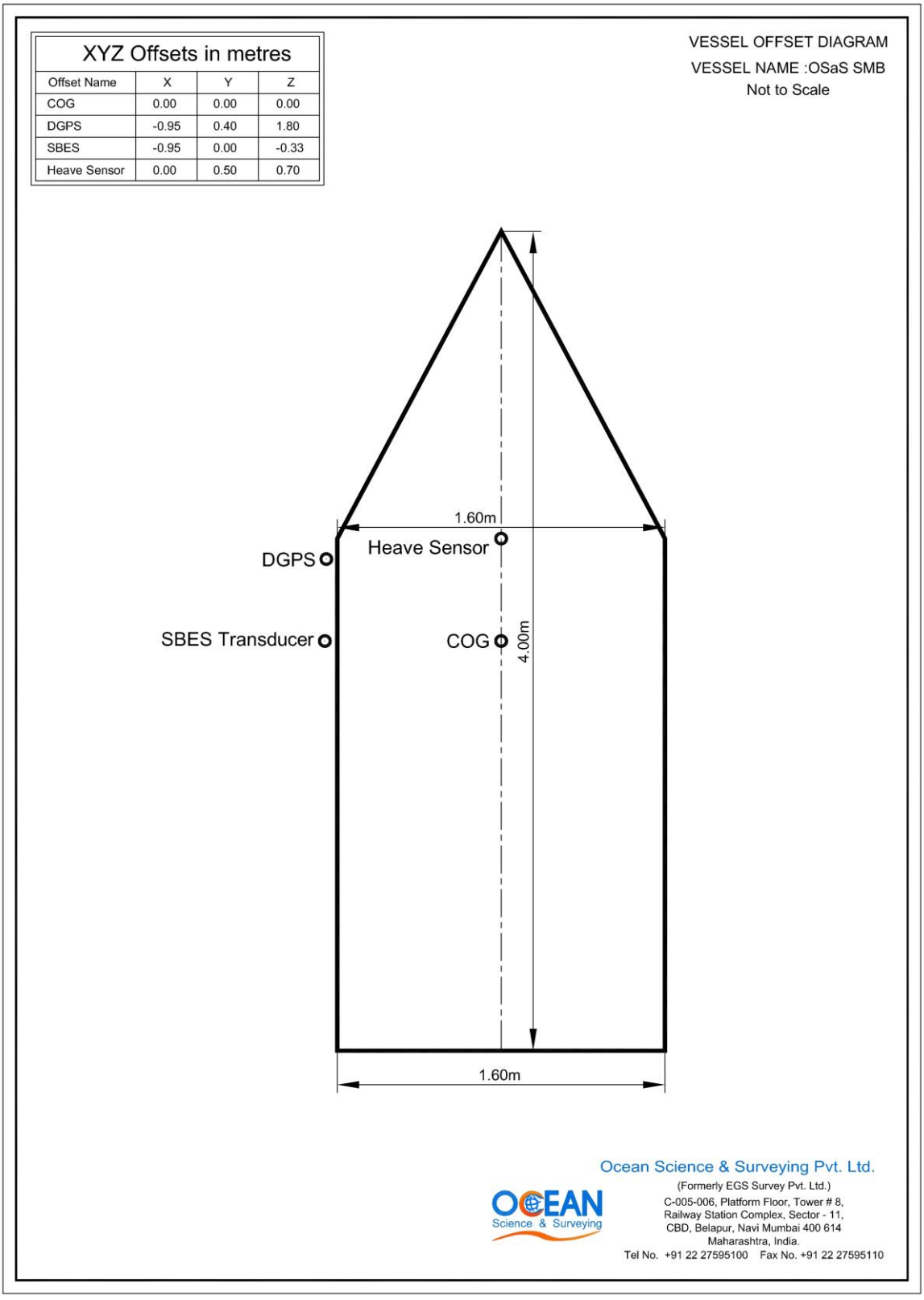


Figure 1: Vessel Offset Diagram

2 EQUIPMENT CALIBRATIONS

2.1 RTK system Calibrations

The details of the RTK system consistency checks are as follows:

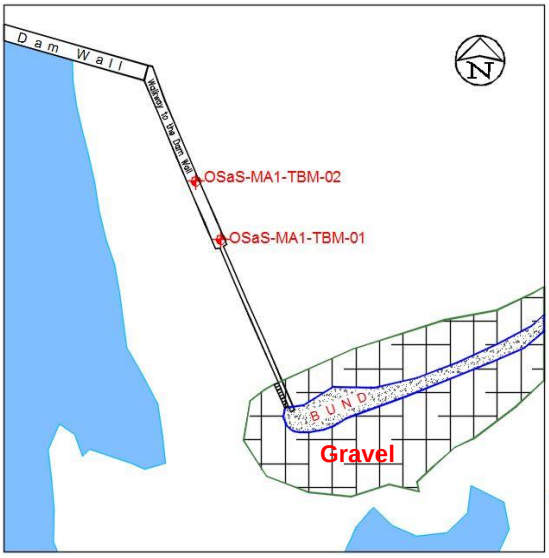
In order to determine the integrity and reliability of the positioning system, the system was checked for its consistency during mobilisation.

