

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

Nara Reservoir

Owner



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OSAS Report no.

OSaS/P34320/WRD/Reservoirs/Nara/178i

27th September 2021 Rev 1

DOCUMENT ISSUE FORM

Document Type	Survey Report			
Prelim/Draft/Final/Other	Draft			
Document Title	Topographic and Bathymetric Survey of Reservoirs for Water Resources Department, Govt. of Gujarat at Saurashtra and Northern Gujarat Region, Gujarat – Nara Reservoir			
Document No.	OSaS/P34320/WRD/Saurashtra/ Nara /178i Rev 1			
Prepared at	Ocean Science & Surveying Pvt. Ltd. Data Processing Centre Navi-Mumbai.			
Submitted to	Narmada Water Resources, Water Supply & Kalpsar Department			
No. of copies	By email			
Project No.	P34320			
Revisions				
Rev	Date	Description	Prepared by	Checked by
0	14.09.2021	Draft	Binukumar	Farokh Patel
1	27.09.2021	Comments inc.	Binukumar	Farokh Patel
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Amendments in Revision 1				
No.	Section, Page	Description		
1.	8.3,1, 24	Table 7 Removed		
2.	8.4, 25	Table 7 Removed		
3.	8.5, 27	Table 7 Removed		
4.	8.8, 30	Area data of 1986 survey included in Table 9		

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1.	OSaS_P34320_WRD_Nara_OV_01	Overview Map Scale: 1:10000
2.	OSaS_P34320_WRD_Nara_CC_02	Contour Map Scale: 1:10000
3.	OSaS_P34320_WRD_Nara_03	Bathymetry and Topography Chart Scale: 1:5000; Grid: 25m X 25m
4.	OSaS_P34320_WRD_Nara 1_04	Bathymetry and Topography Chart Scale: 1:5000; Grid: 25m X 25m
5.	OSaS_P34320_WRD_Nara 1_05	Bathymetry and Topography Chart Scale: 1:5000; Grid: 25m X 25m
6.	OSaS_P34320_WRD_Nara_LP_06	Longitudinal Profile Along Lowest Line Scale: 1:5000
7.	OSaS_P34320_WRD_Nara_CP_07	Cross Section Profiles 01 - 18 Scale: 1:5000
8.	OSaS_P34320_WRD_Nara_CP_08	Cross Section Profiles 19 - 28 Scale: 1:5000
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ABBREVIATIONS

WRD	Water Resources Department
BM	Benchmark
C.M.	Central Meridian
CD	Chart Datum
cm	Centimetre
ddmm.mmm	Degrees minutes. decimal minutes
DGPS	Differential Global Positioning System
DTM	Digital Terrain Model
DSL	Dead Storage Level
FRL	Full reservoir Level
GPS	Global Positioning System
HSE	Health, Safety & Environment
ID	Identification name/number
IHO	International Hydrographic Organization
kHz	Kilohertz
km	Kilometre
KP	Kilometre Post
Lat	Latitude
LBM	Local Benchmark
Long	Longitude
m	Metre
MCum	Million Cubic Metre
MDDL	Minimum Drawdown Level
MSL	Mean Sea Level
MSqm	Million Square Metre
MV	Motor Vessel
NA	Not Applicable
NU	North Up
OSL	Outlet Sill Level
SOW	Scope of Work
SVP	Sound Velocity Profile
UTM	Universal Transverse Mercator projection
w.d.	Water depth
WGS84	World Geodetic System 1984

EXECUTIVE SUMMARY

Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to carry out topographic and bathymetric surveys of thirteen reservoirs in the Saurashtra region; namely Bhadar-1, Bhadar-2, Brahmani-1, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Nara, Tappar, Rudramata, Mitti and Fatehgadh.

This report describes the results of the topographic and bathymetric survey services provided by OSaS to the WRD for topographic and bathymetric mapping of the Nara reservoir, Kutch (Northern Gujarat) region, Gujarat.

The mobilisation of equipment started on 5th June 2021. A DGPS consistency check was done on 5th June by establishing two reference stations (TBMs) using RTK systems. The topographic survey commenced on 6th June at Nara reservoir and was completed on 23rd June.

The mobilisation of the survey boat SMB OSaS for the bathymetric survey was carried out on 16th June. Initial system preparation and equipment checks were completed on the same day. Bathymetric survey commenced on 17th June and was completed on 20th June. The survey boat was demobilised on 22nd June.

The survey data was processed at the site on a daily basis and reporting and charting was completed in the OSaS data processing centre in Navi-Mumbai after 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 data has been reduced to MSL using the observed average water level of each day during the survey period. Topographic data has been reduced to MSL using the TBMs established in the field with respect to the known level of FRL.

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

The construction work of Nara dam commenced in 1972 and was completed in 1981. As per the Capacity survey done in 1986, gross storage was 39.700 M.cu.m (at FRL 27.43m above MSL) and the dead storage was 1.490 M.cu.m (at OSL: 18.28m above MSL).

The current survey (2021) obtained the gross storage at FRL (27.43m above MSL) is 44.235 M.Cu.m and the dead storage (at OSL: 18.28m above MSL) is 1.526 M.cu.m.

Bathymetric and topographic survey was restricted at some places due to the presence of cliff terrain, nallas with unsafe and marshy ground and bushes with thick vegetation.

In the current bathymetric and topographic survey, a minimum elevation of 14.2m was observed in the northeastern portion of the survey area within the bathymetric section and a maximum topographic elevation value of 33.43m is observed at the crest of the dam, in the extreme northeastern portion of the survey area.

The average elevation change within the bathymetric survey area is between 14.2m and 21.2m and that of the topographic survey area between 18.64m and 33.43m.

Most of the outer survey boundaries occur around the 28m elevation contour. Scattered elevated areas with elevation contours between 28m and 33m were observed within the survey area.

In the northern half of the survey area, the topography is observed to be slightly irregular, with moderate to very steep slopes from the outer boundaries to the dam area between the elevation contours 33m and 21m, whereas in the southern half, moderate to very gentle slopes were observed from the outer boundaries to the dam area between the elevation contours 28m and 21m.

Most of the water-occupied area of the reservoir lies within the 21m elevation contour in the central and northeastern portions of the survey area. The reservoir bed within this area is slightly irregular, associated with scattered depressions and humps. A minimum elevation contour of 15m is observed adjacent to the wall of the dam. Two islands were observed within the bathymetric survey area, showing a change in elevation contours between 21m and 23m.

The current survey data was compared with the capacity survey data in 1986. The comparison between 1986 and 2021 (35 years) data results shows a rate of erosion of 5.56 Ha.m/100sq.km./year. Annual percentage of increase of gross storage capacity, live storage capacity and dead storage capacity are 0.33%, 0.34% and 0.07% respectively.

The comparison of current survey data and the capacity data of the 1986 survey shows an increase in capacity due to erosion at both the dead storage area and live storage area. The capacity at OSL (18.28m) increased from 1.490 M.cu.m to 1.526 M.cu.m between the years 1986 and 2021 with an increase in capacity of about 2.42%. The gross capacity at FRL (27.43m) increased from 39.700 M.cu.m to 44.235 M.cu.m between the years 1986 and 2021 with an increase in capacity of about 11.42%.

During the years 1986 to 2021, the amount of sediment eroded during this period up to OSL is 0.036 M.cu.m and amount of sediment eroded up to FRL is 4.535 M.cu.m. The increase in capacity could be due to the erosion of the reservoir bank or conversion of more irregular water spread areas around the F.R.L into levelled cultivation fields.

Within the reservoir, sediment deposition and corresponding reduction in capacity have been observed between the elevations 14m to 17.0m and 18.5m to 21.50m. The increase of sediment deposit and the corresponding reduction in capacity could be due to the abundant sediment inflow into the reservoir due to floods or erosion of reservoir banks above these levels.

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.

To that end Ocean Science & Surveying Pvt. Ltd. (OSaS) was contracted by Narmada Water Resources, Water Supply & Kalpsar Department (WRD) to carry out topographic and bathymetric surveys of thirteen reservoirs in the Saurashtra and northern Gujarat regions; namely Bhadar-1, Bhadar-2, Brahmani-1, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Nara, Tappar, Rudramata, Mitti and Fatehgadh.

This report describes the results of the topographic and bathymetric survey services provided by OSaS to WRD for topographic and bathymetric mapping of the Nara reservoir in Kutch (Northern Gujarat) region, Gujarat.

1.1 Background of survey area

The Nara River originates near the Paneli village, in the southeastern parts of Lakhpat tehsil in the Kachchh district, and empties into the Great Rann of Kutch. It has a length of 25 km, and a catchment area of 233.01 sq.km.

The average rainfall in the Nara basin is 307 mm. In winter, the temperature varies between 16°C and 29°C in different parts of the region. May is the hottest month, when the temperature varies between 29°C and 42°C.

The Nara dam is located on River Nara. The construction works for Nara dam commenced in the year 1972 and were completed in the year 1981. It is an earthen and masonry type dam. This dam fulfills its operating purpose of irrigation and water supply efficiently.

1.2 General Location

The reservoirs of Saurashtra and Northern Gujarat region surveyed in this project are shown on the Google Earth image in **Figure 1**.



Figure 1: Survey areas/reservoirs of Saurashtra and Northern Gujarat regions

This report specifically focuses on the results of topographic and bathymetric survey of the Nara reservoir situated within the Kutch (Northern Gujarat) region, shown in the Google earth image below:

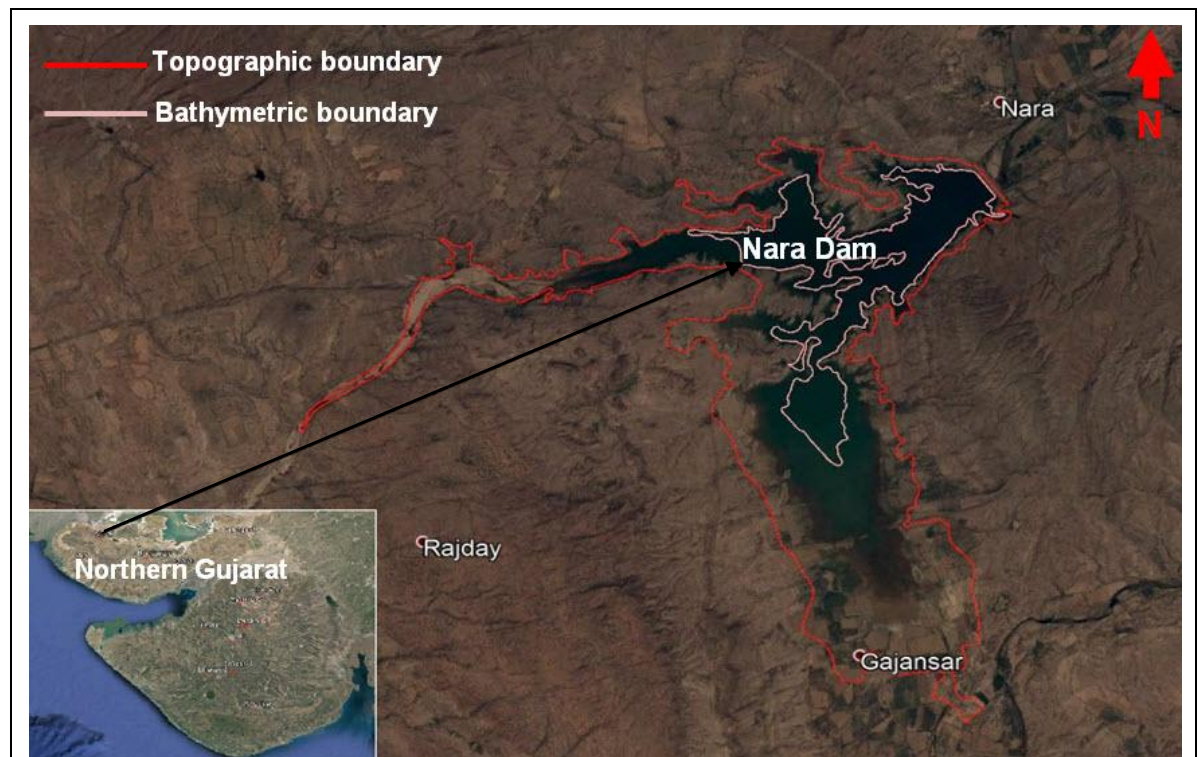


Figure 2: Survey area – Reservoir Nara

2 SCOPE OF WORK

The scope of work for the survey was:

- To mobilize requisite topographic equipment and personnel at the sites specified by the client.
- To mobilize a suitable vessel along with requisite bathymetric equipment and personnel at the sites specified by the client.
- To carry out topographic and single beam echo sounder bathymetric survey in the specified areas.
- To estimate and study the sedimentation behaviour of the 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 topography 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 topography change over time.
- To upgrade elevation-area-capacity tables /curves of the reservoirs.
- To prepare contour plan, Longitudinal profile (L-section), Cross section profiles...etc.

2.1 Salient Features of Survey Area

The Nara dam is basically an irrigation scheme located on River Nara in the Kutch (Northern Gujarat) region, in the Western Indian state of Gujarat. The construction works for Nara dam commenced in the year 1972 and were completed in the year 1981.

The following salient features of Nara reservoir are extracted from the document provided by the client:

- | | |
|---------------------------------|------------------------|
| a. Location | |
| Latitude | : 23° – 38' – 30.49" N |
| Longitude | : 69° – 07' – 12.46" E |
| b. Total Catchment Area | : 233.01 sq.km |
| c. Full Reservoir Level (FRL) | : 27.43 m |
| d. High Flood Level (HFL) | : 32.54 m |
| e. Outlet Sill Level (MDDL/OSL) | : 18.28 m |
| f. Gross Storage | : 39.700 M.cu.m |
| g. Dead Storage | : 01.490 M.cu.m |
| h. Live Storage | : 38.220 M.cu.m |
| i. Area at FRL | : 09.30 sq.km |

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 FRL of the reservoir, which is 27.43m (89.99ft.) above MSL, as provided by the client. The bathymetric survey was conducted using RTK positioning system and single beam echo sounder.

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

Name of Reservoir	Bathymetric area surveyed (sq. km.)	Topographic area surveyed (sq. km.)
Nara	2.606	8.191

Table 1: Surveyed areas for Nara reservoir

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.

GEODETTIC 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 (TBM). The levelling of these TBMs was carried out using an auto level with respect to the known level of FRL which is given as 27.43m above MSL, as provided by the client. The base stations of the RTK were set up at these positions and two-hour long continuous observations were conducted using a 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 the base station.

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

Station Number:	OSaS-NA-TBM-01	Latitude:	23° 38' 29.532" N
Locality:	Nara, Gujarat	Longitude:	69° 7' 19.869" E
Geodetic Datum:	WGS84	Northing:	2614545.91 m N
Projection:	Universal Transverse Mercator	Easting:	512461.85 m E
Date:	5 th June 2021	Elevation:	30.696 m above MSL
Station Description:	A circle with text OS-TBM-1 is drawn with yellow paint on the walkway to the valve tower from the top of the dam.		
Access:	Road to the top of the reservoir. The TBM-01 is situated on the walkway to the valve tower from the top of the dam.		

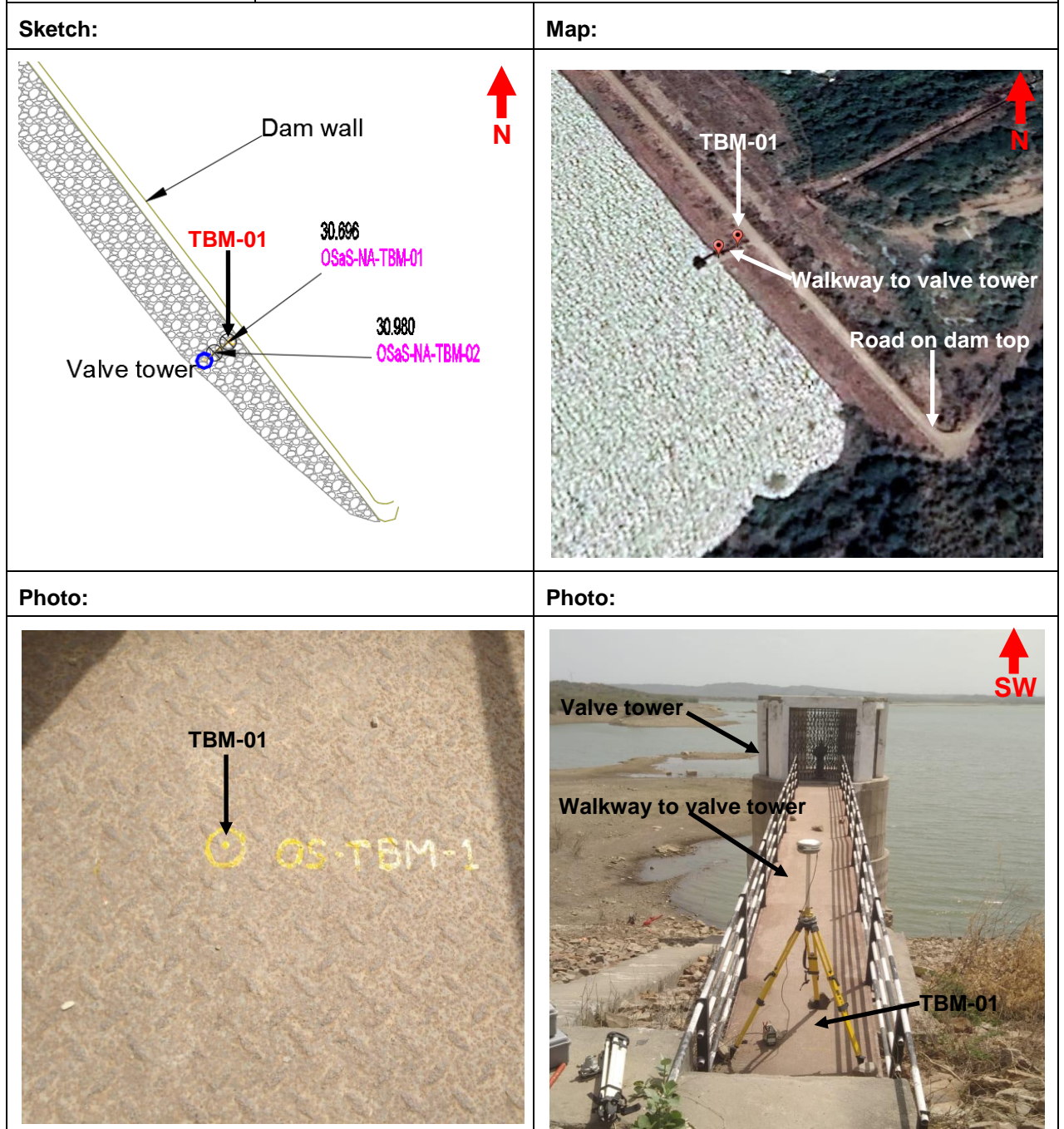


Figure 3: Details of OSaS-NA-TBM-01

Station Number:	OSaS-NA-TBM-02	Latitude:	23° 38' 29.331" N
Locality:	Nara, Gujarat	Longitude:	69° 7' 19.592" E
Geodetic Datum:	WGS84	Northing:	2614539.73 m N
Projection:	Universal Transverse Mercator	Easting:	512453.99 m E
Date:	5 th June 2021	Elevation:	30.980 m above MSL
Station Description:	A circle with text OS-TBM-2 is drawn with yellow paint on the walkway to the valve tower from the top of the dam.		
Access:	Road to the top of the reservoir. The TBM-02 is situated 10m southwest of TBM1 on the walkway to the valve tower from top of the dam.		