Two points were manually marked on the dam wall walkway, 20m apart. About 2 hours of DGPS observations were carried out at each of the two points. After observations, the two points were established as temporary control points/ temporary benchmark (TBM). The levelling of these TBMs were completed using Geomax auto level with respect to the known level of the FRL, which is given as 135.33m above MSL, provided by the client. The base stations of the Hemisphere Atlas Link RTK were set up at these positions and two-hour continuous observations were conducted using Hemisphere RTK positioning system to fix the consistency of the position for horizontal control. The system provides real time correction signals, providing centimetre level accuracy. Additional TBMs were established at various parts of the survey area to keep the rover in range with respect to this base station.

The details of reference stations OSaS-MA-TBM-01 and OSaS-MA-TBM-02 are provided in **Table 1** and **Table 2**.

Station Number:	OSAS-MA-TBM-01	**Latitude:**	22° 27.988' N
Locality:	Machhu-1, Gujarat	**Longitude:**	70° 58.404' E
Geodetic Datum:	WGS84	**Northing:**	2485795.762 m N
Projection:	Universal Transverse Mercator	**Easting:**	703052.022 m E
Date:	05th February 2021	**Elevation:**	143.04m above MSL
Station Description:	A square with a cross mark drawn inside it and text OSaS-MA-TBM-01 is written with yellow paint on the walkway to the dam wall.		
Access:	From the guest house at Machhu-1 dam head south-southeast for about 35m after which turn towards south-west and continue along the bund for about 135m to reach the dam walkway. Head towards north-west on the dam walkway for about 60m to reach the TBM location.		

Sketch:



Map:

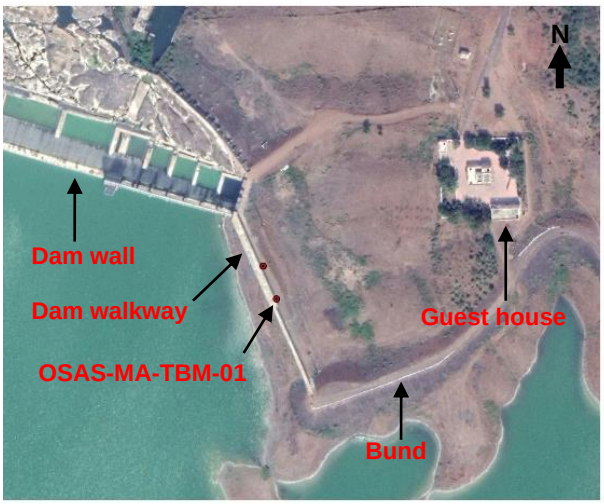
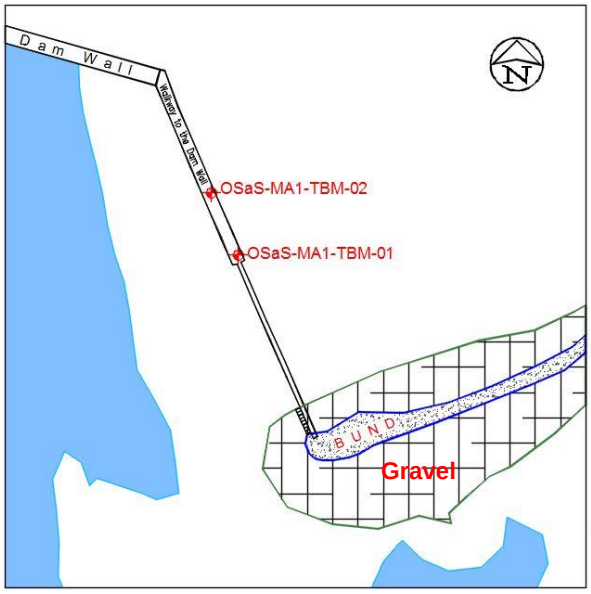


Table 1: Details of OSaS-MA-TBM-01

Station Number:	OSAS-MA-TBM-02	**Latitude:**	22° 27.998' N
Locality:	Machhu-1, Gujarat	**Longitude:**	70° 58.400' E
Geodetic Datum:	WGS84	**Northing:**	2485814.184 m N
Projection:	Universal Transverse Mercator	**Easting:**	703044.072 m E
Date:	05th February 2021	**Elevation:**	143.02m above MSL
Station Description:	A square with a cross mark drawn inside it and text OSaS-MA-TBM-02 is written with yellow paint on the walkway to the dam wall.		
Access:	From the guest house at Machhu-1 dam head south-southeast for about 35m after which turn towards south-west and continue along the bund for about 135m to reach the dam walkway. Head towards north-west on the dam walkway for about 80m to reach the TBM location.		

Sketch:



Map:

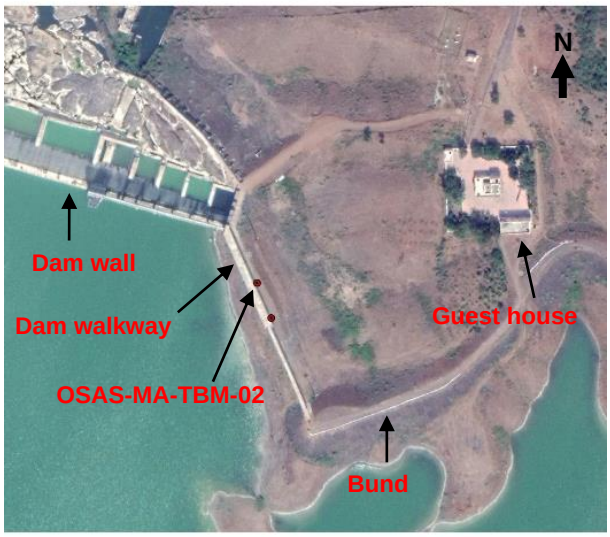


Table 2: Details of OSaS-MA-TBM-02

The following table summarises the details of the additional temporary control points (TBM) established at site during the survey to maintain the moving rover within the range of the base reference point.

Sr. No.	Easting	Northing	Elevation (m above MSL)	Station Code
1	702948.932	2483667.669	144.8	OSAS-MA1-TBM-03
2	704506.615	2483784.675	150.62	OSAS-MA1-TBM-04
3	700212.835	2481632.138	141.8	OSAS-MA1-TBM-05

2.2 Single Beam Echo Sounder

The average speed of sound through the water column was input to the single beam echo sounder when a bar-check was performed before the start of survey operations. The following **Figure 2** shows the bar check extract of the Odom MK III echo sounder used in SMB Ocean.

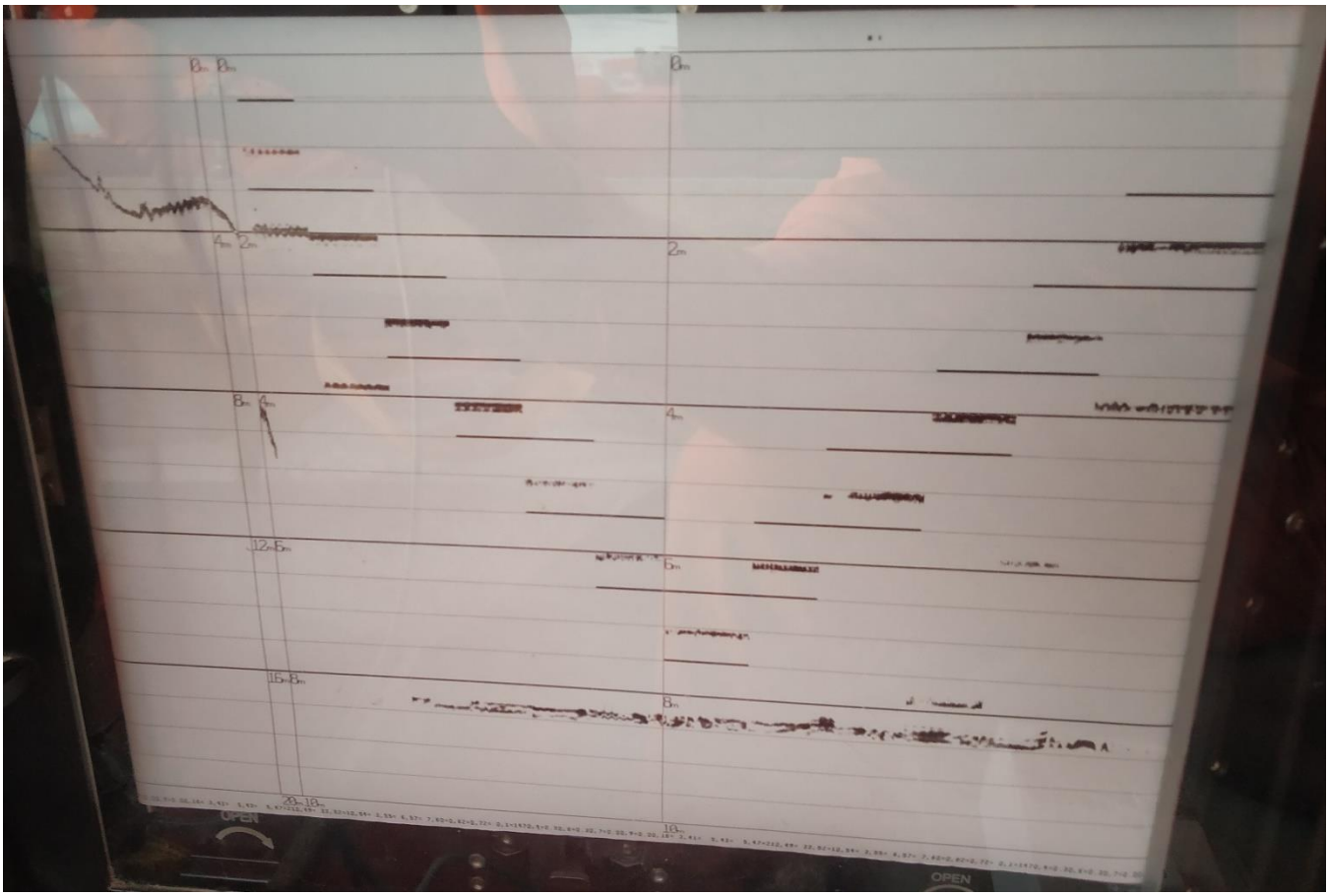


Figure 2: Bar check calibration on board OSAS SMB

3 CONCLUSIONS

Mobilisation for this project, including calibration and verification were carried out on board SMB Ocean in a safe and acceptable manner. All systems performed to the specifications throughout the length of the survey.