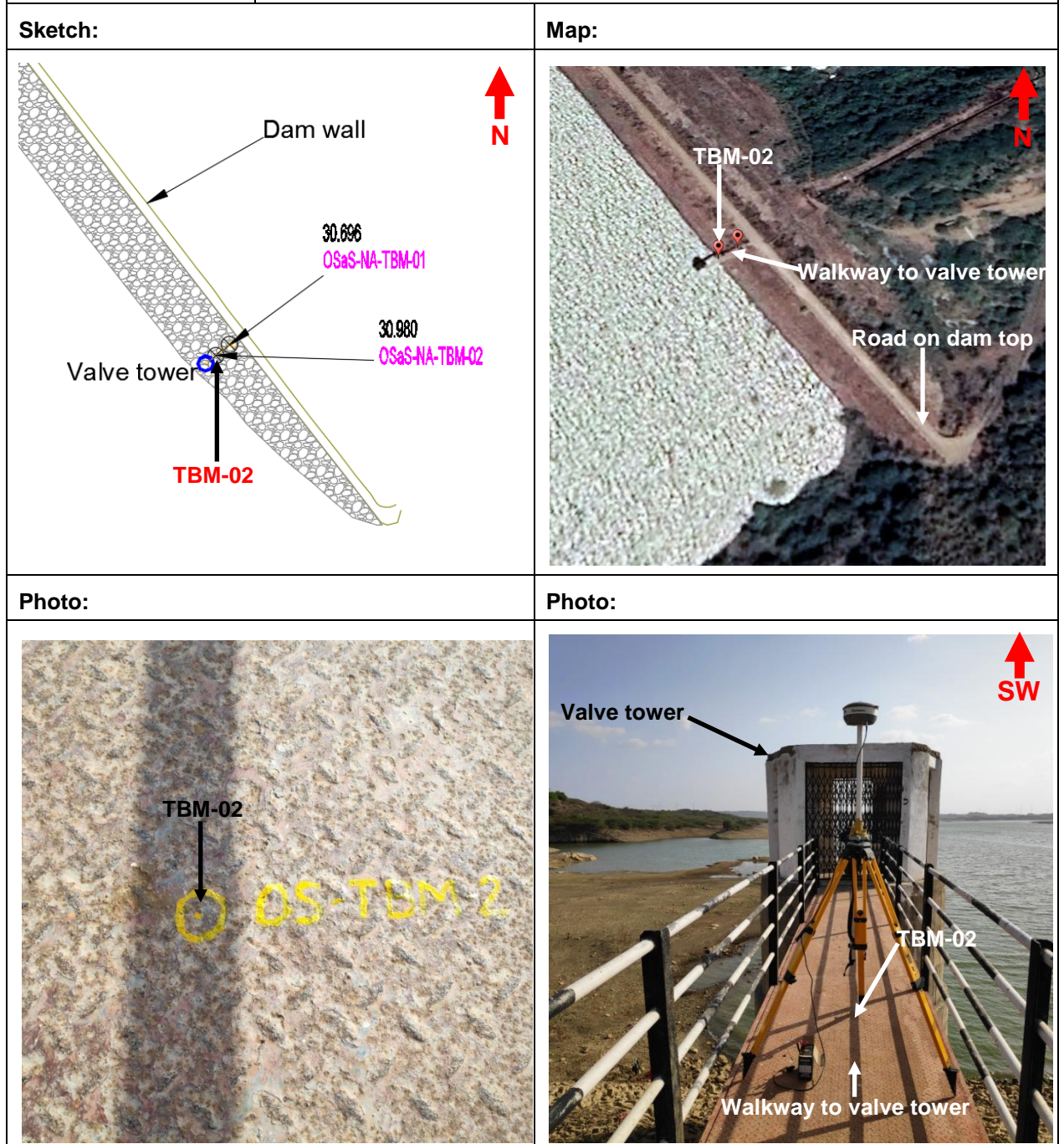


Figure 4: Details of OSaS-NA-TBM-02

Additional temporary control points were established in the field to maintain the moving rover within the range of the base reference point. The following **Table 3** 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)	Reduced Level-MSL (m)
1	OSaS-NA-TBM-01	23° 38' 29.532"	69° 07' 19.869"	512461.85	2614545.91	30.696
2	OSaS-NA-TBM-02	23° 38' 29.331"	69° 07' 19.592"	512453.99	2614539.73	30.980
3	OSaS-NA-TBM-03	23° 38' 29.520"	69° 07' 19.952"	512464.18	2614545.53	31.455
4	OSaS-NA-TBM-04	23° 38' 53.364"	69° 06' 10.841"	510505.69	2615277.27	36.299
5	OSaS-NA-TBM-05	23° 38' 18.047"	69° 05' 33.955"	509461.43	2614190.46	30.760
6	OSaS-NA-TBM-06	23° 38' 09.346"	69° 05' 11.886"	508836.36	2613922.48	29.676
7	OSaS-NA-TBM-07	23° 38' 01.002"	69° 04' 41.860"	507985.79	2613665.39	31.442
8	OSaS-NA-TBM-08	23° 38' 00.137"	69° 04' 28.283"	507601.15	2613638.59	28.656
9	OSaS-NA-TBM-09	23° 37' 59.342"	69° 04' 02.087"	506858.94	2613613.77	35.142
10	OSaS-NA-TBM-10	23° 37' 13.425"	69° 03' 22.043"	505724.96	2612201.23	40.281
11	OSaS-NA-TBM-11	23° 36' 55.425"	69° 06' 45.595"	511493.1	2611651.08	27.122
12	OSaS-NA-TBM-12	23° 36' 18.865"	69° 06' 50.051"	511620.28	2610526.89	24.872
13	OSaS-NA-TBM-13	23° 35' 35.325"	69° 07' 04.348"	512026.52	2609188.26	27.956
14	OSaS-NA-TBM-14	23° 37' 26.083"	69° 06' 04.808"	510336.69	2612593.04	32.495
15	OSaS-NA-TBM-15	23° 37' 47.421"	69° 05' 58.118"	510146.67	2613249.09	24.347
16	OSaS-NA-TBM-16	23° 38' 02.852"	69° 05' 59.405"	510182.79	2613723.68	28.692

Table 3: Details of TBMs

3.2.2 Bathymetric survey

The same two reference stations, established as temporary control points/temporary benchmarks (TBMs) for the topographic survey, were also used as the base stations for RTK positioning during the bathymetric survey. The rover fixed in the survey boat received calculated X Y Z of its position at any point with centimetre-level accuracy with respect to the known base positions. The details of these reference stations are given in **Figure 3** and **Figure 4**.

The water level of the reservoir with respect to the known value of FRL (27.43m 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 are given in **Table 4**.

Date	Water level				Average level in metres (MSL, m)
	Start		End		
	Time (AM)	Level (MSL, m)	Time (PM)	Level (MSL, m)	
17-06-21	09:00	21.85	06:00	21.83	21.84
18-06-21	09:00	21.82	06:00	21.80	21.81
19-06-21	09:00	21.79	06:00	21.78	21.785
20-06-21	09:00	21.78	06:00	21.78	21.78

Table 4: Observed Water Levels

3.3 Survey Vessel

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



Figure 5: Survey vessel – SMB OSaS

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 / Surveyor	05 th June – 23 rd June 2021
Prasant Panda	Survey Engineer	05 th June – 22 nd June 2021
Gaurav Sharma	Survey Engineer	05 th June – 22 nd June 2021
Arsh Mansuri	Surveyor	05 th June – 11 th June 2021
Binukumar	Surveyor	22 nd June – 23 rd June 2021
Salman	Surveyor	22 nd June – 23 rd June 2021
Sivyes Chaudhri	Client Representative	Project duration

Table 5: Survey Personnel

5 SURVEY EQUIPMENT DETAILS

5.1 General

The equipment used for the survey is described below.

Bathymetry:

- Hemisphere GPS S320 GNSS RTK Base and Rover system with accessories
- Odom MK III dual frequency single beam echo sounder system with accessories
- TSS HS50 heave sensor
- Hypack navigation system
- 2 x computers with associated accessories

Topography:

- Hemisphere GPS S320 GNSS RTK Base and Rover system with accessories
- Geomax Auto Level with 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:

- Hemisphere GPS R320 GNSS base station
- Hemisphere GPS R320 rover

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 DGPS system and its heading determined by the course made good method (CMG). The positioning system was interfaced to the Hypack navigation software. Vessel track and offset positions were recorded digitally in the navigation software. DGPS positioning accuracy of the moving vessel was better than $\pm 1\text{m}$.

The vessel's computed position from the DGPS 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 the mobilisation report.

5.3 Single Beam Echo Sounder System

Bathymetric data was acquired using a dual frequency Odom MK III single beam echo sounder. The SBES transducer assembly was side-mounted on a pole on the port side of the 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

TSS HS50 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 establish the local benchmark by transfer and level the TBM with respect to the known level of FRL at 27.43m above MSL, as provided by the client.

5.6 Real Time Kinematic (RTK) For Topographic Survey

A Hemisphere R320 GNSS RTK system with base station and rover was used to conduct the survey. Base stations were established with respect to FRL at the TBM and rover used to fix the positions. This is a positioning system which can measure and calculate the XYZ of any given point with centimeter 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 Odom 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, create side scan mosaics 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 DGPS 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 Odom MK III echo sounder was processed using the Hypack navigation package. The vertical datum for all bathymetric measurements was the known MSL value of FRL. The depth soundings obtained from the single beam echo sounder were reduced to MSL with the help of the observed water level in the reservoir.

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

Lakebed Gradient Classification

The following terms were used to describe the lakebed 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 bathymetry data processor, CAD processor and geophysicist prepared the report and accompanying charts to WRD's specifications.

6.3 Topographic Data

A Hemisphere R320 GNSS RTK system with base station and rover was used to conduct the survey. This is a positioning system which can measure and calculate the XYZ of any given point with centimeter level accuracy with respect to the known base positions. The data is downloaded from the controller system, processed in the OSaS Data Processing Centre in Navi Mumbai and formatted to a compatible ASCII format for plotting in AutoCAD.

6.4 Charting

The results of this survey are presented in nine charts. They consist of the following:

- One overview chart displaying a 2-dimensional image of bathymetry and topography
- One contour map displaying elevation contours at 1m intervals
- Three charts showing topography and bathymetry of the surveyed area
- One longitudinal profile along the lowest elevation line within the surveyed area
- Five charts showing cross section profiles at 100m intervals within the surveyed area.

Their details are listed after the List of Annexures at the beginning of this report.

7 SURVEY RESULTS

7.1 Overview and Contour Charts

One chart each has been prepared for an overview of the surveyed area as well as elevation contours at 1m intervals, as described in Section 6.4 **Charting**. These charts also show the topographic survey boundary and the boundary between the bathymetric and topographic surveys.

7.2 Bathymetry and Topography

The bathymetric elevations mentioned in this report and associated charts have been reduced to Mean Sea Level (MSL) using the observed average water level of the Nara reservoir for the corresponding survey day. The topographic elevations are with respect to the known level at FRL, (27.43m above MSL). Hence, all the bathymetric and topographic values mentioned in this report are with respect to MSL.

The MSL-reduced bathymetric and topographic data are plotted in 1:5000 scale in a 25m X 25m grid. A total of three charts were created for the purpose of plotting bathymetric and topographic data. For more details refer to Section 6.4 **Charting**.

The RTK positioning accuracy is metric, resulting in a similar positioning accuracy of single beam echo sounder data since the sensor was side-mounted on the vessel.

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

Nara dam is constructed across Nara river, generally flows from southwest to northeast, situated in the southwestern part of the survey area and bringing a considerable amount of water to Nara reservoir. In addition, a number of medium and small sized rivers and streams also bring water to the dam area.

A minimum elevation of 14.2m was observed in the northeastern portion of the survey area within the bathymetric section. A maximum topographic elevation value of 33.43m is observed at the crest of the dam, in the extreme northeastern portion of the survey area.

The processed topographic data shows that the land is sloping from all the sides of the survey area towards the river channels and dam area. Scattered elevated areas are observed within the survey area associated with islands and tiny hills. The average elevation change within the topographic area is between 18.64m and 33.43m. Features like nalla, rocky areas, majar and roads are observed within the topographic survey area. The Nara dam wall is located in the northeastern portion of the survey area and the waste weir is located in the southern portion of the survey area.

Most of the outer survey boundaries occur around the 28m elevation contour. Scattered elevated areas with elevations contours between 28m and 33m were observed within the survey area. The extreme northeastern portion of the survey area shows dam wall with very steep slopes from the top of the dam to the water-occupied area with a change in elevation contours between 33m and 21m.

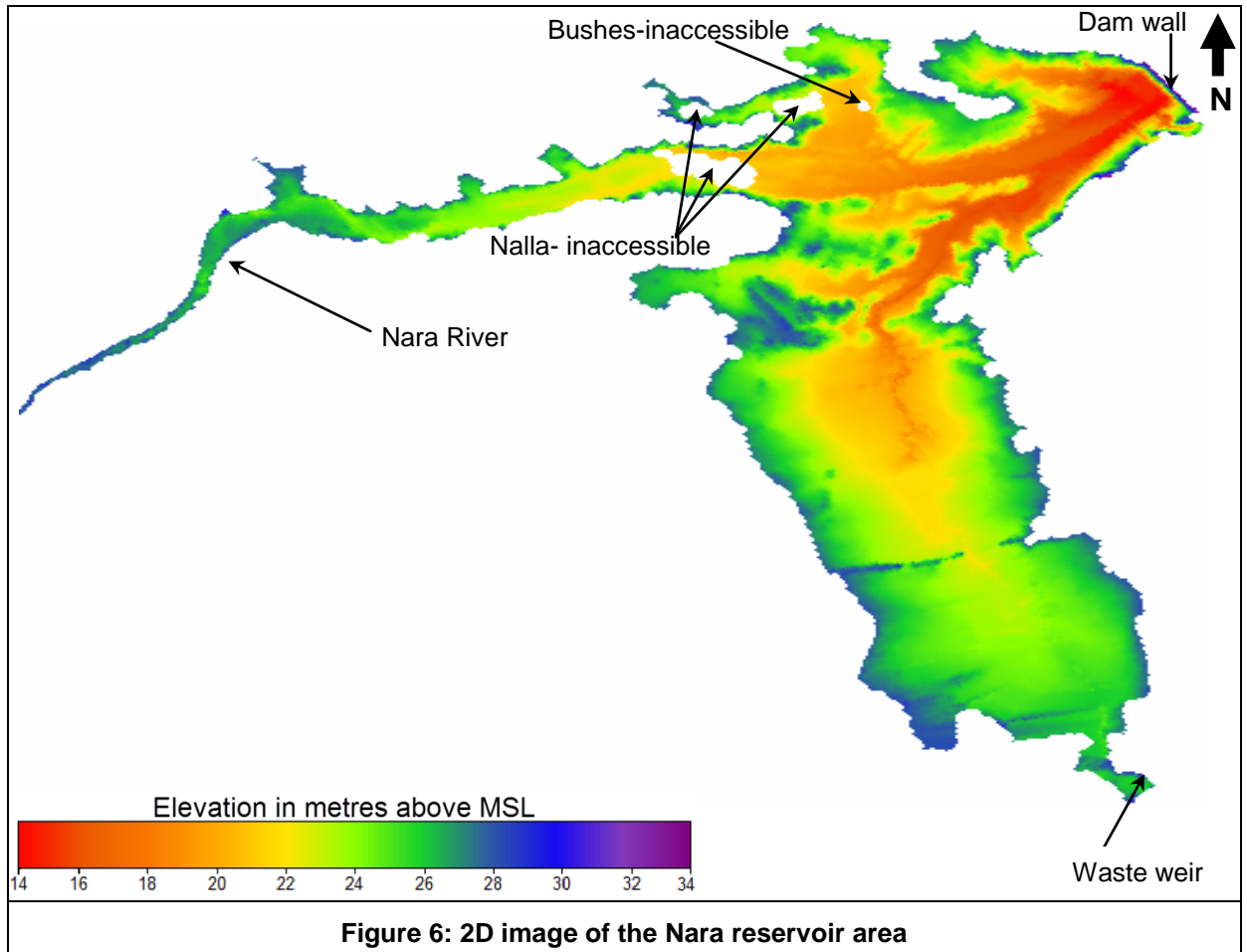
In the northern half of the survey area, the topography is observed to be slightly irregular, with moderate to very steep slopes from the outer boundaries to the dam area between the elevation contours 33m and 21m, whereas in the southern half, moderate to very gentle slopes were observed from the outer boundaries to the dam area between the elevation contours 28m to 21m. Nara river generally flows from southwest to northeast towards the dam walls, and is observed as a narrower and irregular riverbed in the southwestern portion with a change in elevation contours between 28m and 21m.

The average elevation change within the bathymetric survey area is between 14.2m and 21.2m. Most of the water-occupied area of the reservoir lies within the 21m elevation contour in the central and north-eastern portion of the survey area. The reservoir bed within this area is slightly irregular, associated with scattered depressions and humps. A minimum elevation contour of 15m is observed

adjacent to the wall of the dam. Two islands were observed within the bathymetric survey area showing a change in elevation contour between 21m and 23m.

Bathymetric and topographic survey was restricted at some places due to the presence of cliff terrain, nallas with unsafe and marshy ground and bushes with thick vegetation.

The following **Figure 6** shows a 2-dimensional image of the Nara reservoir area using the gridded bathymetric and topographic data.



7.3 Longitudinal Profile

A longitudinal profile of the reservoir was prepared from the line created by connecting the lowest bed level for each survey line. For more details refer to the charts listed in the section on **Charting**.

7.4 Cross Section Profiles

Cross section profiles consist of the bed levels along the survey lines at 100m intervals. The cross-section profiles will also be provided in a compact disk/USB as per the instructions mentioned for deliverables. For more details refer to the charts listed in the section on **Charting**.

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

8.3.1 Capacity survey of 1986

The construction works of Nara dam commenced in 1972 and were completed in 1981. As per the documents received from client, a silt survey was conducted in 1986 on Nara dam. One of the provided documents contains elevation-capacity data of the 1986 survey from 14.0m above MSL to 27.43m above MSL, at intervals of 0.1m. Another document contains the details of elevation-area-capacity at an interval of 1m from 13m to 27.45m.

For ease of further calculations and preparation of elevation-capacity curves, the elevation-area-capacity data have been extracted from the provided documents at preferred intervals from 14m to 27.43m (FRL). **Table 7** shows the elevation-capacity at these intervals. The details of previous data are given in **Annexure 3**.

8.4 Capacity survey of 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 Nara reservoir at intervals of 0.01m with respect to the corresponding elevation above MSL. Within the survey area a few places were not accessible to the survey personnel due to the existing marshy streams, very steep cliffs and bushes with thick vegetation areas. However, these areas with elevations below FRL were taken into account while calculating the water spread area by assigning interpolated values with respect to the acquired values around the restricted areas.

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. The data obtained from the topographic survey was then merged with the bathymetric 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. Further, 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.

The detailed elevation-area-capacity data at 0.01m is available in **Annexure 1**. For ease of further calculations and preparation of elevation-area-capacity curve, the data has been selected at regular intervals of approximately 0.5m from 14m to 27.43m (FRL). **Table 7** shows the elevation-area-capacity at these intervals.

8.5 Elevation-Area-Capacity Curves

One of the most important physical characteristics of dams and their reservoirs are elevation-area-capacity curves. These 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.

One of the provided documents gives the details of elevation-capacity data of 1986 survey at intervals of 0.1m from 14.0m above MSL to 27.43m above MSL and another document gives the elevation-area-capacity data of 1986 survey at intervals of 1.0m from 13.0m above MSL to 27.45m

above MSL. Elevation-area-capacity data have been extracted from the provided documents at preferred intervals from 14m to 27.43m (FRL).

The current survey was conducted in 2021 and the data is provided at intervals of 0.01m. For ease of further calculations and preparation of elevation-area-capacity curve, current survey data in 2021 and the elevation capacity data in 1986 have been selected at regular intervals of approximately 0.5m.

The following **Table 7** shows the comparative statement of data between the silt survey of 1986 and the current silt survey (2021).

Elevation (Above MSL, m)	As per 1986 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)	
14.00	0.046	0.060	0.000	0.000	
14.50	0.085	-	0.001	0.011	
15.00	0.123	0.110	0.024	0.078	
15.50	0.210	-	0.081	0.155	
16.00	0.296	0.250	0.189	0.284	
16.50	0.465	-	0.367	0.426	
17.00	0.633	0.420	0.614	0.562	
17.50	0.920	-	0.927	0.684	
18.00	1.206	0.800	1.297	0.790	
18.28	1.490	-	1.526	0.848	MDDL/OSL
18.50	1.719	-	1.718	0.897	
19.00	2.239	1.200	2.201	1.040	
19.50	2.914	-	2.760	1.204	
20.00	3.589	1.550	3.428	1.481	
20.50	4.499	-	4.253	1.831	
21.00	5.409	2.110	5.278	2.277	
21.50	6.609	-	6.516	2.654	
22.00	7.809	2.850	7.969	3.273	
22.50	9.524	-	9.722	3.736	
23.00	11.239	4.000	11.715	4.255	
23.50	13.512	-	13.985	4.853	
24.00	15.785	4.900	16.580	5.505	
24.50	18.475	-	19.507	6.223	
25.00	21.165	6.180	22.821	7.029	
25.50	24.612	-	26.537	7.818	

Elevation (Above MSL, m)	As per 1986 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)	
26.00	28.058	7.200	30.630	8.570	
26.50	31.842	-	35.093	9.274	
27.00	35.625	8.400	39.891	9.883	
27.43	39.700	9.300	44.235	10.304	FRL

Table 7: Comparative statement of Nara reservoir

The above data was used for the preparation of elevation-area-capacity curves. The following **Figure 7** shows the Elevation-Area-Capacity curves of 2021 superimposed on the elevation-area-capacity curves of 1986.