Annexure - 3

Previous data

Machhu 1 Reservoir

Table 1 and **Table 2** provide the previous survey data (1958), extracted from client provided report (Sedimentation studies in Machhu-1 irrigation scheme Nov. 1990).

STATEMENT NO: I

MACHHU-I IRRIGATION SCHEME

Calculation for Reservoir capacity as per original contour plan.

Sr. No.	Level R.L. in M/ft	Area of contour in Mm^2	Capacity in Mm^3	Commulative capacity in Mm^3
(1)	(2)	(3)	(4)	(5)
1.	114.30/375.00	0.0147	-	-
2.	115.82/380.00	0.1458	0.1047	0.1047
3.	117.34/385.00	0.2292	0.3143	0.4190
4.	118.87/390.00	0.4161	0.4349	0.8539
5.	120.39/395.00	0.6573	0.8575	1.7114
6.	121.92/400.00	0.9728	1.1783	2.8897
7.	123.44/405.00	1.4131	1.8422	4.7319
8.	124.96/410.00	1.7819	2.4173	7.1492
9.	126.49/415.00	2.4907	3.1719	10.3211
10.	128.01/420.00	3.6587	4.6324	14.9535
11.	129.54/425.00	5.1215	6.6394	21.5929
12.	131.06/430.00	7.7841	9.5378	31.1307

.. 2 ..

Table 1: Previous data (1958) Page 1 of 2

-: 2 :-

(1)	(2)	(3)	(4)	(5)
13.	132.28/434.00	9.9175	10.7717	41.9024
14.	134.11/440.00	13.2590	21.1326	63.0350
15.	135.33/444.00	19.9093	20.0957	83.1307

1. Prepared and Checked by me checked date 23.11.90

1. Shri P.J.Pankja, Asstt.Engineer Sd/-
2. Shri G.J.Joshi, Addl.Astt.Engineer Sd/-
3. Shri A.D.Virsodiya, Addl.Asstt.Engr. Sd/-

:::

Table 2: Previous data (1958) Page 2 of 2

Table 3 and **Error! Reference source not found.** provide the previous survey data (1989), extracted from client provided report (Sedimentation studies in Machhu-1 irrigation scheme Nov. 1990).

STATEMENT NO: II

MACHHU-I IRRIGATION SCHEME

Silt Survey of Machhu-I Irrigation Scheme (Capacity after siltation in June- 1989)

CAPACITY TABLE

Sr. No.	R.L. in m.	Interval of contour in m.	Area of contour Mm^2	Capacity Mm^3	Commulative capacity Mm^3	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	120.39	-	0.0007	-	-	O.S.L.
2.	121.00	0.61	0.2444	0.0497	0.0497	
3.	122.00	1.00	0.3387	0.389	0.4387	
4.	123.00	1.00	0.5331	0.3217	0.7604	
5.	124.11	1.11	1.65	1.155	1.9154	
6.	125.00	0.89	1.82	1.54	3.4554	
7.	126.00	1.00	2.200	2.170	5.6254	
8.	127.00	1.00	2.700	2.270	7.8954	
9.	128.00	1.00	3.750	3.313	11.2084	
10.	129.00	1.00	5.300	4.354	15.5624	

Table 3: Previous data (1989) Page 1 of 2

(2)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
11.	130.00	1.00	6.782	6.220	21.7824	
12.	131.00	1.00	8.290	7.350	29.1324	
13.	132.00	1.00	9.800	9.231	38.3634	
14.	133.00	1.00	11.100	10.299	48.6624	
15.	134.00	1.00	11.400	11.568	60.2304	
16.	135.33	1.33	12.000	15.559	75.7894	F.S.L.

Prepared by me
(Shri. D.B Patel

Checked by me
Shri Samir Eghal

:::

Table 4: Previous data (1989) Page 2 of 2

Annexure - 4

Daily Progress Reports

Machhu 1 Reservoir

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 001

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	06-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: M.I. Mansuri		Client Rep.	

Survey Personnel:

1. Prasant Panda	2. Pankaj Rabari	3. Nikhil Rane
4. Manoj More	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0745	0800	Transit to guest house to Machu 1 Dam.
0800	0830	RTK base setup.
0830	0845	Bar check carried out.
0915		Commenced Bathymetry survey.
1600		Commenced topographic survey.
1815	1845	Stopped survey for the day and team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.658sq.km**	Line km:**26.32**	Bathymetry: .658**sq.km**	Line km**: 26.32**
		Topo: **.122sq.km**	Line km: **4.88**	Topo: **,122 sq.km**	Line km: **4.88**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 002

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	07-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: M.I. Mansuri		Client Rep.	

Survey Personnel:

1. Prasant Panda	2. Pankaj Rabari	3. Nikhil Rane
4. Manoj More	5.	6.
7.	8.	9.
10.		

Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0715	0815	Team reached site and set up RTK reference station.
0815	0830	Bar check carried out
0840	0900	Commenced Bathymetry & Topographic survey.
1740	1815	Stopped bathymetry survey and picked up topo team on-board survey boat
1815	1900	Transit to base station and secured base.
1900	1920	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.41sq.km**	Line km:**24.0**	Bathymetry: .1.058 **sq.km**	Line km: **50.32**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:

Party Chief	**Client Representative**

DAILY PROGRESS REPORT	Form No.:	Sy01R
	Revision:	01
	Date:	11/07/2014
	Approved By	PKT

Location Machhu 1 DPR No. 003

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	08-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: M.I. Mansuri		Client Rep.	

Survey Personnel:

1.Prasant Panda	2.Pankaj Rabari	3.Nikhil Rane
4.Manoj More	5.	6.
7.	8.	9.
10.		

Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0715	0815	Team reached site and set up RTK reference station.
0815	1700	Commenced Bathymetry & Topographic survey.
1700	1745	Stopped bathymetry survey and picked up topographicsurvey team on-board survey boat.
1745	1830	Bar check carried out.
1830	1900	Transit to base station and secured base.
1830	1900	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.364sq.km**	Line km**:14.56**	Bathymetry: 1.269 **sq.km**	Line km**: 64.88**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 004

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	09-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: M.I. Mansuri		Client Rep.	

Survey Personnel:

1.Prasant Panda	2.Pankaj Rabari	3.Nikhil Rane
4.Manoj More	5.	6.
7.	8.	9.
10.		

Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0730	0825	Team reached site and set up RTK reference station.
0830	1730	Commenced Bathymetry & Topographic survey.
1600	1615	Bar check carried out
1730	1745	Stopped bathymetry survey and picked up topo team on-board survey boat
1800	1815	Transit to base station and secured base.
1815	1845	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.529 sq.km**	Line km:**31.17**	Bathymetry: 2.43**sq.km**	Line km:**97.28**
		Topo: **..424sq.km**	Line km:**17.00**	Topo:0.424 **sq.km**	Line km:**21.88**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 005

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	10-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: M.I. Mansuri		Client Rep.	

Survey Personnel:

1.Prasant Panda	2.Pankaj Rabari	3.Nikhil Rane
4.Manoj More	5.	6.
7.	8.	9.
10.		

Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0730	0835	Team reached site and set up RTK reference station.
0835	1730	Commenced Topographic survey.
0900	1645	Boat engine break down, called mechanic and repaired the engine.
1645	1745	Carried out engine trial and picked up topographic survey team
1800	1815	Transit to base station and secured base.
1815	1845	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.nil**	Line km: **0**	Bathymetry: .2.43sqkms	Line km: **97.28**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 006

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	11-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: M.I. Mansuri		Client Rep.	

Survey Personnel:

1.Prasant Panda	2.Pankaj Rabari	3.Nikhil Rane
4.Manoj More	5.	6.
7.	8.	9.
10.		

Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0715	0840	Team reached site and set up RTK reference station.
0835	1730	Commenced Bathymetric survey and Topographic survey.
0900	0915	Bar check carried out.
1730	1745	Stopped survey and picked up topo team on-board survey boat
1800	1815	Transit to base station and secured base.
1815	1830	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.825 sq.km**	Line km:**33.00**	Bathymetry: .3.255**sq.km**	Line km: **130.28**
		Topo: **.144sq.km**	Line km:**7.27**	Topo:0.913 **sq.km**	Line km:**38.07**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:

Party Chief	**Client Representative**

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 007

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	12-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: M.I. Mansuri		Client Rep.	

Survey Personnel:

1.Pankaj Rabari	2.Nikhil Rane	3.Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0715	0830	Team reached site and set up RTK reference station.
0830	0900	Bar check carried out.
0830	1730	Commenced Bathymetric survey and Topographic survey.
1730	1745	Stopped survey and picked up topo team on-board survey boat
1800	1815	Transit to base station and secured base.
1815	1830	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.0.877 sq kms**	Line km:**35.8**	Bathymetry: .4.13 Sq kms	Line km: **166.08**
		Topo: **0.436sq.km**	Line km:**17.44**	Topo:1.349. **sq.km**	Line km:**55.51**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Party Chief	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 008

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	13-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Pankaj Rabari		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Manoj More	3.
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0715	0830	Team reached site and set up RTK reference station.
0830	0900	Topography team reached at survey location.
0830	1730	Topographic survey commenced.
1730	1745	Topography team on-board survey boat.
1800	1815	Transit to base station and secured base.
1815	1830	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **.0**	Line km**: 0**	Bathymetry: 4.132**sq.km**	Line km**: 166.08**
		Topo: **.284sq.km**	Line km:**13.36**	Topo:1.633 **sq.km**	Line kms 68.87
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks: No bathy survey today due to generator break down.

Pankaj **Party Chief**	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 009

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	14-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Pankaj Rabari		Client Rep.	