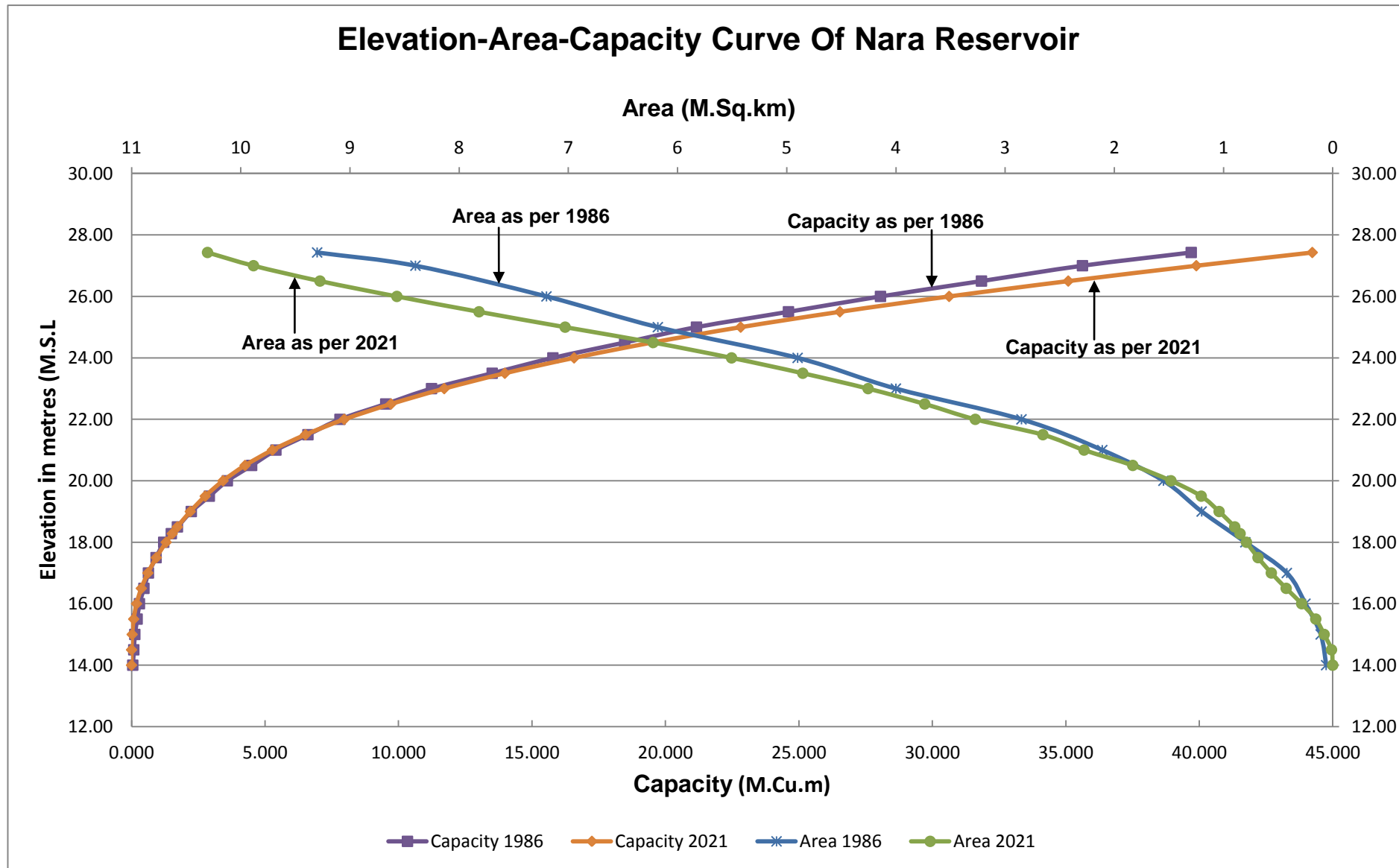


Figure 7: Elevation-Area-Capacity Curves

8.6 Data Comparison between 1986 and 2021

Definitions

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

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

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

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

Outlet Sill Level (OSL) / Dead Storage Level (DSL): This is the level below which there is no outlets to drain the water in the reservoir by gravity.

Dead storage: This 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.

8.6.1 Rate of erosion

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

- i) The catchment area of the reservoir is 233.01 sq.km.
- ii) The FRL of the reservoir is given as 27.43m.
- iii) The dead storage level/Outlet sill level of the reservoir is at 18.28m.

The results obtained after comparing the survey data of the year 1986 with that of 2021 are provided below:

Capacity at FRL (27.43m) as per the 1986 survey	= 39.700 M.cu.m
Capacity at FRL (27.43m) as per 2021 survey	= 44.235 M.cu.m
Erosion in 35 years (1986-2021)	= 44.235 – 39.700 = 4.535 M.cu.m
Annual erosion	= 4.535/35 = 0.13 M.cu.m/yr
Rate of erosion (Erosion index)	= (0.13/233.01) x 1000 = 0.556 Th.cu.m/sq.km/year = 5.56 Ha.m/100sq.km./year

8.6.2 Increase of gross storage capacity at FRL

Capacity at FRL (27.43m) as per the 1986 survey	= 39.700 M.cu.m
Capacity at FRL (27.43m) as per 2021 survey	= 44.235 M.cu.m
Increase of storage capacity in 35 years (1986-2021)	= 44.235 – 39.700 = 4.535 M.cu.m
Percentage of increase of Gross storage capacity up to FRL in 35 years	= (4.535/39.700) x 100 = 11.42%
Annual percentage of increase	= 11.42/35 = 0.33%

8.6.3 Increase of dead storage capacity

Capacity at MDDL/OSL (18.28m) as per the 1986 survey	= 1.490 M.cu.m
Capacity at MDDL / OSL as per 2021 survey	= 1.526 M.cu.m
Increase of storage capacity in 35 years (1986-2021)	= 1.526 – 1.490 = 0.036 M.cu.m
Percentage of increase of dead storage capacity up to OSL in 35 years	= (0.036/1.490) x 100 = 2.42%
Annual percentage of increase	= 2.42/35 = 0.07%

8.6.4 Increase of live storage capacity

Live storage capacity as per the 1986 survey	= 39.700 – 1.490 = 38.210 M.cu.m
Live storage capacity as per 2021 survey	= 44.235 – 1.526 = 42.709 M.cu.m
Increase of Live storage capacity in 35 years (1986-2021)	= 42.709 – 38.210 = 4.499 M.cu.m
Percentage of increase of live storage capacity in 35 years	= (4.499/38.210) x 100 = 11.77%
Annual percentage of increase	= 11.77/35 = 0.34%

8.7 Summary of Capacity Surveys (1986 and 2021)

Reservoir data as per Capacity survey 1986:

Catchment Area : 233.01 sq.km
 Gross storage at FRL (27.43m) : 39.700 M.cu.m
 Dead storage at OSL (18.28m) : 01.490 M.cu.m
 Live storage at FRL (27.43m) : 38.210 M.cu.m

Rate of erosion (at FRL 27.43m) with respect to the capacity survey data in the year 1986													
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 ha.m/100 sq.km/Yr	Annual % increase of capacity	Remarks
		Dead	Live	Gross				Dead	Live	Gross			
1	1986	01.490	38.210	39.700	-	-	-	-	-	-	-	-	-
2	2021	01.526	42.709	44.235	4.535	35	0.13	0.036 2.42%	4.499 11.77%	4.535 11.42%	5.56	0.33	-

Table 8: Rate of erosion at FRL (27.43m)

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

8.8 Loss/Increase of Storage due to Sediment Deposit/Erosion

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 loss or increase in capacity within the reservoir is directly proportional to the amount of sediment deposited or eroded within the reservoir. This sediment deposition or removal can occur at any level of the reservoir throughout the live and dead storage area. This deposition or erosion of the sediment within the reservoir results in a corresponding loss or increase of capacity.

For Nara reservoir, the detailed comparison of current capacity data (2021) at different levels with the capacity data of the 1986 survey shows an increase in capacity due to sediment erosion at the dead storage area and the live storage area. The sediment erosion and corresponding increase in capacity have been observed between the elevations 17.50m to 18.28 (OSL) and 22.0m to 27.43m (FRL). The increase in capacity could be due to erosion of the reservoir bank at these levels or conversion of more irregular water spread areas around the FRL into levelled cultivation fields. The capacity at OSL (18.28m) increased from 1.490 M.cu.m to 1.526 M.cu.m between the years 1986 and 2021 with an increase in capacity of about 2.42%. The amount of sediment eroded during this period up to OSL is 0.036 M.cu.m. The gross capacity at FRL (27.43m) is increased from 39.700 M.cu.m to 44.235 M.cu.m between the years 1986 and 2021 with an increase in capacity of about 11.42%. The amount of sediment eroded during this period up to FRL is 4.535 M.cu.m.

Within the reservoir, sediment deposition and corresponding reduction in capacity have been observed between the elevations 14m to 17.0m and 18.5m to 21.50m. The increase of sediment deposit and the corresponding reduction in capacity could be due to the abundant sediment inflow into the reservoir due to floods or erosion of reservoir banks above these levels.

The following **Table 9** shows the amount of deposition/erosion of sediment at different levels of reservoir and corresponding percentage of loss/increase in storage capacity.

Elevation (Above MSL, m)	Area 1986 (sq.km)	Capacity 1986 (M.cu.m)	Area 2021 (sq.km)	Capacity 2021 (M.cu.m)	Deposition/ Erosion of Sediment (M.cu.m)	% Loss/ Increase of Capacity	Remarks
14.00	0.060	0.046	0.000	0.000	0.046	100.00	Sediment deposit, loss of capacity
14.50	-	0.085	0.011	0.001	0.084	98.82	Sediment deposit, loss of capacity
15.00	0.110	0.123	0.078	0.024	0.099	80.49	Sediment deposit, loss of capacity
15.50	-	0.210	0.155	0.081	0.129	61.34	Sediment deposit, loss of capacity
16.00	0.250	0.296	0.284	0.189	0.107	36.15	Sediment deposit, loss of capacity
16.50	-	0.465	0.426	0.367	0.098	20.99	Sediment deposit, loss of capacity
17.00	0.420	0.633	0.562	0.614	0.019	3.00	Sediment deposit, loss of capacity

Elevation (Above MSL, m)	Area 1986 (sq.km)	Capacity 1986 (M.cu.m)	Area 2021 (sq.km)	Capacity 2021 (M.cu.m)	Deposition/ Erosion of Sediment (M.cu.m)	% Loss/ Increase of Capacity	Remarks
17.50	-	0.920	0.684	0.927	*0.008	**0.82	Sediment erosion, increase of capacity
18.00	0.800	1.206	0.790	1.297	*0.091	**7.55	Sediment erosion, increase of capacity
18.28 (OSL)	-	1.490	0.848	1.526	*0.036	**2.42	Sediment erosion, increase of capacity
18.50	-	1.719	0.897	1.718	0.001	0.05	Sediment deposit, loss of capacity
19.00	1.200	2.239	1.040	2.201	0.038	1.70	Sediment deposit, loss of capacity
19.50	-	2.914	1.204	2.760	0.154	5.28	Sediment deposit, loss of capacity
20.00	1.550	3.589	1.481	3.428	0.161	4.49	Sediment deposit, loss of capacity
20.50	-	4.499	1.831	4.253	0.246	5.47	Sediment erosion Increase of capacity
21.00	2.110	5.409	2.277	5.278	0.131	2.42	Sediment erosion Increase of capacity
21.50	-	6.609	2.654	6.516	0.093	1.41	Sediment erosion Increase of capacity
22.00	2.850	7.809	3.273	7.969	*0.160	**2.05	Sediment erosion, increase of capacity
22.50	-	9.524	3.736	9.722	*0.198	**2.08	Sediment erosion, increase of capacity
23.00	4.000	11.239	4.255	11.715	*0.476	**4.24	Sediment erosion, increase of capacity
23.50	-	13.512	4.853	13.985	*0.473	**3.50	Sediment erosion, increase of capacity
24.00	4.900	15.785	5.505	16.580	*0.795	**5.04	Sediment erosion, increase of capacity
24.50	-	18.475	6.223	19.507	*1.032	**5.59	Sediment erosion, increase of capacity
25.00	6.180	21.165	7.029	22.821	*1.656	**7.82	Sediment erosion, increase of capacity
25.50	-	24.612	7.818	26.537	*1.926	**7.82	Sediment erosion, increase of capacity
26.00	7.200	28.058	8.570	30.630	*2.572	**9.17	Sediment erosion, increase of capacity

Elevation (Above MSL, m)	Area 1986 (sq.km)	Capacity 1986 (M.cu.m)	Area 2021 (sq.km)	Capacity 2021 (M.cu.m)	Deposition/ Erosion of Sediment (M.cu.m)	% Loss/ Increase of Capacity	Remarks
26.50	-	31.842	9.274	35.093	*3.252	**10.21	Sediment erosion, increase of capacity
27.00	8.400	35.625	9.883	39.891	*4.266	**11.97	Sediment erosion, increase of capacity
27.43 (FRL)	9.300	39.700	10.304	44.235	*4.535	**11.42	Sediment erosion, increase of capacity

Table 9: Loss/increase of storage capacity between 1986 and 2021

Note:

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

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 erosional 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

8.9 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 sizes 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

8.9.1 *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 result in 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, and 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

8.9.2 *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 preventive 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.

8.9.3 *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 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.

8.9.4 *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 & flushing, sluicing aided by measures like 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 work of Nara dam commenced in 1972 and was completed in 1981. As per the capacity survey done in 1986, gross storage was 39.700 M.cu.m (at FRL 27.43m above MSL) and the dead storage was 1.490 M.cu.m (at OSL: 18.28m above MSL).
- The current survey (2021) obtained the gross storage at FRL (27.43m above MSL) is 44.235 M.cu.m and the dead storage (at OSL: 18.28m above MSL) is 1.526 M.cu.m.
- Bathymetric and topographic survey was restricted at some places due to the presence of cliff terrain, nallas with unsafe and marshy ground and bushes with thick vegetation.
- In the current bathymetric and topographic survey, a minimum elevation of 14.2m was observed in the northeastern portion of the survey area within the bathymetric section and a maximum topographic elevation value of 33.43m is observed at the crest of the dam, in the extreme northeastern portion of the survey area.
- The average elevation change within the bathymetric survey area is between 14.2m and 21.2m and that of the topographic survey area is between 18.64m and 33.43m.
- Most of the outer survey boundaries occur around the 28m elevation contour. Scattered elevated areas with elevations contours between 28m and 33m were observed within the survey area.
- In the northern half of the survey area, the topography is observed to be slightly irregular, with moderate to very steep slopes from the outer boundaries to the dam area between the elevation contours 33m and 21m, whereas in the southern half, moderate to very gentle slopes were observed from the outer boundaries to the dam area between the elevation contours 28m to 21m.
- Most of the water-occupied area of the reservoir lies within the 21m elevation contour in the central and north-eastern portion of the survey area. The reservoir bed within this area is slightly irregular, associated with scattered depressions and humps. A minimum elevation contour of 15m is observed adjacent to the wall of the dam. Two islands were observed within the bathymetric survey area showing a change in elevation contour between 21m and 23m.
- The current survey data was compared with the capacity survey data in 1986. The comparison between 1986 and 2021 (35 years) data results shows a rate of erosion of 5.56 Ha.m/100sq.km./year. Annual percentage of increase of gross storage capacity, live storage capacity and dead storage capacity are 0.33%, 0.34% and 0.07% respectively.
- The comparison of current survey data and the capacity data of the 1986 survey shows an increase in capacity due to erosion at both the dead storage area and live storage area. The capacity at OSL (18.28m) increased from 1.490 M.cu.m to 1.526 M.cu.m between the years 1986 and 2021 with an increase in capacity of about 2.42%. The gross capacity at FRL (27.43m) is increased from 39.700 M.cu.m to 44.235 M.cu.m between the years 1986 and 2021 with an increase in capacity of about 11.42%.
- During the years 1986 to 2021, the amount of sediment eroded during this period up to OSL is 0.036 M.cu.m and amount of sediment eroded up to FRL is 4.535 M.cu.m. The increase in capacity could be due to the erosion of the reservoir bank or conversion of more irregular water spread areas around the F.R.L into levelled cultivation fields.
- Within the reservoir, sediment deposition and corresponding reduction in capacity have been observed between the elevations 14m to 17.0m and 18.5m to 21.50m. The increase of sediment deposit and the corresponding reduction in capacity could be due to the abundant sediment inflow into the reservoir due to floods or erosion of reservoir banks above these levels.

10 REFERENCES

1. Wikipedia - [https://en.wikipedia.org/wiki/Nara_River_\(India\)](https://en.wikipedia.org/wiki/Nara_River_(India))
2. Website - <http://117.252.14.242/rbis/basin%20maps/wfrkuch.htm>
3. Website - <https://www.worldweatheronline.com/rapar-weather-averages/gujarat/in.aspx>
4. Website - <https://guj-nwrws.gujarat.gov.in/showpage.aspx?contentid=1798&lang=English>
5. CE IIT, Kharagpur - <https://nptel.ac.in/content/storage2/courses/105105110/pdf/m4l05.pdf>
6. *Siltation in reservoirs* by C.N. Mama and F.O. Okafor
7. *Space Technology in Assessment of Loss in Live Storage Capacity of Reservoir* by Karishma Bhatnagar Malhotra, Rishi Srivastava and Amrendra Kumar Singh.
8. *Erosion and reservoir sedimentation* by The McGraw Hill Companies.
9. *Soil erosion, sediment yield and sedimentation of reservoir* by S. Dutta
10. *Statement showing the details of dams in Gujarat (report_15-03-2021)* by N.W.R.W.S.AND KALPSAR DEPARTMENT.
11. *Hydrological model for design flood estimation for the Bhadar dam* by Jahnvi Bhatt, P.H. Pandya and Prof H.M. Gandhi

Annexure - 1
Elevation-Area-Capacity (2021)
Nara Reservoir

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
47.15	14.37	0.00	0.00	0.043	0.004	0.000	0.000	0.000	0.000
47.18	14.38	0.00	0.00	0.043	0.004	0.000	0.000	0.035	0.001
47.21	14.39	0.00	0.00	0.054	0.005	0.000	0.000	0.035	0.001
47.24	14.40	0.00	0.00	0.054	0.005	0.000	0.000	0.035	0.001
47.28	14.41	0.00	0.00	0.054	0.005	0.000	0.000	0.035	0.001
47.31	14.42	0.00	0.00	0.054	0.005	0.000	0.000	0.035	0.001
47.34	14.43	0.00	0.00	0.065	0.006	0.000	0.000	0.035	0.001
47.38	14.44	0.00	0.00	0.065	0.006	0.000	0.000	0.035	0.001
47.41	14.45	0.00	0.00	0.065	0.006	0.000	0.000	0.035	0.001
47.44	14.46	0.00	0.00	0.075	0.007	0.000	0.000	0.035	0.001
47.47	14.47	0.00	0.00	0.086	0.008	0.000	0.000	0.035	0.001
47.51	14.48	0.00	0.00	0.097	0.009	0.000	0.000	0.035	0.001
47.54	14.49	0.00	0.00	0.108	0.010	0.000	0.000	0.035	0.001
47.57	14.50	0.00	0.00	0.118	0.011	0.000	0.000	0.035	0.001
47.60	14.51	0.00	0.00	0.140	0.013	0.000	0.000	0.035	0.001
47.64	14.52	0.00	0.00	0.151	0.014	0.000	0.000	0.071	0.002
47.67	14.53	0.00	0.00	0.172	0.016	0.000	0.000	0.071	0.002
47.70	14.54	0.00	0.00	0.194	0.018	0.000	0.000	0.071	0.002
47.74	14.55	0.00	0.00	0.205	0.019	0.000	0.000	0.071	0.002
47.77	14.56	0.00	0.00	0.215	0.020	0.000	0.000	0.071	0.002
47.80	14.57	0.00	0.00	0.237	0.022	0.000	0.000	0.071	0.002
47.83	14.58	0.00	0.00	0.248	0.023	0.000	0.000	0.106	0.003
47.87	14.59	0.00	0.00	0.258	0.024	0.000	0.000	0.106	0.003
47.90	14.60	0.00	0.00	0.280	0.026	0.000	0.000	0.106	0.003

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
47.93	14.61	0.00	0.00	0.291	0.027	0.000	0.000	0.106	0.003
47.97	14.62	0.00	0.00	0.301	0.028	0.000	0.000	0.141	0.004
48.00	14.63	0.00	0.00	0.323	0.030	0.000	0.000	0.141	0.004
48.03	14.64	0.00	0.00	0.334	0.031	0.000	0.000	0.141	0.004
48.06	14.65	0.00	0.00	0.344	0.032	0.000	0.000	0.177	0.005
48.10	14.66	0.00	0.00	0.355	0.033	0.000	0.000	0.177	0.005
48.13	14.67	0.00	0.00	0.366	0.034	0.000	0.000	0.177	0.005
48.16	14.68	0.00	0.00	0.388	0.036	0.000	0.000	0.212	0.006
48.20	14.69	0.00	0.00	0.398	0.037	0.000	0.000	0.212	0.006
48.23	14.70	0.00	0.00	0.409	0.038	0.000	0.000	0.212	0.006
48.26	14.71	0.00	0.00	0.420	0.039	0.000	0.000	0.247	0.007
48.29	14.72	0.00	0.00	0.431	0.040	0.000	0.000	0.247	0.007
48.33	14.73	0.00	0.00	0.441	0.041	0.000	0.000	0.283	0.008
48.36	14.74	0.00	0.00	0.452	0.042	0.000	0.000	0.283	0.008
48.39	14.75	0.00	0.00	0.463	0.043	0.000	0.000	0.283	0.008
48.43	14.76	0.00	0.00	0.474	0.044	0.000	0.000	0.318	0.009
48.46	14.77	0.00	0.00	0.484	0.045	0.000	0.000	0.318	0.009
48.49	14.78	0.00	0.00	0.506	0.047	0.000	0.000	0.353	0.010
48.52	14.79	0.00	0.00	0.517	0.048	0.000	0.000	0.353	0.010
48.56	14.80	0.00	0.00	0.538	0.050	0.000	0.000	0.388	0.011
48.59	14.81	0.00	0.00	0.560	0.052	0.000	0.000	0.388	0.011
48.62	14.82	0.00	0.00	0.570	0.053	0.000	0.000	0.424	0.012
48.65	14.83	0.00	0.00	0.592	0.055	0.000	0.000	0.424	0.012
48.69	14.84	0.00	0.00	0.614	0.057	0.000	0.000	0.459	0.013

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
48.72	14.85	0.00	0.00	0.624	0.058	0.000	0.000	0.459	0.013
48.75	14.86	0.00	0.00	0.646	0.060	0.000	0.000	0.494	0.014
48.79	14.87	0.00	0.00	0.657	0.061	0.000	0.000	0.530	0.015
48.82	14.88	0.00	0.00	0.678	0.063	0.000	0.000	0.530	0.015
48.85	14.89	0.00	0.00	0.689	0.064	0.000	0.000	0.565	0.016
48.88	14.90	0.00	0.00	0.710	0.066	0.000	0.000	0.565	0.016
48.92	14.91	0.00	0.00	0.721	0.067	0.000	0.000	0.600	0.017
48.95	14.92	0.00	0.00	0.743	0.069	0.000	0.000	0.636	0.018
48.98	14.93	0.00	0.00	0.753	0.070	0.000	0.000	0.671	0.019
49.02	14.94	0.00	0.00	0.764	0.071	0.000	0.000	0.671	0.019
49.05	14.95	0.00	0.00	0.775	0.072	0.000	0.000	0.706	0.020
49.08	14.96	0.00	0.00	0.786	0.073	0.000	0.000	0.742	0.021
49.11	14.97	0.00	0.00	0.797	0.074	0.000	0.000	0.742	0.021
49.15	14.98	0.00	0.00	0.818	0.076	0.000	0.000	0.777	0.022
49.18	14.99	0.00	0.00	0.829	0.077	0.000	0.000	0.812	0.023
49.21	15.00	0.00	0.00	0.840	0.078	0.000	0.000	0.848	0.024
49.25	15.01	0.00	0.00	0.850	0.079	0.000	0.000	0.848	0.024
49.28	15.02	0.00	0.00	0.861	0.080	0.000	0.000	0.883	0.025
49.31	15.03	0.00	0.00	0.883	0.082	0.000	0.000	0.918	0.026
49.34	15.04	0.00	0.00	0.893	0.083	0.000	0.000	0.953	0.027
49.38	15.05	0.00	0.00	0.904	0.084	0.000	0.000	0.989	0.028
49.41	15.06	0.00	0.00	0.926	0.086	0.000	0.000	1.024	0.029
49.44	15.07	0.00	0.00	0.936	0.087	0.000	0.000	1.024	0.029
49.48	15.08	0.00	0.00	0.947	0.088	0.000	0.000	1.059	0.030

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
49.51	15.09	0.00	0.00	0.969	0.090	0.000	0.000	1.095	0.031
49.54	15.10	0.00	0.00	0.980	0.091	0.000	0.000	1.130	0.032
49.57	15.11	0.00	0.00	0.990	0.092	0.000	0.000	1.165	0.033
49.61	15.12	0.00	0.00	1.001	0.093	0.000	0.000	1.201	0.034
49.64	15.13	0.00	0.00	1.023	0.095	0.000	0.000	1.236	0.035
49.67	15.14	0.00	0.00	1.033	0.096	0.000	0.000	1.271	0.036
49.70	15.15	0.00	0.00	1.044	0.097	0.000	0.000	1.307	0.037
49.74	15.16	0.00	0.00	1.066	0.099	0.000	0.000	1.342	0.038
49.77	15.17	0.00	0.00	1.087	0.101	0.000	0.000	1.377	0.039
49.80	15.18	0.00	0.00	1.109	0.103	0.000	0.000	1.413	0.040
49.84	15.19	0.00	0.00	1.130	0.105	0.000	0.000	1.448	0.041
49.87	15.20	0.00	0.00	1.152	0.107	0.000	0.000	1.483	0.042
49.90	15.21	0.00	0.00	1.184	0.110	0.000	0.000	1.519	0.043
49.93	15.22	0.00	0.00	1.206	0.112	0.000	0.000	1.554	0.044
49.97	15.23	0.00	0.00	1.238	0.115	0.000	0.000	1.589	0.045
50.00	15.24	0.00	0.00	1.249	0.116	0.000	0.000	1.624	0.046
50.03	15.25	0.00	0.00	1.270	0.118	0.000	0.000	1.695	0.048
50.07	15.26	0.00	0.00	1.281	0.119	0.000	0.000	1.730	0.049
50.10	15.27	0.00	0.00	1.292	0.120	0.000	0.000	1.766	0.050
50.13	15.28	0.00	0.00	1.313	0.122	0.000	0.000	1.801	0.051
50.16	15.29	0.00	0.00	1.324	0.123	0.000	0.000	1.836	0.052
50.20	15.30	0.00	0.00	1.335	0.124	0.000	0.000	1.907	0.054
50.23	15.31	0.00	0.00	1.356	0.126	0.000	0.000	1.942	0.055
50.26	15.32	0.00	0.00	1.367	0.127	0.000	0.000	1.978	0.056

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
50.30	15.33	0.00	0.00	1.389	0.129	0.000	0.000	2.013	0.057
50.33	15.34	0.00	0.00	1.399	0.130	0.000	0.000	2.084	0.059
50.36	15.35	0.00	0.00	1.410	0.131	0.000	0.000	2.119	0.060
50.39	15.36	0.00	0.00	1.432	0.133	0.000	0.000	2.154	0.061
50.43	15.37	0.00	0.00	1.442	0.134	0.000	0.000	2.225	0.063
50.46	15.38	0.00	0.00	1.464	0.136	0.000	0.000	2.260	0.064
50.49	15.39	0.00	0.00	1.485	0.138	0.000	0.000	2.295	0.065
50.52	15.40	0.00	0.00	1.496	0.139	0.000	0.000	2.366	0.067
50.56	15.41	0.00	0.00	1.518	0.141	0.000	0.000	2.401	0.068
50.59	15.42	0.00	0.00	1.528	0.142	0.000	0.000	2.472	0.070
50.62	15.43	0.00	0.00	1.550	0.144	0.000	0.000	2.507	0.071
50.66	15.44	0.00	0.00	1.561	0.145	0.000	0.000	2.543	0.072
50.69	15.45	0.00	0.00	1.582	0.147	0.000	0.000	2.613	0.074
50.72	15.46	0.00	0.00	1.593	0.148	0.000	0.000	2.649	0.075
50.75	15.47	0.00	0.00	1.615	0.150	0.000	0.000	2.719	0.077
50.79	15.48	0.00	0.00	1.625	0.151	0.000	0.000	2.755	0.078
50.82	15.49	0.00	0.00	1.647	0.153	0.000	0.000	2.825	0.080
50.85	15.50	0.00	0.00	1.668	0.155	0.000	0.000	2.860	0.081
50.89	15.51	0.00	0.00	1.690	0.157	0.000	0.000	2.931	0.083
50.92	15.52	0.00	0.00	1.711	0.159	0.000	0.000	3.002	0.085
50.95	15.53	0.00	0.00	1.733	0.161	0.000	0.000	3.037	0.086
50.98	15.54	0.00	0.00	1.755	0.163	0.000	0.000	3.108	0.088
51.02	15.55	0.00	0.00	1.776	0.165	0.000	0.000	3.143	0.089
51.05	15.56	0.00	0.00	1.798	0.167	0.000	0.000	3.214	0.091

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
51.08	15.57	0.00	0.00	1.819	0.169	0.000	0.000	3.284	0.093
51.12	15.58	0.00	0.00	1.841	0.171	0.000	0.000	3.355	0.095
51.15	15.59	0.00	0.00	1.873	0.174	0.000	0.000	3.390	0.096
51.18	15.60	0.00	0.00	1.894	0.176	0.000	0.000	3.461	0.098
51.21	15.61	0.00	0.00	1.927	0.179	0.000	0.000	3.531	0.100
51.25	15.62	0.00	0.00	1.948	0.181	0.000	0.000	3.602	0.102
51.28	15.63	0.00	0.00	1.981	0.184	0.000	0.000	3.637	0.103
51.31	15.64	0.00	0.00	2.013	0.187	0.000	0.000	3.708	0.105
51.35	15.65	0.00	0.00	2.034	0.189	0.000	0.000	3.779	0.107
51.38	15.66	0.00	0.00	2.056	0.191	0.000	0.000	3.849	0.109
51.41	15.67	0.00	0.00	2.077	0.193	0.000	0.000	3.920	0.111
51.44	15.68	0.00	0.00	2.110	0.196	0.000	0.000	3.991	0.113
51.48	15.69	0.00	0.00	2.131	0.198	0.000	0.000	4.061	0.115
51.51	15.70	0.00	0.00	2.153	0.200	0.000	0.000	4.132	0.117
51.54	15.71	0.00	0.00	2.185	0.203	0.000	0.000	4.202	0.119
51.57	15.72	0.00	0.00	2.207	0.205	0.000	0.000	4.273	0.121
51.61	15.73	0.00	0.00	2.239	0.208	0.000	0.000	4.344	0.123
51.64	15.74	0.00	0.00	2.271	0.211	0.000	0.000	4.414	0.125
51.67	15.75	0.00	0.00	2.303	0.214	0.000	0.000	4.485	0.127
51.71	15.76	0.00	0.00	2.336	0.217	0.000	0.000	4.556	0.129
51.74	15.77	0.00	0.00	2.357	0.219	0.000	0.000	4.662	0.132
51.77	15.78	0.00	0.00	2.390	0.222	0.000	0.000	4.732	0.134
51.80	15.79	0.00	0.00	2.411	0.224	0.000	0.000	4.803	0.136
51.84	15.80	0.00	0.00	2.443	0.227	0.000	0.000	4.873	0.138

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
51.87	15.81	0.00	0.00	2.476	0.230	0.000	0.000	4.979	0.141
51.90	15.82	0.00	0.00	2.508	0.233	0.000	0.000	5.050	0.143
51.94	15.83	0.00	0.00	2.540	0.236	0.000	0.000	5.121	0.145
51.97	15.84	0.00	0.00	2.573	0.239	0.000	0.000	5.227	0.148
52.00	15.85	0.00	0.00	2.605	0.242	0.000	0.000	5.297	0.150
52.03	15.86	0.00	0.00	2.637	0.245	0.000	0.000	5.368	0.152
52.07	15.87	0.00	0.00	2.669	0.248	0.000	0.000	5.474	0.155
52.10	15.88	0.00	0.00	2.702	0.251	0.000	0.000	5.544	0.157
52.13	15.89	0.00	0.00	2.723	0.253	0.000	0.000	5.650	0.160
52.17	15.90	0.00	0.00	2.756	0.256	0.000	0.000	5.721	0.162
52.20	15.91	0.00	0.00	2.788	0.259	0.000	0.000	5.827	0.165
52.23	15.92	0.00	0.00	2.809	0.261	0.000	0.000	5.933	0.168
52.26	15.93	0.00	0.00	2.842	0.264	0.000	0.000	6.003	0.170
52.30	15.94	0.00	0.00	2.874	0.267	0.000	0.000	6.109	0.173
52.33	15.95	0.00	0.00	2.906	0.270	0.000	0.000	6.215	0.176
52.36	15.96	0.00	0.00	2.939	0.273	0.000	0.000	6.286	0.178
52.40	15.97	0.00	0.00	2.971	0.276	0.000	0.000	6.392	0.181
52.43	15.98	0.00	0.00	3.003	0.279	0.000	0.000	6.498	0.184
52.46	15.99	0.00	0.00	3.025	0.281	0.000	0.000	6.604	0.187
52.49	16.00	0.00	0.00	3.057	0.284	0.000	0.000	6.674	0.189
52.53	16.01	0.00	0.00	3.078	0.286	0.000	0.000	6.780	0.192
52.56	16.02	0.00	0.00	3.111	0.289	0.000	0.000	6.886	0.195
52.59	16.03	0.00	0.00	3.132	0.291	0.000	0.000	6.992	0.198
52.62	16.04	0.00	0.00	3.165	0.294	0.000	0.000	7.098	0.201

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
52.66	16.05	0.00	0.00	3.197	0.297	0.000	0.000	7.204	0.204
52.69	16.06	0.00	0.00	3.218	0.299	0.000	0.000	7.310	0.207
52.72	16.07	0.00	0.00	3.251	0.302	0.000	0.000	7.416	0.210
52.76	16.08	0.00	0.00	3.283	0.305	0.000	0.000	7.522	0.213
52.79	16.09	0.00	0.00	3.315	0.308	0.000	0.000	7.628	0.216
52.82	16.10	0.00	0.00	3.348	0.311	0.000	0.000	7.734	0.219
52.85	16.11	0.00	0.00	3.380	0.314	0.000	0.000	7.840	0.222
52.89	16.12	0.00	0.00	3.412	0.317	0.000	0.000	7.946	0.225
52.92	16.13	0.00	0.00	3.444	0.320	0.000	0.000	8.087	0.229
52.95	16.14	0.00	0.00	3.477	0.323	0.000	0.000	8.193	0.232
52.99	16.15	0.00	0.00	3.498	0.325	0.000	0.000	8.299	0.235
53.02	16.16	0.00	0.00	3.531	0.328	0.000	0.000	8.405	0.238
53.05	16.17	0.00	0.00	3.563	0.331	0.000	0.000	8.546	0.242
53.08	16.18	0.00	0.00	3.595	0.334	0.000	0.000	8.652	0.245
53.12	16.19	0.00	0.00	3.627	0.337	0.000	0.000	8.758	0.248
53.15	16.20	0.00	0.00	3.670	0.341	0.000	0.000	8.899	0.252
53.18	16.21	0.00	0.00	3.703	0.344	0.000	0.000	9.005	0.255
53.22	16.22	0.00	0.00	3.735	0.347	0.000	0.000	9.147	0.259
53.25	16.23	0.00	0.00	3.767	0.350	0.000	0.000	9.252	0.262
53.28	16.24	0.00	0.00	3.800	0.353	0.000	0.000	9.394	0.266
53.31	16.25	0.00	0.00	3.832	0.356	0.000	0.000	9.500	0.269
53.35	16.26	0.00	0.00	3.864	0.359	0.000	0.000	9.641	0.273
53.38	16.27	0.00	0.00	3.897	0.362	0.000	0.000	9.747	0.276
53.41	16.28	0.00	0.00	3.929	0.365	0.000	0.000	9.888	0.280

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
53.44	16.29	0.00	0.00	3.961	0.368	0.000	0.000	10.029	0.284
53.48	16.30	0.00	0.00	3.993	0.371	0.000	0.000	10.135	0.287
53.51	16.31	0.00	0.00	4.026	0.374	0.000	0.000	10.277	0.291
53.54	16.32	0.00	0.00	4.069	0.378	0.000	0.000	10.418	0.295
53.58	16.33	0.00	0.00	4.090	0.380	0.000	0.000	10.559	0.299
53.61	16.34	0.00	0.00	4.123	0.383	0.000	0.000	10.665	0.302
53.64	16.35	0.00	0.00	4.155	0.386	0.000	0.000	10.806	0.306
53.67	16.36	0.00	0.00	4.176	0.388	0.000	0.000	10.948	0.310
53.71	16.37	0.00	0.00	4.209	0.391	0.000	0.000	11.089	0.314
53.74	16.38	0.00	0.00	4.230	0.393	0.000	0.000	11.230	0.318
53.77	16.39	0.00	0.00	4.263	0.396	0.000	0.000	11.371	0.322
53.81	16.40	0.00	0.00	4.284	0.398	0.000	0.000	11.513	0.326
53.84	16.41	0.00	0.00	4.306	0.400	0.000	0.000	11.654	0.330
53.87	16.42	0.00	0.00	4.338	0.403	0.000	0.000	11.795	0.334
53.90	16.43	0.00	0.00	4.370	0.406	0.000	0.000	11.936	0.338
53.94	16.44	0.00	0.00	4.402	0.409	0.000	0.000	12.078	0.342
53.97	16.45	0.00	0.00	4.424	0.411	0.000	0.000	12.219	0.346
54.00	16.46	0.00	0.00	4.456	0.414	0.000	0.000	12.360	0.350
54.04	16.47	0.00	0.00	4.489	0.417	0.000	0.000	12.501	0.354
54.07	16.48	0.00	0.00	4.521	0.420	0.000	0.000	12.678	0.359
54.10	16.49	0.00	0.00	4.553	0.423	0.000	0.000	12.819	0.363
54.13	16.50	0.00	0.00	4.585	0.426	0.000	0.000	12.960	0.367
54.17	16.51	0.00	0.00	4.607	0.428	0.000	0.000	13.102	0.371
54.20	16.52	0.00	0.00	4.639	0.431	0.000	0.000	13.278	0.376

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
54.23	16.53	0.00	0.00	4.672	0.434	0.000	0.000	13.420	0.380
54.27	16.54	0.00	0.00	4.704	0.437	0.000	0.000	13.561	0.384
54.30	16.55	0.00	0.00	4.736	0.440	0.000	0.000	13.737	0.389
54.33	16.56	0.00	0.00	4.758	0.442	0.000	0.000	13.879	0.393
54.36	16.57	0.00	0.00	4.790	0.445	0.000	0.000	14.020	0.397
54.40	16.58	0.00	0.00	4.822	0.448	0.000	0.000	14.197	0.402
54.43	16.59	0.00	0.00	4.855	0.451	0.000	0.000	14.338	0.406
54.46	16.60	0.00	0.00	4.887	0.454	0.000	0.000	14.514	0.411
54.49	16.61	0.00	0.00	4.919	0.457	0.000	0.000	14.691	0.416
54.53	16.62	0.00	0.00	4.941	0.459	0.000	0.000	14.832	0.420
54.56	16.63	0.00	0.00	4.973	0.462	0.000	0.000	15.009	0.425
54.59	16.64	0.00	0.00	5.005	0.465	0.000	0.000	15.150	0.429
54.63	16.65	0.00	0.00	5.038	0.468	0.000	0.000	15.327	0.434
54.66	16.66	0.00	0.00	5.059	0.470	0.000	0.000	15.503	0.439
54.69	16.67	0.00	0.00	5.091	0.473	0.000	0.000	15.644	0.443
54.72	16.68	0.00	0.00	5.124	0.476	0.000	0.000	15.821	0.448
54.76	16.69	0.00	0.00	5.145	0.478	0.000	0.000	15.998	0.453
54.79	16.70	0.00	0.00	5.177	0.481	0.000	0.000	16.174	0.458
54.82	16.71	0.00	0.00	5.199	0.483	0.000	0.000	16.351	0.463
54.86	16.72	0.00	0.00	5.231	0.486	0.000	0.000	16.492	0.467
54.89	16.73	0.00	0.00	5.253	0.488	0.000	0.000	16.669	0.472
54.92	16.74	0.00	0.00	5.274	0.490	0.000	0.000	16.845	0.477
54.95	16.75	0.00	0.00	5.307	0.493	0.000	0.000	17.022	0.482
54.99	16.76	0.00	0.00	5.328	0.495	0.000	0.000	17.198	0.487