Survey Personnel:

1. Nikhil Rane	2. Manoj More	3.
4.	5.	6.
7.	8.	9.
10.		

Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypack nav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0900	0930	Team reached site and set up RTK reference station.
0930	1000	Bar check carried out.
1000	1730	Commenced Bathymetric survey and Topographic survey.
1730	1745	Stopped survey and picked up topo team on-board survey boat
1800	1815	Transit to base station and secured base.
1815	1830	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.82sq.km**	Line km:**32.8**	Bathymetry: 4.952**sq.km**	Line km: **198.88**
		Topo: **0.361 sq.km**	Line km:**14.44**	Topo:1.994 **sq.km**	Line km:**83.31**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:

Pankaj **Party Chief**	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 010

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	15-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

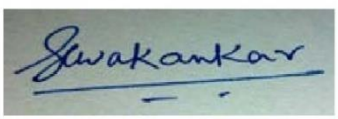
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	0900	Team reached site and set up RTK reference station.
0900	0920	Bar check carried out.
0920	1730	Commenced Bathymetric survey and Topographic survey.
1730	1745	Stopped survey and picked up topo team on-board survey boat
1800	1820	Transit to base station and secured base.
1820	1830	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.89sq.km**	Line km:**37.9**	Bathymetry: 5.842**sq.km**	Line km: **236.78**
		Topo: **0.41 sq.km**	Line km:**16.00**	Topo:2.404 **sq.km**	Line km:**99.31**
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 011

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	16-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

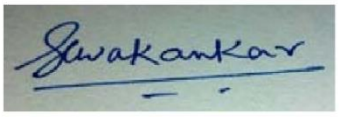
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
1100	1130	Team reached site and set up RTK reference station.
1130	1145	Bar check carried out.
1145	1700	Transit and Commenced Bathymetric survey and Topographic survey.
1730	1745	Stopped survey and picked up topo team on-board survey boat
1745	1820	Transit to base station and secured base.
1820	1830	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.46sq.km**	Line km**:18.4**	Bathymetry: **6.302sq.km**	Line km**: 255.18**
		Topo: **0.44 sq.km**	Line km:**17.93**	Topo:**2.844 sq.km**	Line km:**117.24**
		Weather downtime today: 3 hours		Cumulative weather downtime: 3 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 012

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	17-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

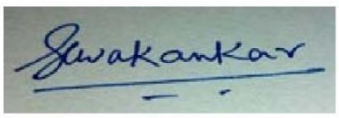
Equipment					
	RTKsystem	SBES system	Auto level	Heave sensor	
	Hypacknav system	Bar check	Generator		
	Computer				

Time (hrs)		**Activities**
0930	1000	Team reached site and set up RTK reference station.
1000	1300	Base station transferred, Bar check
1300	1700	Transit and Commenced Bathymetric survey and Topographic survey.
1700	1800	Stopped survey and picked up topo team on-board survey boat.
1800	1900	Transit to base station and secured base.
1900	1915	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.487sq.km**	Line km:**19.5**	Bathymetry: **6.789sq.km**	Line km: **274.68**
		Topo: **0.195 sq.km**	Line km:**7.8**	Topo:**3.039 sq.km**	Line km:**125.04**
		Weather downtime today: 1 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 013

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	18-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

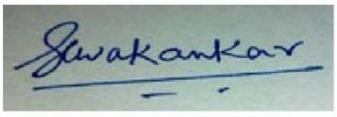
Equipment					
	RTKsystem	SBES system	Auto level	Heave sensor	
	Hypacknav system	Bar check	Generator		
	Computer				

Time (hrs)		**Activities**
0830	0930	Team reached site and set up RTK reference station.
0930	1000	Topo team dropped at survey location, Bar check carried out
1000	1700	Transit and Commenced Bathymetric survey and Topographic survey.
1700	1730	Stopped survey and picked up topo team on-board survey boat
1730	1800	Transit to base station and secured base.
1800	1815	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.55sq.km**	Line km:**22.0**	Bathymetry: 7.**339 sq.km**	Line km: **296.68**
		Topo: **0..203sq.km**	Line km:**8.15**	Topo:**3.242 sq.km**	Line km:**133.19**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 014

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	19-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

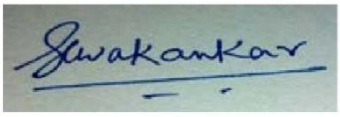
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	1000	Team reached site and set up RTK reference station
1000	1100	Topo team dropped at survey location, Bar check carried out
1100	1700	Transit and Commenced Bathymetric survey and Topographic survey.
1700	1730	Stopped survey and picked up topo team on-board survey boat
1730	1800	Transit to base station and secured base.
1800	1815	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.475sq.km**	Line km:**19.0**	Bathymetry**: 7.814sq.km**	Line km**: 315.68**
		Topo: **0.237 sq.km**	Line km:**9.50**	Topo:3**.479 sq.km**	Line km:**142.69**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with bathymetric and topographic survey.

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 015

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	20-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

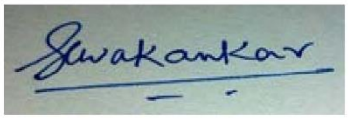
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0830	1000	Team reached site and set up RTK reference station.
1000	1700	Topo team Commenced topographic survey.
1300	1330	Bar check carried out.
1330	1700	Transit to the survey area and Commenced Bathymetric survey.
1700	1800	Picked topo team on board and transit to the base, secured base.
1800	1815	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.075sq.km**	Line km**:3.0**	Bathymetry**: 7.889sq.km**	Line km**: 318.68**
		Topo: **0.51 sq.km**	Line km:**20.4**	Topo:3**.989 sq.km**	Line km:**163.09**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with topographic survey.

Remarks: 1030 to 1300, Boat engine propeller protection plate repaired.