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
55.02	16.77	0.00	0.00	5.350	0.497	0.000	0.000	17.375	0.492
55.05	16.78	0.00	0.00	5.382	0.500	0.000	0.000	17.551	0.497
55.09	16.79	0.00	0.00	5.403	0.502	0.000	0.000	17.728	0.502
55.12	16.80	0.00	0.00	5.436	0.505	0.000	0.000	17.905	0.507
55.15	16.81	0.00	0.00	5.457	0.507	0.000	0.000	18.081	0.512
55.18	16.82	0.00	0.00	5.490	0.510	0.000	0.000	18.258	0.517
55.22	16.83	0.00	0.00	5.511	0.512	0.000	0.000	18.434	0.522
55.25	16.84	0.00	0.00	5.543	0.515	0.000	0.000	18.611	0.527
55.28	16.85	0.00	0.00	5.576	0.518	0.000	0.000	18.823	0.533
55.31	16.86	0.00	0.00	5.619	0.522	0.000	0.000	18.999	0.538
55.35	16.87	0.00	0.00	5.651	0.525	0.000	0.000	19.176	0.543
55.38	16.88	0.00	0.00	5.683	0.528	0.000	0.000	19.352	0.548
55.41	16.89	0.00	0.00	5.716	0.531	0.000	0.000	19.564	0.554
55.45	16.90	0.00	0.00	5.748	0.534	0.000	0.000	19.741	0.559
55.48	16.91	0.00	0.00	5.791	0.538	0.000	0.000	19.917	0.564
55.51	16.92	0.00	0.00	5.813	0.540	0.000	0.000	20.129	0.570
55.54	16.93	0.00	0.00	5.845	0.543	0.000	0.000	20.306	0.575
55.58	16.94	0.00	0.00	5.877	0.546	0.000	0.000	20.483	0.580
55.61	16.95	0.00	0.00	5.909	0.549	0.000	0.000	20.694	0.586
55.64	16.96	0.00	0.00	5.942	0.552	0.000	0.000	20.871	0.591
55.68	16.97	0.00	0.00	5.963	0.554	0.000	0.000	21.083	0.597
55.71	16.98	0.00	0.00	5.995	0.557	0.000	0.000	21.295	0.603
55.74	16.99	0.00	0.00	6.028	0.560	0.000	0.000	21.471	0.608
55.77	17.00	0.00	0.00	6.049	0.562	0.000	0.000	21.683	0.614

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
55.81	17.01	0.00	0.00	6.082	0.565	0.000	0.000	21.860	0.619
55.84	17.02	0.00	0.00	6.114	0.568	0.000	0.000	22.072	0.625
55.87	17.03	0.00	0.00	6.146	0.571	0.000	0.000	22.284	0.631
55.91	17.04	0.00	0.00	6.178	0.574	0.000	0.000	22.460	0.636
55.94	17.05	0.00	0.00	6.211	0.577	0.000	0.000	22.672	0.642
55.97	17.06	0.00	0.00	6.243	0.580	0.000	0.000	22.884	0.648
56.00	17.07	0.00	0.00	6.275	0.583	0.000	0.000	23.096	0.654
56.04	17.08	0.00	0.00	6.308	0.586	0.000	0.000	23.308	0.660
56.07	17.09	0.00	0.00	6.340	0.589	0.000	0.000	23.520	0.666
56.10	17.10	0.00	0.00	6.372	0.592	0.000	0.000	23.696	0.671
56.14	17.11	0.00	0.00	6.405	0.595	0.000	0.000	23.908	0.677
56.17	17.12	0.00	0.00	6.426	0.597	0.000	0.000	24.120	0.683
56.20	17.13	0.00	0.00	6.458	0.600	0.000	0.000	24.332	0.689
56.23	17.14	0.00	0.00	6.480	0.602	0.000	0.000	24.544	0.695
56.27	17.15	0.00	0.00	6.501	0.604	0.000	0.000	24.756	0.701
56.30	17.16	0.00	0.00	6.523	0.606	0.000	0.000	24.967	0.707
56.33	17.17	0.00	0.00	6.555	0.609	0.000	0.000	25.179	0.713
56.36	17.18	0.00	0.00	6.577	0.611	0.000	0.000	25.427	0.720
56.40	17.19	0.00	0.00	6.598	0.613	0.000	0.000	25.638	0.726
56.43	17.20	0.00	0.00	6.631	0.616	0.000	0.000	25.850	0.732
56.46	17.21	0.00	0.00	6.652	0.618	0.000	0.000	26.062	0.738
56.50	17.22	0.00	0.00	6.674	0.620	0.000	0.000	26.274	0.744
56.53	17.23	0.00	0.00	6.706	0.623	0.000	0.000	26.486	0.750
56.56	17.24	0.00	0.00	6.727	0.625	0.000	0.000	26.733	0.757

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
56.59	17.25	0.00	0.00	6.749	0.627	0.000	0.000	26.945	0.763
56.63	17.26	0.00	0.00	6.770	0.629	0.000	0.000	27.157	0.769
56.66	17.27	0.00	0.00	6.803	0.632	0.000	0.000	27.404	0.776
56.69	17.28	0.00	0.00	6.824	0.634	0.000	0.000	27.616	0.782
56.73	17.29	0.00	0.00	6.846	0.636	0.000	0.000	27.828	0.788
56.76	17.30	0.00	0.00	6.878	0.639	0.000	0.000	28.075	0.795
56.79	17.31	0.00	0.00	6.900	0.641	0.000	0.000	28.287	0.801
56.82	17.32	0.00	0.00	6.921	0.643	0.000	0.000	28.499	0.807
56.86	17.33	0.00	0.00	6.943	0.645	0.000	0.000	28.746	0.814
56.89	17.34	0.00	0.00	6.975	0.648	0.000	0.000	28.958	0.820
56.92	17.35	0.00	0.00	6.997	0.650	0.000	0.000	29.205	0.827
56.96	17.36	0.00	0.00	7.018	0.652	0.000	0.000	29.417	0.833
56.99	17.37	0.00	0.00	7.050	0.655	0.000	0.000	29.664	0.840
57.02	17.38	0.00	0.00	7.072	0.657	0.000	0.000	29.876	0.846
57.05	17.39	0.00	0.00	7.093	0.659	0.000	0.000	30.123	0.853
57.09	17.40	0.00	0.00	7.115	0.661	0.000	0.000	30.371	0.860
57.12	17.41	0.00	0.00	7.147	0.664	0.000	0.000	30.583	0.866
57.15	17.42	0.00	0.00	7.169	0.666	0.000	0.000	30.830	0.873
57.19	17.43	0.00	0.00	7.190	0.668	0.000	0.000	31.077	0.880
57.22	17.44	0.00	0.00	7.223	0.671	0.000	0.000	31.289	0.886
57.25	17.45	0.00	0.00	7.244	0.673	0.000	0.000	31.536	0.893
57.28	17.46	0.00	0.00	7.266	0.675	0.000	0.000	31.783	0.900
57.32	17.47	0.00	0.00	7.287	0.677	0.000	0.000	31.995	0.906
57.35	17.48	0.00	0.00	7.319	0.680	0.000	0.000	32.242	0.913

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
57.38	17.49	0.00	0.00	7.341	0.682	0.000	0.000	32.490	0.920
57.41	17.50	0.00	0.00	7.363	0.684	0.000	0.000	32.737	0.927
57.45	17.51	0.00	0.00	7.395	0.687	0.000	0.000	32.984	0.934
57.48	17.52	0.00	0.00	7.416	0.689	0.000	0.000	33.231	0.941
57.51	17.53	0.00	0.00	7.449	0.692	0.000	0.000	33.443	0.947
57.55	17.54	0.00	0.00	7.470	0.694	0.000	0.000	33.690	0.954
57.58	17.55	0.00	0.00	7.502	0.697	0.000	0.000	33.937	0.961
57.61	17.56	0.00	0.00	7.535	0.700	0.000	0.000	34.185	0.968
57.64	17.57	0.00	0.00	7.556	0.702	0.000	0.000	34.432	0.975
57.68	17.58	0.00	0.00	7.589	0.705	0.000	0.000	34.679	0.982
57.71	17.59	0.00	0.00	7.610	0.707	0.000	0.000	34.926	0.989
57.74	17.60	0.00	0.00	7.632	0.709	0.000	0.000	35.209	0.997
57.78	17.61	0.00	0.00	7.653	0.711	0.000	0.000	35.456	1.004
57.81	17.62	0.00	0.00	7.675	0.713	0.000	0.000	35.703	1.011
57.84	17.63	0.00	0.00	7.696	0.715	0.000	0.000	35.950	1.018
57.87	17.64	0.00	0.00	7.728	0.718	0.000	0.000	36.198	1.025
57.91	17.65	0.00	0.00	7.750	0.720	0.000	0.000	36.445	1.032
57.94	17.66	0.00	0.00	7.772	0.722	0.000	0.000	36.692	1.039
57.97	17.67	0.00	0.00	7.793	0.724	0.000	0.000	36.974	1.047
58.01	17.68	0.00	0.00	7.815	0.726	0.000	0.000	37.222	1.054
58.04	17.69	0.00	0.00	7.836	0.728	0.000	0.000	37.469	1.061
58.07	17.70	0.00	0.00	7.868	0.731	0.000	0.000	37.751	1.069
58.10	17.71	0.00	0.00	7.890	0.733	0.000	0.000	37.999	1.076
58.14	17.72	0.00	0.00	7.911	0.735	0.000	0.000	38.246	1.083

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
58.17	17.73	0.00	0.00	7.933	0.737	0.000	0.000	38.528	1.091
58.20	17.74	0.00	0.00	7.955	0.739	0.000	0.000	38.776	1.098
58.23	17.75	0.00	0.00	7.976	0.741	0.000	0.000	39.023	1.105
58.27	17.76	0.00	0.00	7.998	0.743	0.000	0.000	39.305	1.113
58.30	17.77	0.00	0.00	8.019	0.745	0.000	0.000	39.552	1.120
58.33	17.78	0.00	0.00	8.041	0.747	0.000	0.000	39.835	1.128
58.37	17.79	0.00	0.00	8.073	0.750	0.000	0.000	40.082	1.135
58.40	17.80	0.00	0.00	8.094	0.752	0.000	0.000	40.365	1.143
58.43	17.81	0.00	0.00	8.116	0.754	0.000	0.000	40.612	1.150
58.46	17.82	0.00	0.00	8.138	0.756	0.000	0.000	40.894	1.158
58.50	17.83	0.00	0.00	8.170	0.759	0.000	0.000	41.142	1.165
58.53	17.84	0.00	0.00	8.191	0.761	0.000	0.000	41.424	1.173
58.56	17.85	0.00	0.00	8.213	0.763	0.000	0.000	41.707	1.181
58.60	17.86	0.00	0.00	8.224	0.764	0.000	0.000	41.954	1.188
58.63	17.87	0.00	0.00	8.245	0.766	0.000	0.000	42.236	1.196
58.66	17.88	0.00	0.00	8.267	0.768	0.000	0.000	42.484	1.203
58.69	17.89	0.00	0.00	8.288	0.770	0.000	0.000	42.766	1.211
58.73	17.90	0.00	0.00	8.310	0.772	0.000	0.000	43.049	1.219
58.76	17.91	0.00	0.00	8.331	0.774	0.000	0.000	43.331	1.227
58.79	17.92	0.00	0.00	8.353	0.776	0.000	0.000	43.578	1.234
58.83	17.93	0.00	0.00	8.364	0.777	0.000	0.000	43.861	1.242
58.86	17.94	0.00	0.00	8.385	0.779	0.000	0.000	44.143	1.250
58.89	17.95	0.00	0.00	8.407	0.781	0.000	0.000	44.426	1.258
58.92	17.96	0.00	0.00	8.428	0.783	0.000	0.000	44.708	1.266

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
58.96	17.97	0.00	0.00	8.450	0.785	0.000	0.000	44.956	1.273
58.99	17.98	0.00	0.00	8.471	0.787	0.000	0.000	45.238	1.281
59.02	17.99	0.00	0.00	8.493	0.789	0.000	0.000	45.521	1.289
59.06	18.00	0.00	0.00	8.503	0.790	0.000	0.000	45.803	1.297
59.09	18.01	0.00	0.00	8.525	0.792	0.000	0.000	46.086	1.305
59.12	18.02	0.00	0.00	8.547	0.794	0.000	0.000	46.368	1.313
59.15	18.03	0.00	0.00	8.579	0.797	0.000	0.000	46.651	1.321
59.19	18.04	0.00	0.00	8.600	0.799	0.000	0.000	46.933	1.329
59.22	18.05	0.00	0.00	8.622	0.801	0.000	0.000	47.216	1.337
59.25	18.06	0.00	0.00	8.643	0.803	0.000	0.000	47.498	1.345
59.28	18.07	0.00	0.00	8.665	0.805	0.000	0.000	47.781	1.353
59.32	18.08	0.00	0.00	8.686	0.807	0.000	0.000	48.063	1.361
59.35	18.09	0.00	0.00	8.708	0.809	0.000	0.000	48.346	1.369
59.38	18.10	0.00	0.00	8.730	0.811	0.000	0.000	48.628	1.377
59.42	18.11	0.00	0.00	8.751	0.813	0.000	0.000	48.911	1.385
59.45	18.12	0.00	0.00	8.773	0.815	0.000	0.000	49.193	1.393
59.48	18.13	0.00	0.00	8.794	0.817	0.000	0.000	49.476	1.401
59.51	18.14	0.00	0.00	8.816	0.819	0.000	0.000	49.794	1.410
59.55	18.15	0.00	0.00	8.848	0.822	0.000	0.000	50.076	1.418
59.58	18.16	0.00	0.00	8.869	0.824	0.000	0.000	50.359	1.426
59.61	18.17	0.00	0.00	8.891	0.826	0.000	0.000	50.641	1.434
59.65	18.18	0.00	0.00	8.913	0.828	0.000	0.000	50.959	1.443
59.68	18.19	0.00	0.00	8.934	0.830	0.000	0.000	51.242	1.451
59.71	18.20	0.00	0.00	8.956	0.832	0.000	0.000	51.524	1.459

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
59.74	18.21	0.00	0.00	8.977	0.834	0.000	0.000	51.842	1.468
59.78	18.22	0.00	0.00	8.999	0.836	0.000	0.000	52.124	1.476
59.81	18.23	0.00	0.00	9.020	0.838	0.000	0.000	52.407	1.484
59.84	18.24	0.00	0.00	9.042	0.840	0.000	0.000	52.725	1.493
59.88	18.25	0.00	0.00	9.063	0.842	0.000	0.000	53.007	1.501
59.91	18.26	0.00	0.00	9.085	0.844	0.000	0.000	53.290	1.509
59.94	18.27	0.00	0.00	9.106	0.846	0.000	0.000	53.608	1.518
59.97	18.28	0.00	0.00	9.128	0.848	0.000	0.000	53.890	1.526
60.01	18.29	0.03	0.01	9.149	0.850	0.318	0.009	54.208	1.535
60.04	18.30	0.07	0.02	9.171	0.852	0.600	0.017	54.491	1.543
60.07	18.31	0.10	0.03	9.192	0.854	0.918	0.026	54.808	1.552
60.10	18.32	0.13	0.04	9.225	0.857	1.201	0.034	55.091	1.560
60.14	18.33	0.16	0.05	9.246	0.859	1.519	0.043	55.409	1.569
60.17	18.34	0.20	0.06	9.268	0.861	1.836	0.052	55.727	1.578
60.20	18.35	0.23	0.07	9.289	0.863	2.119	0.060	56.009	1.586
60.24	18.36	0.26	0.08	9.311	0.865	2.437	0.069	56.327	1.595
60.27	18.37	0.30	0.09	9.332	0.867	2.755	0.078	56.645	1.604
60.30	18.38	0.33	0.10	9.354	0.869	3.037	0.086	56.927	1.612
60.33	18.39	0.36	0.11	9.386	0.872	3.355	0.095	57.245	1.621
60.37	18.40	0.39	0.12	9.408	0.874	3.673	0.104	57.563	1.630
60.40	18.41	0.43	0.13	9.429	0.876	3.955	0.112	57.845	1.638
60.43	18.42	0.46	0.14	9.451	0.878	4.273	0.121	58.163	1.647
60.47	18.43	0.49	0.15	9.483	0.881	4.591	0.130	58.481	1.656
60.50	18.44	0.52	0.16	9.505	0.883	4.909	0.139	58.799	1.665

O.S.L/D.S.L

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
60.53	18.45	0.56	0.17	9.526	0.885	5.227	0.148	59.117	1.674
60.56	18.46	0.59	0.18	9.558	0.888	5.544	0.157	59.435	1.683
60.60	18.47	0.62	0.19	9.580	0.890	5.827	0.165	59.717	1.691
60.63	18.48	0.66	0.20	9.601	0.892	6.145	0.174	60.035	1.700
60.66	18.49	0.69	0.21	9.634	0.895	6.463	0.183	60.353	1.709
60.70	18.50	0.72	0.22	9.655	0.897	6.780	0.192	60.671	1.718
60.73	18.51	0.75	0.23	9.677	0.899	7.098	0.201	60.988	1.727
60.76	18.52	0.79	0.24	9.709	0.902	7.416	0.210	61.306	1.736
60.79	18.53	0.82	0.25	9.731	0.904	7.734	0.219	61.624	1.745
60.83	18.54	0.85	0.26	9.763	0.907	8.052	0.228	61.942	1.754
60.86	18.55	0.89	0.27	9.784	0.909	8.370	0.237	62.260	1.763
60.89	18.56	0.92	0.28	9.817	0.912	8.723	0.247	62.613	1.773
60.93	18.57	0.95	0.29	9.849	0.915	9.041	0.256	62.931	1.782
60.96	18.58	0.98	0.30	9.881	0.918	9.358	0.265	63.249	1.791
60.99	18.59	1.02	0.31	9.903	0.920	9.676	0.274	63.566	1.800
61.02	18.60	1.05	0.32	9.935	0.923	9.994	0.283	63.884	1.809
61.06	18.61	1.08	0.33	9.957	0.925	10.312	0.292	64.202	1.818
61.09	18.62	1.12	0.34	9.989	0.928	10.665	0.302	64.555	1.828
61.12	18.63	1.15	0.35	10.021	0.931	10.983	0.311	64.873	1.837
61.15	18.64	1.18	0.36	10.043	0.933	11.301	0.320	65.191	1.846
61.19	18.65	1.21	0.37	10.075	0.936	11.654	0.330	65.544	1.856
61.22	18.66	1.25	0.38	10.107	0.939	11.972	0.339	65.862	1.865
61.25	18.67	1.28	0.39	10.140	0.942	12.290	0.348	66.180	1.874
61.29	18.68	1.31	0.40	10.172	0.945	12.643	0.358	66.533	1.884

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
61.32	18.69	1.35	0.41	10.193	0.947	12.960	0.367	66.851	1.893
61.35	18.70	1.38	0.42	10.226	0.950	13.314	0.377	67.204	1.903
61.38	18.71	1.41	0.43	10.258	0.953	13.631	0.386	67.522	1.912
61.42	18.72	1.44	0.44	10.290	0.956	13.985	0.396	67.875	1.922
61.45	18.73	1.48	0.45	10.323	0.959	14.302	0.405	68.193	1.931
61.48	18.74	1.51	0.46	10.355	0.962	14.656	0.415	68.546	1.941
61.52	18.75	1.54	0.47	10.387	0.965	15.009	0.425	68.899	1.951
61.55	18.76	1.57	0.48	10.409	0.967	15.327	0.434	69.217	1.960
61.58	18.77	1.61	0.49	10.441	0.970	15.680	0.444	69.570	1.970
61.61	18.78	1.64	0.50	10.473	0.973	16.033	0.454	69.923	1.980
61.65	18.79	1.67	0.51	10.506	0.976	16.386	0.464	70.276	1.990
61.68	18.80	1.71	0.52	10.538	0.979	16.704	0.473	70.594	1.999
61.71	18.81	1.74	0.53	10.570	0.982	17.057	0.483	70.947	2.009
61.75	18.82	1.77	0.54	10.602	0.985	17.410	0.493	71.300	2.019
61.78	18.83	1.80	0.55	10.635	0.988	17.763	0.503	71.654	2.029
61.81	18.84	1.84	0.56	10.667	0.991	18.116	0.513	72.007	2.039
61.84	18.85	1.87	0.57	10.699	0.994	18.470	0.523	72.360	2.049
61.88	18.86	1.90	0.58	10.732	0.997	18.823	0.533	72.713	2.059
61.91	18.87	1.94	0.59	10.764	1.000	19.176	0.543	73.066	2.069
61.94	18.88	1.97	0.60	10.796	1.003	19.529	0.553	73.419	2.079
61.98	18.89	2.00	0.61	10.828	1.006	19.882	0.563	73.772	2.089
62.01	18.90	2.03	0.62	10.861	1.009	20.235	0.573	74.126	2.099
62.04	18.91	2.07	0.63	10.893	1.012	20.588	0.583	74.479	2.109
62.07	18.92	2.10	0.64	10.925	1.015	20.942	0.593	74.832	2.119