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 016

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	21-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

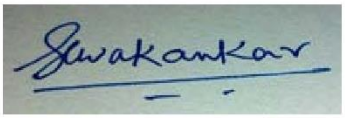
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	0900	Team reached site and set up RTK reference station
0900	0930	Topo Team dropped at survey location,
0930	1700	Topo Infill survey carried out
1700	1800	Picked topo team on board and transit to the base, secured base
1800	1815	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry**: 7.889sq.km**	Line km**: 318.68**
		Topo: **0.127 sq.km**	Line km:**5.10**	Topo:4.116 **sq.km**	Line km:**168.19**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with Topographic survey.

Remarks: Boat engine is under repair and bathy survey will continue after the engine is operational.

 **Party Chief**	**Client Representative**

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 017

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	22-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

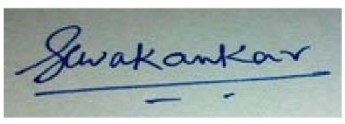
1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

Equipment					
	RTKsystem	SBES system	Auto level	Heave sensor	
	Hypacknav system	Bar check	Generator		
	Computer				

Time (hrs)		**Activities**			
0830	1830	No progress due to non-availability of boat and transport. Engine sent to workshop at Alang for repair			
		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.889sq.km**	Line km: **318.68**
		Topo: **00 sq.km**	Line km:	Topo:4.116 **sq.km**	Line km:**168.19**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with Topographic and Bathy survey.

Remarks: boat engine operational at 2200 hrs.



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 018

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	23-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

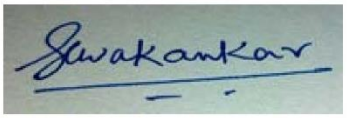
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	0900	Team reached site and set up RTK reference station.
0900	0930	Topo team dropped at survey location,
0930	1700	Topo survey carried out.
1700	1800	Picked topo team on board and transit to the base, secured base.
1800	1815	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.889sq.km**	Line km: **318.68**
		Topo: **0.42 sq.km**	Line km:**16.80**	Topo:**4.536 sq.km**	Line km:**184.99**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks: Both the teams carried out topographic survey. Bathy area almost completed except few patches



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 019

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	24-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

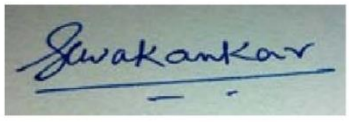
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	0930	Team reached site and set up RTK reference station.
0930	1000	Topo Team dropped at survey location.
1000	1800	Topo survey carried out.
1800	1900	Picked topo team on board and transit to the base, secured base.
1900	1915	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.652sq.km**	Line km: **318.68**
		Topo: **0.437 sq.km**	Line km:**17.50**	Topo:**4.973 sq.km**	Line km:**202.49**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 020

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	25-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

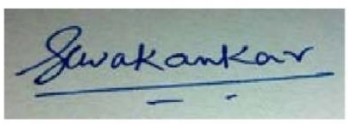
Equipment				
	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0830	0930	Team reached site and set up RTK reference station
0930	1000	Topo team dropped at survey location by boat.
1000	1730	Topo survey carried out.
1730	1800	Picked topo team on board and transit to the base, secured base.
1800	1815	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.652sq.km**	Line km: **318.68**
		Topo: **0.80 sq.km**	Line km:**32.00**	Topo:5.773 **sq.km**	Line km:**234.49**
		Weather downtime today: 0 hour		Cumulative weather downtime: 4 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 021

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	26-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

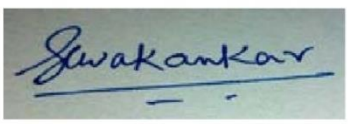
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0930	1030	Team reached site and set up RTK reference station
1030	1100	Topo team dropped at survey location,
1100	1700	Topo survey carried out
1700	1800	Picked up topo team on board and transit to the base, secured base
1800	1815	Team return to guest house.

	Today's coverage		Cumulative coverage	
	Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry**: 7.889sq.km**	Line km**: 318.68**
	Topo: **0.71 sq.km**	Line km:28**.40**	Topo:**6.483 sq.km**	Line km:**262.89**
	Weather downtime today: 1 hour		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks: Start of survey delayed due to poor visibility



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 022

Client:	Narmada Water Resources, Water Supply &Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	27-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

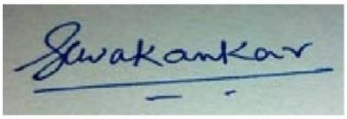
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	1000	Team reached site and set up RTK reference station
1000	1700	Topo survey carried out
1700	1830	Picked up topo team on board and transit to the base, secured base
1830	1845	Team return to guest house.

	Today's coverage		Cumulative coverage	
	Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.889sq.km**	Line km: **318.68**
	Topo: **0.89 sq.km**	Line km:**35.6**	Topo:**7.373sq.km**	Line km:**298.49**
	Weather downtime today: 1 hour		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks: Start of survey delayed due to poor visibility



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 023

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	28-02-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

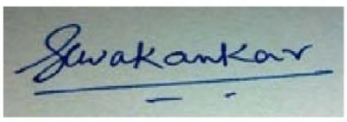
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	1000	Team reached site and set up RTK reference station
1000	1700	Topo survey carried out
1700	1830	Picked up topo team on board and transit to the base, secured base
1830	1845	Team return to guest house.