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
62.11	18.93	2.13	0.65	10.958	1.018	21.295	0.603	75.185	2.129
62.14	18.94	2.17	0.66	11.001	1.022	21.648	0.613	75.538	2.139
62.17	18.95	2.20	0.67	11.033	1.025	22.036	0.624	75.927	2.150
62.20	18.96	2.23	0.68	11.065	1.028	22.390	0.634	76.280	2.160
62.24	18.97	2.26	0.69	11.098	1.031	22.743	0.644	76.633	2.170
62.27	18.98	2.30	0.70	11.130	1.034	23.096	0.654	76.986	2.180
62.30	18.99	2.33	0.71	11.162	1.037	23.484	0.665	77.375	2.191
62.34	19.00	2.36	0.72	11.194	1.040	23.837	0.675	77.728	2.201
62.37	19.01	2.40	0.73	11.227	1.043	24.226	0.686	78.116	2.212
62.40	19.02	2.43	0.74	11.259	1.046	24.579	0.696	78.469	2.222
62.43	19.03	2.46	0.75	11.291	1.049	24.967	0.707	78.858	2.233
62.47	19.04	2.49	0.76	11.324	1.052	25.321	0.717	79.211	2.243
62.50	19.05	2.53	0.77	11.356	1.055	25.709	0.728	79.599	2.254
62.53	19.06	2.56	0.78	11.388	1.058	26.062	0.738	79.952	2.264
62.57	19.07	2.59	0.79	11.420	1.061	26.451	0.749	80.341	2.275
62.60	19.08	2.62	0.80	11.453	1.064	26.804	0.759	80.694	2.285
62.63	19.09	2.66	0.81	11.485	1.067	27.192	0.770	81.083	2.296
62.66	19.10	2.69	0.82	11.517	1.070	27.581	0.781	81.471	2.307
62.70	19.11	2.72	0.83	11.550	1.073	27.934	0.791	81.824	2.317
62.73	19.12	2.76	0.84	11.582	1.076	28.322	0.802	82.213	2.328
62.76	19.13	2.79	0.85	11.614	1.079	28.711	0.813	82.601	2.339
62.80	19.14	2.82	0.86	11.647	1.082	29.099	0.824	82.990	2.350
62.83	19.15	2.85	0.87	11.679	1.085	29.488	0.835	83.378	2.361
62.86	19.16	2.89	0.88	11.722	1.089	29.841	0.845	83.731	2.371

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
62.89	19.17	2.92	0.89	11.754	1.092	30.229	0.856	84.120	2.382
62.93	19.18	2.95	0.90	11.786	1.095	30.618	0.867	84.508	2.393
62.96	19.19	2.99	0.91	11.819	1.098	31.006	0.878	84.897	2.404
62.99	19.20	3.02	0.92	11.851	1.101	31.395	0.889	85.285	2.415
63.02	19.21	3.05	0.93	11.883	1.104	31.783	0.900	85.673	2.426
63.06	19.22	3.08	0.94	11.916	1.107	32.172	0.911	86.062	2.437
63.09	19.23	3.12	0.95	11.948	1.110	32.560	0.922	86.450	2.448
63.12	19.24	3.15	0.96	11.991	1.114	32.984	0.934	86.874	2.460
63.16	19.25	3.18	0.97	12.023	1.117	33.372	0.945	87.263	2.471
63.19	19.26	3.22	0.98	12.056	1.120	33.761	0.956	87.651	2.482
63.22	19.27	3.25	0.99	12.088	1.123	34.149	0.967	88.040	2.493
63.25	19.28	3.28	1.00	12.131	1.127	34.538	0.978	88.428	2.504
63.29	19.29	3.31	1.01	12.163	1.130	34.962	0.990	88.852	2.516
63.32	19.30	3.35	1.02	12.195	1.133	35.350	1.001	89.240	2.527
63.35	19.31	3.38	1.03	12.239	1.137	35.738	1.012	89.629	2.538
63.39	19.32	3.41	1.04	12.271	1.140	36.162	1.024	90.052	2.550
63.42	19.33	3.44	1.05	12.303	1.143	36.551	1.035	90.441	2.561
63.45	19.34	3.48	1.06	12.346	1.147	36.974	1.047	90.865	2.573
63.48	19.35	3.51	1.07	12.378	1.150	37.363	1.058	91.253	2.584
63.52	19.36	3.54	1.08	12.411	1.153	37.787	1.070	91.677	2.596
63.55	19.37	3.58	1.09	12.454	1.157	38.175	1.081	92.065	2.607
63.58	19.38	3.61	1.10	12.486	1.160	38.599	1.093	92.489	2.619
63.62	19.39	3.64	1.11	12.518	1.163	38.987	1.104	92.878	2.630
63.65	19.40	3.67	1.12	12.561	1.167	39.411	1.116	93.301	2.642

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
63.68	19.41	3.71	1.13	12.594	1.170	39.835	1.128	93.725	2.654
63.71	19.42	3.74	1.14	12.637	1.174	40.223	1.139	94.114	2.665
63.75	19.43	3.77	1.15	12.669	1.177	40.647	1.151	94.537	2.677
63.78	19.44	3.81	1.16	12.712	1.181	41.071	1.163	94.961	2.689
63.81	19.45	3.84	1.17	12.744	1.184	41.495	1.175	95.385	2.701
63.85	19.46	3.87	1.18	12.788	1.188	41.919	1.187	95.809	2.713
63.88	19.47	3.90	1.19	12.831	1.192	42.307	1.198	96.197	2.724
63.91	19.48	3.94	1.20	12.874	1.196	42.731	1.210	96.621	2.736
63.94	19.49	3.97	1.21	12.917	1.200	43.155	1.222	97.045	2.748
63.98	19.50	4.00	1.22	12.960	1.204	43.578	1.234	97.469	2.760
64.01	19.51	4.04	1.23	13.014	1.209	44.002	1.246	97.892	2.772
64.04	19.52	4.07	1.24	13.057	1.213	44.461	1.259	98.351	2.785
64.07	19.53	4.10	1.25	13.110	1.218	44.885	1.271	98.775	2.797
64.11	19.54	4.13	1.26	13.153	1.222	45.309	1.283	99.199	2.809
64.14	19.55	4.17	1.27	13.207	1.227	45.733	1.295	99.623	2.821
64.17	19.56	4.20	1.28	13.261	1.232	46.156	1.307	100.047	2.833
64.21	19.57	4.23	1.29	13.304	1.236	46.615	1.320	100.506	2.846
64.24	19.58	4.27	1.30	13.358	1.241	47.039	1.332	100.929	2.858
64.27	19.59	4.30	1.31	13.412	1.246	47.498	1.345	101.389	2.871
64.30	19.60	4.33	1.32	13.455	1.250	47.922	1.357	101.812	2.883
64.34	19.61	4.36	1.33	13.509	1.255	48.381	1.370	102.271	2.896
64.37	19.62	4.40	1.34	13.563	1.260	48.805	1.382	102.695	2.908
64.40	19.63	4.43	1.35	13.606	1.264	49.264	1.395	103.154	2.921
64.44	19.64	4.46	1.36	13.659	1.269	49.723	1.408	103.613	2.934

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
64.47	19.65	4.49	1.37	13.713	1.274	50.147	1.420	104.037	2.946
64.50	19.66	4.53	1.38	13.767	1.279	50.606	1.433	104.496	2.959
64.53	19.67	4.56	1.39	13.821	1.284	51.065	1.446	104.955	2.972
64.57	19.68	4.59	1.40	13.875	1.289	51.524	1.459	105.414	2.985
64.60	19.69	4.63	1.41	13.928	1.294	51.983	1.472	105.873	2.998
64.63	19.70	4.66	1.42	13.993	1.300	52.442	1.485	106.333	3.011
64.67	19.71	4.69	1.43	14.058	1.306	52.901	1.498	106.792	3.024
64.70	19.72	4.72	1.44	14.111	1.311	53.361	1.511	107.251	3.037
64.73	19.73	4.76	1.45	14.176	1.317	53.820	1.524	107.710	3.050
64.76	19.74	4.79	1.46	14.241	1.323	54.279	1.537	108.169	3.063
64.80	19.75	4.82	1.47	14.305	1.329	54.738	1.550	108.628	3.076
64.83	19.76	4.86	1.48	14.381	1.336	55.232	1.564	109.122	3.090
64.86	19.77	4.89	1.49	14.445	1.342	55.691	1.577	109.582	3.103
64.90	19.78	4.92	1.50	14.499	1.347	56.150	1.590	110.041	3.116
64.93	19.79	4.95	1.51	14.564	1.353	56.645	1.604	110.535	3.130
64.96	19.80	4.99	1.52	14.639	1.360	57.104	1.617	110.994	3.143
64.99	19.81	5.02	1.53	14.703	1.366	57.598	1.631	111.489	3.157
65.03	19.82	5.05	1.54	14.779	1.373	58.093	1.645	111.983	3.171
65.06	19.83	5.09	1.55	14.843	1.379	58.587	1.659	112.477	3.185
65.09	19.84	5.12	1.56	14.919	1.386	59.046	1.672	112.936	3.198
65.12	19.85	5.15	1.57	14.983	1.392	59.541	1.686	113.431	3.212
65.16	19.86	5.18	1.58	15.037	1.397	60.035	1.700	113.925	3.226
65.19	19.87	5.22	1.59	15.102	1.403	60.529	1.714	114.420	3.240
65.22	19.88	5.25	1.60	15.166	1.409	61.024	1.728	114.914	3.254

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
65.26	19.89	5.28	1.61	15.231	1.415	61.518	1.742	115.408	3.268
65.29	19.90	5.31	1.62	15.296	1.421	62.048	1.757	115.938	3.283
65.32	19.91	5.35	1.63	15.360	1.427	62.542	1.771	116.433	3.297
65.35	19.92	5.38	1.64	15.414	1.432	63.037	1.785	116.927	3.311
65.39	19.93	5.41	1.65	15.478	1.438	63.531	1.799	117.421	3.325
65.42	19.94	5.45	1.66	15.543	1.444	64.061	1.814	117.951	3.340
65.45	19.95	5.48	1.67	15.608	1.450	64.555	1.828	118.446	3.354
65.49	19.96	5.51	1.68	15.672	1.456	65.085	1.843	118.975	3.369
65.52	19.97	5.54	1.69	15.737	1.462	65.579	1.857	119.470	3.383
65.55	19.98	5.58	1.70	15.801	1.468	66.109	1.872	119.999	3.398
65.58	19.99	5.61	1.71	15.877	1.475	66.639	1.887	120.529	3.413
65.62	20.00	5.64	1.72	15.941	1.481	67.169	1.902	121.059	3.428
65.65	20.01	5.68	1.73	16.017	1.488	67.663	1.916	121.553	3.442
65.68	20.02	5.71	1.74	16.081	1.494	68.193	1.931	122.083	3.457
65.72	20.03	5.74	1.75	16.146	1.500	68.722	1.946	122.613	3.472
65.75	20.04	5.77	1.76	16.221	1.507	69.252	1.961	123.142	3.487
65.78	20.05	5.81	1.77	16.286	1.513	69.782	1.976	123.672	3.502
65.81	20.06	5.84	1.78	16.361	1.520	70.347	1.992	124.237	3.518
65.85	20.07	5.87	1.79	16.426	1.526	70.877	2.007	124.767	3.533
65.88	20.08	5.91	1.80	16.501	1.533	71.406	2.022	125.297	3.548
65.91	20.09	5.94	1.81	16.576	1.540	71.971	2.038	125.862	3.564
65.94	20.10	5.97	1.82	16.652	1.547	72.501	2.053	126.391	3.579
65.98	20.11	6.00	1.83	16.727	1.554	73.031	2.068	126.921	3.594
66.01	20.12	6.04	1.84	16.802	1.561	73.596	2.084	127.486	3.610

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
66.04	20.13	6.07	1.85	16.878	1.568	74.161	2.100	128.051	3.626
66.08	20.14	6.10	1.86	16.953	1.575	74.691	2.115	128.581	3.641
66.11	20.15	6.14	1.87	17.039	1.583	75.256	2.131	129.146	3.657
66.14	20.16	6.17	1.88	17.115	1.590	75.821	2.147	129.711	3.673
66.17	20.17	6.20	1.89	17.179	1.596	76.386	2.163	130.276	3.689
66.21	20.18	6.23	1.90	17.255	1.603	76.951	2.179	130.841	3.705
66.24	20.19	6.27	1.91	17.330	1.610	77.516	2.195	131.406	3.721
66.27	20.20	6.30	1.92	17.405	1.617	78.081	2.211	131.971	3.737
66.31	20.21	6.33	1.93	17.470	1.623	78.646	2.227	132.536	3.753
66.34	20.22	6.36	1.94	17.545	1.630	79.246	2.244	133.136	3.770
66.37	20.23	6.40	1.95	17.610	1.636	79.811	2.260	133.701	3.786
66.40	20.24	6.43	1.96	17.685	1.643	80.376	2.276	134.266	3.802
66.44	20.25	6.46	1.97	17.760	1.650	80.977	2.293	134.867	3.819
66.47	20.26	6.50	1.98	17.825	1.656	81.542	2.309	135.432	3.835
66.50	20.27	6.53	1.99	17.900	1.663	82.142	2.326	136.032	3.852
66.54	20.28	6.56	2.00	17.976	1.670	82.742	2.343	136.633	3.869
66.57	20.29	6.59	2.01	18.051	1.677	83.307	2.359	137.198	3.885
66.60	20.30	6.63	2.02	18.116	1.683	83.908	2.376	137.798	3.902
66.63	20.31	6.66	2.03	18.191	1.690	84.508	2.393	138.398	3.919
66.67	20.32	6.69	2.04	18.266	1.697	85.108	2.410	138.999	3.936
66.70	20.33	6.73	2.05	18.342	1.704	85.709	2.427	139.599	3.953
66.73	20.34	6.76	2.06	18.417	1.711	86.309	2.444	140.199	3.970
66.77	20.35	6.79	2.07	18.492	1.718	86.909	2.461	140.800	3.987
66.80	20.36	6.82	2.08	18.568	1.725	87.510	2.478	141.400	4.004

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
66.83	20.37	6.86	2.09	18.643	1.732	88.145	2.496	142.036	4.022
66.86	20.38	6.89	2.10	18.718	1.739	88.746	2.513	142.636	4.039
66.90	20.39	6.92	2.11	18.794	1.746	89.346	2.530	143.236	4.056
66.93	20.40	6.96	2.12	18.869	1.753	89.982	2.548	143.872	4.074
66.96	20.41	6.99	2.13	18.955	1.761	90.618	2.566	144.508	4.092
66.99	20.42	7.02	2.14	19.031	1.768	91.218	2.583	145.108	4.109
67.03	20.43	7.05	2.15	19.117	1.776	91.854	2.601	145.744	4.127
67.06	20.44	7.09	2.16	19.192	1.783	92.489	2.619	146.379	4.145
67.09	20.45	7.12	2.17	19.278	1.791	93.125	2.637	147.015	4.163
67.13	20.46	7.15	2.18	19.364	1.799	93.761	2.655	147.651	4.181
67.16	20.47	7.19	2.19	19.450	1.807	94.396	2.673	148.286	4.199
67.19	20.48	7.22	2.20	19.536	1.815	95.032	2.691	148.922	4.217
67.22	20.49	7.25	2.21	19.623	1.823	95.668	2.709	149.558	4.235
67.26	20.50	7.28	2.22	19.709	1.831	96.303	2.727	150.193	4.253
67.29	20.51	7.32	2.23	19.795	1.839	96.939	2.745	150.829	4.271
67.32	20.52	7.35	2.24	19.892	1.848	97.610	2.764	151.500	4.290
67.36	20.53	7.38	2.25	19.978	1.856	98.245	2.782	152.136	4.308
67.39	20.54	7.41	2.26	20.075	1.865	98.916	2.801	152.807	4.327
67.42	20.55	7.45	2.27	20.161	1.873	99.587	2.820	153.478	4.346
67.45	20.56	7.48	2.28	20.258	1.882	100.223	2.838	154.113	4.364
67.49	20.57	7.51	2.29	20.344	1.890	100.894	2.857	154.784	4.383
67.52	20.58	7.55	2.30	20.441	1.899	101.565	2.876	155.455	4.402
67.55	20.59	7.58	2.31	20.527	1.907	102.236	2.895	156.126	4.421
67.59	20.60	7.61	2.32	20.624	1.916	102.907	2.914	156.797	4.440

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
67.62	20.61	7.64	2.33	20.710	1.924	103.613	2.934	157.504	4.460
67.65	20.62	7.68	2.34	20.796	1.932	104.284	2.953	158.175	4.479
67.68	20.63	7.71	2.35	20.893	1.941	104.955	2.972	158.846	4.498
67.72	20.64	7.74	2.36	20.979	1.949	105.662	2.992	159.552	4.518
67.75	20.65	7.78	2.37	21.076	1.958	106.333	3.011	160.223	4.537
67.78	20.66	7.81	2.38	21.173	1.967	107.039	3.031	160.929	4.557
67.81	20.67	7.84	2.39	21.259	1.975	107.745	3.051	161.635	4.577
67.85	20.68	7.87	2.40	21.356	1.984	108.416	3.070	162.306	4.596
67.88	20.69	7.91	2.41	21.442	1.992	109.122	3.090	163.013	4.616
67.91	20.70	7.94	2.42	21.539	2.001	109.829	3.110	163.719	4.636
67.95	20.71	7.97	2.43	21.635	2.010	110.535	3.130	164.425	4.656
67.98	20.72	8.01	2.44	21.743	2.020	111.241	3.150	165.132	4.676
68.01	20.73	8.04	2.45	21.840	2.029	111.983	3.171	165.873	4.697
68.04	20.74	8.07	2.46	21.926	2.037	112.689	3.191	166.579	4.717
68.08	20.75	8.10	2.47	22.023	2.046	113.396	3.211	167.286	4.737
68.11	20.76	8.14	2.48	22.120	2.055	114.137	3.232	168.027	4.758
68.14	20.77	8.17	2.49	22.217	2.064	114.879	3.253	168.769	4.779
68.18	20.78	8.20	2.50	22.324	2.074	115.585	3.273	169.475	4.799
68.21	20.79	8.23	2.51	22.421	2.083	116.327	3.294	170.217	4.820
68.24	20.80	8.27	2.52	22.529	2.093	117.068	3.315	170.958	4.841
68.27	20.81	8.30	2.53	22.626	2.102	117.810	3.336	171.700	4.862
68.31	20.82	8.33	2.54	22.723	2.111	118.551	3.357	172.442	4.883
68.34	20.83	8.37	2.55	22.830	2.121	119.293	3.378	173.183	4.904
68.37	20.84	8.40	2.56	22.927	2.130	120.035	3.399	173.925	4.925

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
68.41	20.85	8.43	2.57	23.024	2.139	120.812	3.421	174.702	4.947
68.44	20.86	8.46	2.58	23.121	2.148	121.553	3.442	175.443	4.968
68.47	20.87	8.50	2.59	23.218	2.157	122.330	3.464	176.220	4.990
68.50	20.88	8.53	2.60	23.315	2.166	123.072	3.485	176.962	5.011
68.54	20.89	8.56	2.61	23.411	2.175	123.849	3.507	177.739	5.033
68.57	20.90	8.60	2.62	23.498	2.183	124.626	3.529	178.516	5.055
68.60	20.91	8.63	2.63	23.594	2.192	125.402	3.551	179.293	5.077
68.64	20.92	8.66	2.64	23.691	2.201	126.179	3.573	180.070	5.099
68.67	20.93	8.69	2.65	23.799	2.211	126.956	3.595	180.847	5.121
68.70	20.94	8.73	2.66	23.907	2.221	127.733	3.617	181.624	5.143
68.73	20.95	8.76	2.67	24.014	2.231	128.510	3.639	182.400	5.165
68.77	20.96	8.79	2.68	24.111	2.240	129.287	3.661	183.177	5.187
68.80	20.97	8.83	2.69	24.219	2.250	130.099	3.684	183.990	5.210
68.83	20.98	8.86	2.70	24.316	2.259	130.876	3.706	184.767	5.232
68.86	20.99	8.89	2.71	24.413	2.268	131.689	3.729	185.579	5.255
68.90	21.00	8.92	2.72	24.509	2.277	132.501	3.752	186.391	5.278
68.93	21.01	8.96	2.73	24.617	2.287	133.313	3.775	187.203	5.301
68.96	21.02	8.99	2.74	24.725	2.297	134.125	3.798	188.015	5.324
69.00	21.03	9.02	2.75	24.822	2.306	134.937	3.821	188.828	5.347
69.03	21.04	9.06	2.76	24.918	2.315	135.750	3.844	189.640	5.370
69.06	21.05	9.09	2.77	25.015	2.324	136.562	3.867	190.452	5.393
69.09	21.06	9.12	2.78	25.112	2.333	137.374	3.890	191.264	5.416
69.13	21.07	9.15	2.79	25.198	2.341	138.186	3.913	192.077	5.439
69.16	21.08	9.19	2.80	25.295	2.350	139.034	3.937	192.924	5.463