	Today's coverage		Cumulative coverage	
Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry**: 7.889sq.km**	Line km**: 318.68**
Topo: **0.72 sq.km**	Line km:**28.8**	Topo:**8.093 sq.km**	Line km:**327.29**
Weather downtime today: 1 hour		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 024

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	01-03-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

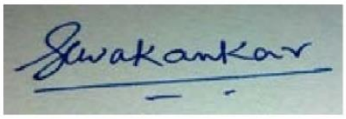
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	1000	Team reached site and set up RTK reference station
1000	1700	Topo survey carried out
1700	1830	Picked topo team on board and transit to the base, secured base
1830	1845	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.652sq.km**	Line km: **318.68**
		Topo: **1.34 sq.km**	Line km:**53.6**	Topo:**9.433 sq.km**	Line km:**380.89**
		Weather downtime today: 1 hour		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks:



Party Chief | **Client Representative**

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 025

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	02-03-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

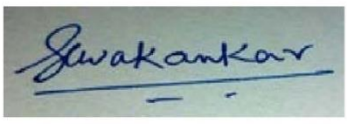
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0830	1000	Team reached site and set up RTK reference station
1000	1700	Topo survey carried out
1700	1830	Picked up topo team on board and transit to the base, secured base
1830	1845	Team return to guest house.

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.652sq.km**	Line km: **318.68**
		Topo: **1.00 sq.km**	Line km:**40.0**	Topo:**10.433 sq.km**	Line km:**420.89**
		Weather downtime today: 0 hour		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Continue with topographic survey

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 026

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	03-03-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

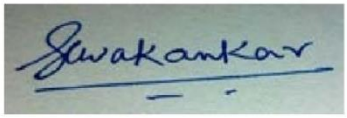
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	0930	Team reached site and set up RTK reference station
0930	1100	Base station transferred
1100	1700	Topo survey carried out
1700	1800	Picked topo team on board and transit to the base, secured base
1800	1900	Survey boat demobilised
1900	1915	Team return to guest house

		Today's coverage		Cumulative coverage	
		Bathymetry: **0.00sq.km**	Line km:**0.0**	Bathymetry: **7.652sq.km**	Line km: **318.68**
		Topo: **0.65 sq.km**	Line km:**26.0**	Topo:**11.083 sq.km**	Line km:**446.89**
		Weather downtime today: 0 hour		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks:



Party Chief

Client Representative

OCEAN Science & Surveying	**DAILY PROGRESS REPORT**	*Form No.:*	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 027

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	04-03-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

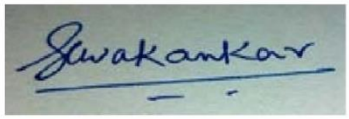
Equipment	RTKsystem	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		**Activities**
0830	0930	Team reached site and set up RTK reference station
0930	1100	Base station transferred
1100	1700	Topo survey carried out
1700	1800	Picked topo team on board and transit to the base, secured base
1800	1815	Team return to guest house

		Today's coverage		Cumulative coverage	
		Bathymetry: **sq.km**	Line km:	Bathymetry: **8.039sq.km**	Line km: **324.68**
		Topo: **1.2 sq.km**	Line km:**48.0**	Topo:**12.283 sq.km**	Line km:**494.89**
		Weather downtime today:hour		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Continue with Topographic survey

Remarks: Bathy infill survey carried out on 2nd March and the coverage is updated in today's DPR



Party Chief

Client Representative

OCEAN Science & Surveying	DAILY PROGRESS REPORT	Form No.:	Sy01R
		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Location Machhu 1 DPR No. 028

Client:	Narmada Water Resources, Water Supply & Kalpsar Department	Project No:	P34320
Vessel:	OSaS SMB	Date:	05-03-2021
Location:	Machhu 1 Dam	Sheet No:	1 of 1
Party Chief: Santosh Wakankar		Client Rep.	

Survey Personnel:

1. Pankaj Rabary	2. Nikhil Rane	3. Manoj More
4.	5.	6.
7.	8.	9.
10.		

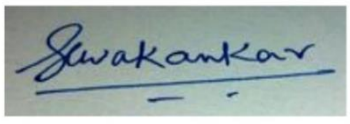
Equipment	RTK system	SBES system	Auto level	Heave sensor
	Hypacknav system	Bar check	Generator	
	Computer			

Time (hrs)		Activities
0830	0930	Team reached site and set up RTK reference station
0930	1030	Base station transferred
1030	1300	Topo survey carried out
1300	1400	Picked topo team on board and transit to the base, secured base
1400	1415	Team return to guest house

		Today's coverage		Cumulative coverage	
		Bathymetry: - **sq.km**	Line km:**-**	Bathymetry: **7.802sq.km**	Line km: **324.68**
		Topo: **0.1 sq.km**	Line km:**10.0**	Topo:**12.654 sq.km**	Line km:**492.914**
		Weather downtime today: -		Cumulative weather downtime: 5 hours	

Plan for next 24 hours: Demobilisation

Remarks: Survey Completed at Machhu 1, requesting Demob.



Party Chief

Client Representative