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
69.19	21.09	9.22	2.81	25.381	2.358	139.846	3.960	193.736	5.486
69.23	21.10	9.25	2.82	25.467	2.366	140.694	3.984	194.584	5.510
69.26	21.11	9.28	2.83	25.553	2.374	141.541	4.008	195.432	5.534
69.29	21.12	9.32	2.84	25.640	2.382	142.389	4.032	196.279	5.558
69.32	21.13	9.35	2.85	25.726	2.390	143.201	4.055	197.091	5.581
69.36	21.14	9.38	2.86	25.812	2.398	144.049	4.079	197.939	5.605
69.39	21.15	9.42	2.87	25.898	2.406	144.896	4.103	198.786	5.629
69.42	21.16	9.45	2.88	25.973	2.413	145.744	4.127	199.634	5.653
69.46	21.17	9.48	2.89	26.059	2.421	146.627	4.152	200.517	5.678
69.49	21.18	9.51	2.90	26.146	2.429	147.474	4.176	201.364	5.702
69.52	21.19	9.55	2.91	26.221	2.436	148.322	4.200	202.212	5.726
69.55	21.20	9.58	2.92	26.307	2.444	149.205	4.225	203.095	5.751
69.59	21.21	9.61	2.93	26.382	2.451	150.052	4.249	203.942	5.775
69.62	21.22	9.65	2.94	26.468	2.459	150.935	4.274	204.825	5.800
69.65	21.23	9.68	2.95	26.544	2.466	151.783	4.298	205.673	5.824
69.69	21.24	9.71	2.96	26.619	2.473	152.665	4.323	206.556	5.849
69.72	21.25	9.74	2.97	26.705	2.481	153.548	4.348	207.439	5.874
69.75	21.26	9.78	2.98	26.781	2.488	154.431	4.373	208.321	5.899
69.78	21.27	9.81	2.99	26.856	2.495	155.279	4.397	209.169	5.923
69.82	21.28	9.84	3.00	26.931	2.502	156.162	4.422	210.052	5.948
69.85	21.29	9.88	3.01	27.007	2.509	157.080	4.448	210.970	5.974
69.88	21.30	9.91	3.02	27.082	2.516	157.963	4.473	211.853	5.999
69.91	21.31	9.94	3.03	27.157	2.523	158.846	4.498	212.736	6.024
69.95	21.32	9.97	3.04	27.233	2.530	159.728	4.523	213.619	6.049

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
69.98	21.33	10.01	3.05	27.308	2.537	160.611	4.548	214.501	6.074
70.01	21.34	10.04	3.06	27.383	2.544	161.529	4.574	215.420	6.100
70.05	21.35	10.07	3.07	27.459	2.551	162.412	4.599	216.303	6.125
70.08	21.36	10.10	3.08	27.534	2.558	163.330	4.625	217.221	6.151
70.11	21.37	10.14	3.09	27.609	2.565	164.249	4.651	218.139	6.177
70.14	21.38	10.17	3.10	27.685	2.572	165.132	4.676	219.022	6.202
70.18	21.39	10.20	3.11	27.760	2.579	166.050	4.702	219.940	6.228
70.21	21.40	10.24	3.12	27.835	2.586	166.968	4.728	220.858	6.254
70.24	21.41	10.27	3.13	27.911	2.593	167.886	4.754	221.776	6.280
70.28	21.42	10.30	3.14	27.975	2.599	168.804	4.780	222.694	6.306
70.31	21.43	10.33	3.15	28.051	2.606	169.722	4.806	223.613	6.332
70.34	21.44	10.37	3.16	28.126	2.613	170.641	4.832	224.531	6.358
70.37	21.45	10.40	3.17	28.201	2.620	171.559	4.858	225.449	6.384
70.41	21.46	10.43	3.18	28.277	2.627	172.477	4.884	226.367	6.410
70.44	21.47	10.47	3.19	28.352	2.634	173.395	4.910	227.285	6.436
70.47	21.48	10.50	3.20	28.427	2.641	174.349	4.937	228.239	6.463
70.51	21.49	10.53	3.21	28.492	2.647	175.267	4.963	229.157	6.489
70.54	21.50	10.56	3.22	28.567	2.654	176.220	4.990	230.111	6.516
70.57	21.51	10.60	3.23	28.643	2.661	177.139	5.016	231.029	6.542
70.60	21.52	10.63	3.24	28.718	2.668	178.092	5.043	231.982	6.569
70.64	21.53	10.66	3.25	28.793	2.675	179.046	5.070	232.936	6.596
70.67	21.54	10.70	3.26	28.869	2.682	179.964	5.096	233.854	6.622
70.70	21.55	10.73	3.27	28.933	2.688	180.917	5.123	234.807	6.649
70.73	21.56	10.76	3.28	29.009	2.695	181.871	5.150	235.761	6.676

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
70.77	21.57	10.79	3.29	29.084	2.702	182.824	5.177	236.714	6.703
70.80	21.58	10.83	3.30	29.159	2.709	183.778	5.204	237.668	6.730
70.83	21.59	10.86	3.31	29.235	2.716	184.731	5.231	238.621	6.757
70.87	21.60	10.89	3.32	29.299	2.722	185.720	5.259	239.610	6.785
70.90	21.61	10.93	3.33	29.375	2.729	186.674	5.286	240.564	6.812
70.93	21.62	10.96	3.34	29.450	2.736	187.627	5.313	241.517	6.839
70.96	21.63	10.99	3.35	29.525	2.743	188.616	5.341	242.506	6.867
71.00	21.64	11.02	3.36	29.601	2.750	189.569	5.368	243.460	6.894
71.03	21.65	11.06	3.37	29.676	2.757	190.558	5.396	244.448	6.922
71.06	21.66	11.09	3.38	29.751	2.764	191.512	5.423	245.402	6.949
71.10	21.67	11.12	3.39	29.827	2.771	192.500	5.451	246.391	6.977
71.13	21.68	11.15	3.40	29.902	2.778	193.489	5.479	247.379	7.005
71.16	21.69	11.19	3.41	29.977	2.785	194.443	5.506	248.333	7.032
71.19	21.70	11.22	3.42	30.053	2.792	195.432	5.534	249.322	7.060
71.23	21.71	11.25	3.43	30.139	2.800	196.420	5.562	250.311	7.088
71.26	21.72	11.29	3.44	30.214	2.807	197.409	5.590	251.299	7.116
71.29	21.73	11.32	3.45	30.311	2.816	198.398	5.618	252.288	7.144
71.33	21.74	11.35	3.46	30.397	2.824	199.422	5.647	253.312	7.173
71.36	21.75	11.38	3.47	30.505	2.834	200.411	5.675	254.301	7.201
71.39	21.76	11.42	3.48	30.634	2.846	201.400	5.703	255.290	7.229
71.42	21.77	11.45	3.49	30.817	2.863	202.424	5.732	256.314	7.258
71.46	21.78	11.48	3.50	31.054	2.885	203.448	5.761	257.338	7.287
71.49	21.79	11.52	3.51	31.301	2.908	204.472	5.790	258.362	7.316
71.52	21.80	11.55	3.52	31.560	2.932	205.496	5.819	259.386	7.345

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
71.56	21.81	11.58	3.53	31.840	2.958	206.520	5.848	260.411	7.374
71.59	21.82	11.61	3.54	32.119	2.984	207.580	5.878	261.470	7.404
71.62	21.83	11.65	3.55	32.399	3.010	208.639	5.908	262.529	7.434
71.65	21.84	11.68	3.56	32.668	3.035	209.699	5.938	263.589	7.464
71.69	21.85	11.71	3.57	32.916	3.058	210.793	5.969	264.684	7.495
71.72	21.86	11.75	3.58	33.110	3.076	211.853	5.999	265.743	7.525
71.75	21.87	11.78	3.59	33.282	3.092	212.948	6.030	266.838	7.556
71.78	21.88	11.81	3.60	33.433	3.106	214.042	6.061	267.933	7.587
71.82	21.89	11.84	3.61	33.551	3.117	215.137	6.092	269.027	7.618
71.85	21.90	11.88	3.62	33.669	3.128	216.232	6.123	270.122	7.649
71.88	21.91	11.91	3.63	33.788	3.139	217.362	6.155	271.252	7.681
71.92	21.92	11.94	3.64	33.906	3.150	218.457	6.186	272.347	7.712
71.95	21.93	11.98	3.65	34.014	3.160	219.587	6.218	273.477	7.744
71.98	21.94	12.01	3.66	34.154	3.173	220.682	6.249	274.572	7.775
72.01	21.95	12.04	3.67	34.326	3.189	221.812	6.281	275.702	7.807
72.05	21.96	12.07	3.68	34.520	3.207	222.942	6.313	276.832	7.839
72.08	21.97	12.11	3.69	34.724	3.226	224.072	6.345	277.962	7.871
72.11	21.98	12.14	3.70	34.907	3.243	225.237	6.378	279.127	7.904
72.15	21.99	12.17	3.71	35.069	3.258	226.367	6.410	280.257	7.936
72.18	22.00	12.20	3.72	35.230	3.273	227.533	6.443	281.423	7.969
72.21	22.01	12.24	3.73	35.359	3.285	228.698	6.476	282.588	8.002
72.24	22.02	12.27	3.74	35.489	3.297	229.863	6.509	283.754	8.035
72.28	22.03	12.30	3.75	35.596	3.307	231.029	6.542	284.919	8.068
72.31	22.04	12.34	3.76	35.704	3.317	232.194	6.575	286.084	8.101

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
72.34	22.05	12.37	3.77	35.801	3.326	233.360	6.608	287.250	8.134
72.38	22.06	12.40	3.78	35.908	3.336	234.525	6.641	288.415	8.167
72.41	22.07	12.43	3.79	36.005	3.345	235.726	6.675	289.616	8.201
72.44	22.08	12.47	3.80	36.102	3.354	236.891	6.708	290.781	8.234
72.47	22.09	12.50	3.81	36.199	3.363	238.092	6.742	291.982	8.268
72.51	22.10	12.53	3.82	36.296	3.372	239.257	6.775	293.147	8.301
72.54	22.11	12.57	3.83	36.404	3.382	240.458	6.809	294.348	8.335
72.57	22.12	12.60	3.84	36.500	3.391	241.658	6.843	295.549	8.369
72.60	22.13	12.63	3.85	36.586	3.399	242.859	6.877	296.749	8.403
72.64	22.14	12.66	3.86	36.683	3.408	244.060	6.911	297.950	8.437
72.67	22.15	12.70	3.87	36.780	3.417	245.261	6.945	299.151	8.471
72.70	22.16	12.73	3.88	36.877	3.426	246.461	6.979	300.352	8.505
72.74	22.17	12.76	3.89	36.974	3.435	247.697	7.014	301.588	8.540
72.77	22.18	12.80	3.90	37.060	3.443	248.898	7.048	302.788	8.574
72.80	22.19	12.83	3.91	37.157	3.452	250.134	7.083	304.024	8.609
72.83	22.20	12.86	3.92	37.254	3.461	251.335	7.117	305.225	8.643
72.87	22.21	12.89	3.93	37.340	3.469	252.571	7.152	306.461	8.678
72.90	22.22	12.93	3.94	37.437	3.478	253.771	7.186	307.662	8.712
72.93	22.23	12.96	3.95	37.534	3.487	255.007	7.221	308.898	8.747
72.97	22.24	12.99	3.96	37.620	3.495	256.243	7.256	310.134	8.782
73.00	22.25	13.02	3.97	37.717	3.504	257.479	7.291	311.370	8.817
73.03	22.26	13.06	3.98	37.814	3.513	258.715	7.326	312.606	8.852
73.06	22.27	13.09	3.99	37.910	3.522	259.952	7.361	313.842	8.887
73.10	22.28	13.12	4.00	38.007	3.531	261.223	7.397	315.113	8.923

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
73.13	22.29	13.16	4.01	38.104	3.540	262.459	7.432	316.349	8.958
73.16	22.30	13.19	4.02	38.201	3.549	263.730	7.468	317.620	8.994
73.20	22.31	13.22	4.03	38.287	3.557	264.966	7.503	318.856	9.029
73.23	22.32	13.25	4.04	38.384	3.566	266.238	7.539	320.128	9.065
73.26	22.33	13.29	4.05	38.481	3.575	267.474	7.574	321.364	9.100
73.29	22.34	13.32	4.06	38.578	3.584	268.745	7.610	322.635	9.136
73.33	22.35	13.35	4.07	38.675	3.593	270.016	7.646	323.906	9.172
73.36	22.36	13.39	4.08	38.772	3.602	271.288	7.682	325.178	9.208
73.39	22.37	13.42	4.09	38.879	3.612	272.559	7.718	326.449	9.244
73.43	22.38	13.45	4.10	38.976	3.621	273.830	7.754	327.720	9.280
73.46	22.39	13.48	4.11	39.073	3.630	275.137	7.791	329.027	9.317
73.49	22.40	13.52	4.12	39.170	3.639	276.408	7.827	330.298	9.353
73.52	22.41	13.55	4.13	39.277	3.649	277.679	7.863	331.570	9.389
73.56	22.42	13.58	4.14	39.374	3.658	278.986	7.900	332.876	9.426
73.59	22.43	13.62	4.15	39.482	3.668	280.257	7.936	334.148	9.462
73.62	22.44	13.65	4.16	39.590	3.678	281.564	7.973	335.454	9.499
73.65	22.45	13.68	4.17	39.697	3.688	282.871	8.010	336.761	9.536
73.69	22.46	13.71	4.18	39.805	3.698	284.177	8.047	338.068	9.573
73.72	22.47	13.75	4.19	39.913	3.708	285.484	8.084	339.374	9.610
73.75	22.48	13.78	4.20	40.009	3.717	286.791	8.121	340.681	9.647
73.79	22.49	13.81	4.21	40.117	3.727	288.097	8.158	341.988	9.684
73.82	22.50	13.85	4.22	40.214	3.736	289.439	8.196	343.330	9.722
73.85	22.51	13.88	4.23	40.311	3.745	290.746	8.233	344.636	9.759
73.88	22.52	13.91	4.24	40.408	3.754	292.088	8.271	345.978	9.797

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
73.92	22.53	13.94	4.25	40.515	3.764	293.395	8.308	347.285	9.834
73.95	22.54	13.98	4.26	40.612	3.773	294.736	8.346	348.627	9.872
73.98	22.55	14.01	4.27	40.720	3.783	296.078	8.384	349.969	9.910
74.02	22.56	14.04	4.28	40.817	3.792	297.385	8.421	351.275	9.947
74.05	22.57	14.07	4.29	40.924	3.802	298.727	8.459	352.617	9.985
74.08	22.58	14.11	4.30	41.021	3.811	300.104	8.498	353.995	10.024
74.11	22.59	14.14	4.31	41.129	3.821	301.446	8.536	355.337	10.062
74.15	22.60	14.17	4.32	41.226	3.830	302.788	8.574	356.678	10.100
74.18	22.61	14.21	4.33	41.333	3.840	304.130	8.612	358.020	10.138
74.21	22.62	14.24	4.34	41.441	3.850	305.507	8.651	359.398	10.177
74.25	22.63	14.27	4.35	41.538	3.859	306.849	8.689	360.740	10.215
74.28	22.64	14.30	4.36	41.646	3.869	308.227	8.728	362.117	10.254
74.31	22.65	14.34	4.37	41.753	3.879	309.604	8.767	363.494	10.293
74.34	22.66	14.37	4.38	41.861	3.889	310.946	8.805	364.836	10.331
74.38	22.67	14.40	4.39	41.968	3.899	312.323	8.844	366.213	10.370
74.41	22.68	14.44	4.40	42.076	3.909	313.700	8.883	367.591	10.409
74.44	22.69	14.47	4.41	42.184	3.919	315.113	8.923	369.003	10.449
74.48	22.70	14.50	4.42	42.291	3.929	316.490	8.962	370.381	10.488
74.51	22.71	14.53	4.43	42.399	3.939	317.868	9.001	371.758	10.527
74.54	22.72	14.57	4.44	42.507	3.949	319.280	9.041	373.170	10.567
74.57	22.73	14.60	4.45	42.614	3.959	320.657	9.080	374.548	10.606
74.61	22.74	14.63	4.46	42.722	3.969	322.070	9.120	375.960	10.646
74.64	22.75	14.67	4.47	42.840	3.980	323.483	9.160	377.373	10.686
74.67	22.76	14.70	4.48	42.948	3.990	324.860	9.199	378.750	10.725

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
74.70	22.77	14.73	4.49	43.056	4.000	326.273	9.239	380.163	10.765
74.74	22.78	14.76	4.50	43.174	4.011	327.685	9.279	381.575	10.805
74.77	22.79	14.80	4.51	43.282	4.021	329.133	9.320	383.023	10.846
74.80	22.80	14.83	4.52	43.400	4.032	330.546	9.360	384.436	10.886
74.84	22.81	14.86	4.53	43.518	4.043	331.958	9.400	385.848	10.926
74.87	22.82	14.90	4.54	43.637	4.054	333.406	9.441	387.296	10.967
74.90	22.83	14.93	4.55	43.755	4.065	334.819	9.481	388.709	11.007
74.93	22.84	14.96	4.56	43.874	4.076	336.267	9.522	390.157	11.048
74.97	22.85	14.99	4.57	44.003	4.088	337.714	9.563	391.605	11.089
75.00	22.86	15.03	4.58	44.121	4.099	339.162	9.604	393.053	11.130
75.03	22.87	15.06	4.59	44.240	4.110	340.610	9.645	394.501	11.171
75.07	22.88	15.09	4.60	44.369	4.122	342.058	9.686	395.948	11.212
75.10	22.89	15.12	4.61	44.487	4.133	343.506	9.727	397.396	11.253
75.13	22.90	15.16	4.62	44.616	4.145	344.989	9.769	398.880	11.295
75.16	22.91	15.19	4.63	44.735	4.156	346.437	9.810	400.327	11.336
75.20	22.92	15.22	4.64	44.853	4.167	347.920	9.852	401.811	11.378
75.23	22.93	15.26	4.65	44.982	4.179	349.368	9.893	403.259	11.419
75.26	22.94	15.29	4.66	45.101	4.190	350.852	9.935	404.742	11.461
75.30	22.95	15.32	4.67	45.219	4.201	352.335	9.977	406.225	11.503
75.33	22.96	15.35	4.68	45.338	4.212	353.818	10.019	407.708	11.545
75.36	22.97	15.39	4.69	45.456	4.223	355.301	10.061	409.191	11.587
75.39	22.98	15.42	4.70	45.574	4.234	356.820	10.104	410.710	11.630
75.43	22.99	15.45	4.71	45.682	4.244	358.303	10.146	412.193	11.672
75.46	23.00	15.49	4.72	45.800	4.255	359.821	10.189	413.712	11.715

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
75.49	23.01	15.52	4.73	45.908	4.265	361.305	10.231	415.195	11.757
75.52	23.02	15.55	4.74	46.026	4.276	362.823	10.274	416.713	11.800
75.56	23.03	15.58	4.75	46.145	4.287	364.342	10.317	418.232	11.843
75.59	23.04	15.62	4.76	46.252	4.297	365.860	10.360	419.751	11.886
75.62	23.05	15.65	4.77	46.371	4.308	367.379	10.403	421.269	11.929
75.66	23.06	15.68	4.78	46.489	4.319	368.897	10.446	422.788	11.972
75.69	23.07	15.72	4.79	46.608	4.330	370.416	10.489	424.306	12.015
75.72	23.08	15.75	4.80	46.715	4.340	371.934	10.532	425.825	12.058
75.75	23.09	15.78	4.81	46.834	4.351	373.452	10.576	427.343	12.102
75.79	23.10	15.81	4.82	46.952	4.362	375.007	10.619	428.897	12.145
75.82	23.11	15.85	4.83	47.060	4.372	376.561	10.663	430.451	12.189
75.85	23.12	15.88	4.84	47.178	4.383	378.114	10.707	432.005	12.233
75.89	23.13	15.91	4.85	47.297	4.394	379.668	10.751	433.559	12.277
75.92	23.14	15.94	4.86	47.404	4.404	381.222	10.795	435.112	12.321
75.95	23.15	15.98	4.87	47.523	4.415	382.776	10.839	436.666	12.365
75.98	23.16	16.01	4.88	47.641	4.426	384.330	10.883	438.220	12.409
76.02	23.17	16.04	4.89	47.759	4.437	385.884	10.927	439.774	12.453
76.05	23.18	16.08	4.90	47.889	4.449	387.473	10.972	441.363	12.498
76.08	23.19	16.11	4.91	48.007	4.460	389.027	11.016	442.917	12.542
76.12	23.20	16.14	4.92	48.125	4.471	390.616	11.061	444.506	12.587
76.15	23.21	16.17	4.93	48.244	4.482	392.205	11.106	446.095	12.632
76.18	23.22	16.21	4.94	48.362	4.493	393.794	11.151	447.684	12.677
76.21	23.23	16.24	4.95	48.491	4.505	395.383	11.196	449.274	12.722
76.25	23.24	16.27	4.96	48.621	4.517	396.973	11.241	450.863	12.767

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
76.28	23.25	16.31	4.97	48.750	4.529	398.562	11.286	452.452	12.812
76.31	23.26	16.34	4.98	48.900	4.543	400.151	11.331	454.041	12.857
76.35	23.27	16.37	4.99	49.040	4.556	401.775	11.377	455.666	12.903
76.38	23.28	16.40	5.00	49.191	4.570	403.365	11.422	457.255	12.948
76.41	23.29	16.44	5.01	49.331	4.583	404.989	11.468	458.879	12.994
76.44	23.30	16.47	5.02	49.482	4.597	406.613	11.514	460.504	13.040
76.48	23.31	16.50	5.03	49.622	4.610	408.238	11.560	462.128	13.086
76.51	23.32	16.54	5.04	49.762	4.623	409.862	11.606	463.753	13.132
76.54	23.33	16.57	5.05	49.901	4.636	411.522	11.653	465.412	13.179
76.57	23.34	16.60	5.06	50.031	4.648	413.147	11.699	467.037	13.225
76.61	23.35	16.63	5.07	50.171	4.661	414.806	11.746	468.697	13.272
76.64	23.36	16.67	5.08	50.310	4.674	416.431	11.792	470.321	13.318
76.67	23.37	16.70	5.09	50.450	4.687	418.091	11.839	471.981	13.365
76.71	23.38	16.73	5.10	50.590	4.700	419.751	11.886	473.641	13.412
76.74	23.39	16.77	5.11	50.730	4.713	421.410	11.933	475.301	13.459
76.77	23.40	16.80	5.12	50.859	4.725	423.070	11.980	476.960	13.506
76.80	23.41	16.83	5.13	50.999	4.738	424.765	12.028	478.655	13.554
76.84	23.42	16.86	5.14	51.139	4.751	426.425	12.075	480.315	13.601
76.87	23.43	16.90	5.15	51.279	4.764	428.120	12.123	482.010	13.649
76.90	23.44	16.93	5.16	51.408	4.776	429.780	12.170	483.670	13.696
76.94	23.45	16.96	5.17	51.548	4.789	431.475	12.218	485.365	13.744
76.97	23.46	16.99	5.18	51.688	4.802	433.170	12.266	487.060	13.792
77.00	23.47	17.03	5.19	51.828	4.815	434.865	12.314	488.755	13.840
77.03	23.48	17.06	5.20	51.957	4.827	436.560	12.362	490.451	13.888

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
77.07	23.49	17.09	5.21	52.097	4.840	438.291	12.411	492.181	13.937
77.10	23.50	17.13	5.22	52.237	4.853	439.986	12.459	493.876	13.985
77.13	23.51	17.16	5.23	52.366	4.865	441.716	12.508	495.606	14.034
77.17	23.52	17.19	5.24	52.506	4.878	443.411	12.556	497.302	14.082
77.20	23.53	17.22	5.25	52.646	4.891	445.142	12.605	499.032	14.131
77.23	23.54	17.26	5.26	52.786	4.904	446.872	12.654	500.762	14.180
77.26	23.55	17.29	5.27	52.926	4.917	448.603	12.703	502.493	14.229
77.30	23.56	17.32	5.28	53.077	4.931	450.368	12.753	504.259	14.279
77.33	23.57	17.36	5.29	53.217	4.944	452.099	12.802	505.989	14.328
77.36	23.58	17.39	5.30	53.357	4.957	453.865	12.852	507.755	14.378
77.40	23.59	17.42	5.31	53.507	4.971	455.595	12.901	509.485	14.427
77.43	23.60	17.45	5.32	53.647	4.984	457.361	12.951	511.251	14.477
77.46	23.61	17.49	5.33	53.798	4.998	459.126	13.001	513.017	14.527
77.49	23.62	17.52	5.34	53.949	5.012	460.892	13.051	514.782	14.577
77.53	23.63	17.55	5.35	54.110	5.027	462.658	13.101	516.548	14.627
77.56	23.64	17.59	5.36	54.261	5.041	464.424	13.151	518.314	14.677
77.59	23.65	17.62	5.37	54.412	5.055	466.225	13.202	520.115	14.728
77.62	23.66	17.65	5.38	54.573	5.070	468.026	13.253	521.916	14.779
77.66	23.67	17.68	5.39	54.724	5.084	469.791	13.303	523.682	14.829
77.69	23.68	17.72	5.40	54.874	5.098	471.593	13.354	525.483	14.880
77.72	23.69	17.75	5.41	55.025	5.112	473.394	13.405	527.284	14.931
77.76	23.70	17.78	5.42	55.187	5.127	475.195	13.456	529.085	14.982
77.79	23.71	17.81	5.43	55.337	5.141	477.031	13.508	530.921	15.034
77.82	23.72	17.85	5.44	55.488	5.155	478.832	13.559	532.722	15.085

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
77.85	23.73	17.88	5.45	55.649	5.170	480.668	13.611	534.559	15.137
77.89	23.74	17.91	5.46	55.800	5.184	482.505	13.663	536.395	15.189
77.92	23.75	17.95	5.47	55.962	5.199	484.341	13.715	538.231	15.241
77.95	23.76	17.98	5.48	56.112	5.213	486.177	13.767	540.068	15.293
77.99	23.77	18.01	5.49	56.263	5.227	488.014	13.819	541.904	15.345
78.02	23.78	18.04	5.50	56.403	5.240	489.850	13.871	543.740	15.397
78.05	23.79	18.08	5.51	56.543	5.253	491.722	13.924	545.612	15.450
78.08	23.80	18.11	5.52	56.683	5.266	493.558	13.976	547.448	15.502
78.12	23.81	18.14	5.53	56.823	5.279	495.430	14.029	549.320	15.555
78.15	23.82	18.18	5.54	56.952	5.291	497.302	14.082	551.192	15.608
78.18	23.83	18.21	5.55	57.081	5.303	499.173	14.135	553.064	15.661
78.22	23.84	18.24	5.56	57.210	5.315	501.045	14.188	554.935	15.714
78.25	23.85	18.27	5.57	57.339	5.327	502.917	14.241	556.807	15.767
78.28	23.86	18.31	5.58	57.468	5.339	504.788	14.294	558.679	15.820
78.31	23.87	18.34	5.59	57.608	5.352	506.695	14.348	560.586	15.874
78.35	23.88	18.37	5.60	57.738	5.364	508.567	14.401	562.457	15.927
78.38	23.89	18.41	5.61	57.867	5.376	510.474	14.455	564.364	15.981
78.41	23.90	18.44	5.62	57.996	5.388	512.381	14.509	566.271	16.035
78.44	23.91	18.47	5.63	58.125	5.400	514.288	14.563	568.178	16.089
78.48	23.92	18.50	5.64	58.254	5.412	516.195	14.617	570.085	16.143
78.51	23.93	18.54	5.65	58.373	5.423	518.102	14.671	571.992	16.197
78.54	23.94	18.57	5.66	58.502	5.435	520.009	14.725	573.899	16.251
78.58	23.95	18.60	5.67	58.620	5.446	521.951	14.780	575.841	16.306
78.61	23.96	18.64	5.68	58.749	5.458	523.858	14.834	577.748	16.360

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
78.64	23.97	18.67	5.69	58.868	5.469	525.801	14.889	579.691	16.415
78.67	23.98	18.70	5.70	58.997	5.481	527.743	14.944	581.633	16.470
78.71	23.99	18.73	5.71	59.126	5.493	529.685	14.999	583.575	16.525
78.74	24.00	18.77	5.72	59.255	5.505	531.627	15.054	585.518	16.580
78.77	24.01	18.80	5.73	59.384	5.517	533.570	15.109	587.460	16.635
78.81	24.02	18.83	5.74	59.514	5.529	535.512	15.164	589.402	16.690
78.84	24.03	18.86	5.75	59.654	5.542	537.454	15.219	591.345	16.745
78.87	24.04	18.90	5.76	59.804	5.556	539.432	15.275	593.322	16.801
78.90	24.05	18.93	5.77	59.966	5.571	541.374	15.330	595.265	16.856
78.94	24.06	18.96	5.78	60.149	5.588	543.352	15.386	597.242	16.912
78.97	24.07	19.00	5.79	60.332	5.605	545.330	15.442	599.220	16.968
79.00	24.08	19.03	5.80	60.482	5.619	547.307	15.498	601.197	17.024
79.04	24.09	19.06	5.81	60.633	5.633	549.320	15.555	603.210	17.081
79.07	24.10	19.09	5.82	60.773	5.646	551.298	15.611	605.188	17.137
79.10	24.11	19.13	5.83	60.902	5.658	553.275	15.667	607.166	17.193
79.13	24.12	19.16	5.84	61.031	5.670	555.288	15.724	609.179	17.250
79.17	24.13	19.19	5.85	61.160	5.682	557.301	15.781	611.192	17.307
79.20	24.14	19.23	5.86	61.300	5.695	559.314	15.838	613.204	17.364
79.23	24.15	19.26	5.87	61.430	5.707	561.327	15.895	615.217	17.421
79.27	24.16	19.29	5.88	61.570	5.720	563.340	15.952	617.230	17.478
79.30	24.17	19.32	5.89	61.720	5.734	565.353	16.009	619.243	17.535
79.33	24.18	19.36	5.90	61.892	5.750	567.401	16.067	621.292	17.593
79.36	24.19	19.39	5.91	62.043	5.764	569.414	16.124	623.304	17.650
79.40	24.20	19.42	5.92	62.183	5.777	571.462	16.182	625.353	17.708

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
79.43	24.21	19.46	5.93	62.334	5.791	573.511	16.240	627.401	17.766
79.46	24.22	19.49	5.94	62.484	5.805	575.559	16.298	629.449	17.824
79.49	24.23	19.52	5.95	62.635	5.819	577.607	16.356	631.497	17.882
79.53	24.24	19.55	5.96	62.797	5.834	579.655	16.414	633.546	17.940
79.56	24.25	19.59	5.97	62.958	5.849	581.704	16.472	635.594	17.998
79.59	24.26	19.62	5.98	63.120	5.864	583.787	16.531	637.678	18.057
79.63	24.27	19.65	5.99	63.270	5.878	585.871	16.590	639.761	18.116
79.66	24.28	19.69	6.00	63.432	5.893	587.954	16.649	641.845	18.175
79.69	24.29	19.72	6.01	63.593	5.908	590.038	16.708	643.928	18.234
79.72	24.30	19.75	6.02	63.755	5.923	592.122	16.767	646.012	18.293
79.76	24.31	19.78	6.03	63.927	5.939	594.205	16.826	648.095	18.352
79.79	24.32	19.82	6.04	64.077	5.953	596.324	16.886	650.214	18.412
79.82	24.33	19.85	6.05	64.250	5.969	598.408	16.945	652.298	18.471
79.86	24.34	19.88	6.06	64.411	5.984	600.526	17.005	654.417	18.531
79.89	24.35	19.91	6.07	64.573	5.999	602.645	17.065	656.536	18.591
79.92	24.36	19.95	6.08	64.734	6.014	604.764	17.125	658.654	18.651
79.95	24.37	19.98	6.09	64.896	6.029	606.883	17.185	660.773	18.711
79.99	24.38	20.01	6.10	65.057	6.044	609.002	17.245	662.892	18.771
80.02	24.39	20.05	6.11	65.218	6.059	611.156	17.306	665.046	18.832
80.05	24.40	20.08	6.12	65.380	6.074	613.310	17.367	667.201	18.893
80.09	24.41	20.11	6.13	65.541	6.089	615.429	17.427	669.320	18.953
80.12	24.42	20.14	6.14	65.692	6.103	617.583	17.488	671.474	19.014
80.15	24.43	20.18	6.15	65.854	6.118	619.773	17.550	673.663	19.076
80.18	24.44	20.21	6.16	66.015	6.133	621.927	17.611	675.817	19.137

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
80.22	24.45	20.24	6.17	66.166	6.147	624.081	17.672	677.972	19.198
80.25	24.46	20.28	6.18	66.327	6.162	626.271	17.734	680.161	19.260
80.28	24.47	20.31	6.19	66.489	6.177	628.425	17.795	682.315	19.321
80.31	24.48	20.34	6.20	66.650	6.192	630.615	17.857	684.505	19.383
80.35	24.49	20.37	6.21	66.812	6.207	632.804	17.919	686.694	19.445
80.38	24.50	20.41	6.22	66.984	6.223	634.994	17.981	688.884	19.507
80.41	24.51	20.44	6.23	67.156	6.239	637.218	18.044	691.109	19.570
80.45	24.52	20.47	6.24	67.328	6.255	639.408	18.106	693.298	19.632
80.48	24.53	20.51	6.25	67.490	6.270	641.633	18.169	695.523	19.695
80.51	24.54	20.54	6.26	67.662	6.286	643.858	18.232	697.748	19.758
80.54	24.55	20.57	6.27	67.834	6.302	646.082	18.295	699.973	19.821
80.58	24.56	20.60	6.28	67.996	6.317	648.307	18.358	702.197	19.884
80.61	24.57	20.64	6.29	68.179	6.334	650.532	18.421	704.422	19.947
80.64	24.58	20.67	6.30	68.351	6.350	652.757	18.484	706.647	20.010
80.68	24.59	20.70	6.31	68.534	6.367	655.017	18.548	708.907	20.074
80.71	24.60	20.73	6.32	68.706	6.383	657.277	18.612	711.167	20.138
80.74	24.61	20.77	6.33	68.900	6.401	659.537	18.676	713.428	20.202
80.77	24.62	20.80	6.34	69.083	6.418	661.797	18.740	715.688	20.266
80.81	24.63	20.83	6.35	69.255	6.434	664.058	18.804	717.948	20.330
80.84	24.64	20.87	6.36	69.438	6.451	666.318	18.868	720.208	20.394
80.87	24.65	20.90	6.37	69.610	6.467	668.613	18.933	722.503	20.459
80.91	24.66	20.93	6.38	69.793	6.484	670.909	18.998	724.799	20.524
80.94	24.67	20.96	6.39	69.976	6.501	673.204	19.063	727.094	20.589
80.97	24.68	21.00	6.40	70.148	6.517	675.500	19.128	729.390	20.654

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
81.00	24.69	21.03	6.41	70.321	6.533	677.795	19.193	731.685	20.719
81.04	24.70	21.06	6.42	70.504	6.550	680.090	19.258	733.981	20.784
81.07	24.71	21.10	6.43	70.687	6.567	682.421	19.324	736.311	20.850
81.10	24.72	21.13	6.44	70.859	6.583	684.752	19.390	738.642	20.916
81.14	24.73	21.16	6.45	71.031	6.599	687.083	19.456	740.973	20.982
81.17	24.74	21.19	6.46	71.203	6.615	689.414	19.522	743.304	21.048
81.20	24.75	21.23	6.47	71.375	6.631	691.744	19.588	745.635	21.114
81.23	24.76	21.26	6.48	71.548	6.647	694.075	19.654	747.965	21.180
81.27	24.77	21.29	6.49	71.709	6.662	696.441	19.721	750.331	21.247
81.30	24.78	21.33	6.50	71.881	6.678	698.807	19.788	752.698	21.314
81.33	24.79	21.36	6.51	72.054	6.694	701.138	19.854	755.028	21.380
81.36	24.80	21.39	6.52	72.226	6.710	703.504	19.921	757.394	21.447
81.40	24.81	21.42	6.53	72.398	6.726	705.906	19.989	759.796	21.515
81.43	24.82	21.46	6.54	72.570	6.742	708.272	20.056	762.162	21.582
81.46	24.83	21.49	6.55	72.742	6.758	710.638	20.123	764.528	21.649
81.50	24.84	21.52	6.56	72.915	6.774	713.039	20.191	766.929	21.717
81.53	24.85	21.56	6.57	73.087	6.790	715.441	20.259	769.331	21.785
81.56	24.86	21.59	6.58	73.259	6.806	717.842	20.327	771.732	21.853
81.59	24.87	21.62	6.59	73.421	6.821	720.243	20.395	774.134	21.921
81.63	24.88	21.65	6.60	73.593	6.837	722.645	20.463	776.535	21.989
81.66	24.89	21.69	6.61	73.765	6.853	725.081	20.532	778.972	22.058
81.69	24.90	21.72	6.62	73.937	6.869	727.483	20.600	781.373	22.126
81.73	24.91	21.75	6.63	74.099	6.884	729.920	20.669	783.810	22.195
81.76	24.92	21.78	6.64	74.271	6.900	732.356	20.738	786.246	22.264

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
81.79	24.93	21.82	6.65	74.443	6.916	734.793	20.807	788.683	22.333
81.82	24.94	21.85	6.66	74.615	6.932	737.230	20.876	791.120	22.402
81.86	24.95	21.88	6.67	74.788	6.948	739.702	20.946	793.592	22.472
81.89	24.96	21.92	6.68	74.960	6.964	742.138	21.015	796.029	22.541
81.92	24.97	21.95	6.69	75.132	6.980	744.610	21.085	798.501	22.611
81.96	24.98	21.98	6.70	75.315	6.997	747.082	21.155	800.973	22.681
81.99	24.99	22.01	6.71	75.487	7.013	749.555	21.225	803.445	22.751
82.02	25.00	22.05	6.72	75.659	7.029	752.027	21.295	805.917	22.821
82.05	25.01	22.08	6.73	75.832	7.045	754.534	21.366	808.424	22.892
82.09	25.02	22.11	6.74	76.004	7.061	757.006	21.436	810.896	22.962
82.12	25.03	22.15	6.75	76.176	7.077	759.513	21.507	813.403	23.033
82.15	25.04	22.18	6.76	76.348	7.093	762.021	21.578	815.911	23.104
82.19	25.05	22.21	6.77	76.521	7.109	764.528	21.649	818.418	23.175
82.22	25.06	22.24	6.78	76.693	7.125	767.035	21.720	820.926	23.246
82.25	25.07	22.28	6.79	76.876	7.142	769.543	21.791	823.433	23.317
82.28	25.08	22.31	6.80	77.059	7.159	772.085	21.863	825.976	23.389
82.32	25.09	22.34	6.81	77.242	7.176	774.593	21.934	828.483	23.460
82.35	25.10	22.38	6.82	77.425	7.193	777.135	22.006	831.026	23.532
82.38	25.11	22.41	6.83	77.608	7.210	779.678	22.078	833.568	23.604
82.41	25.12	22.44	6.84	77.780	7.226	782.221	22.150	836.111	23.676
82.45	25.13	22.47	6.85	77.963	7.243	784.799	22.223	838.689	23.749
82.48	25.14	22.51	6.86	78.146	7.260	787.341	22.295	841.231	23.821
82.51	25.15	22.54	6.87	78.329	7.277	789.919	22.368	843.809	23.894
82.55	25.16	22.57	6.88	78.512	7.294	792.497	22.441	846.387	23.967

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
82.58	25.17	22.60	6.89	78.695	7.311	795.075	22.514	848.965	24.040
82.61	25.18	22.64	6.90	78.867	7.327	797.653	22.587	851.543	24.113
82.64	25.19	22.67	6.91	79.029	7.342	800.231	22.660	854.121	24.186
82.68	25.20	22.70	6.92	79.201	7.358	802.844	22.734	856.735	24.260
82.71	25.21	22.74	6.93	79.373	7.374	805.422	22.807	859.313	24.333
82.74	25.22	22.77	6.94	79.534	7.389	808.036	22.881	861.926	24.407
82.78	25.23	22.80	6.95	79.696	7.404	810.649	22.955	864.539	24.481
82.81	25.24	22.83	6.96	79.868	7.420	813.262	23.029	867.152	24.555
82.84	25.25	22.87	6.97	80.040	7.436	815.911	23.104	869.801	24.630
82.87	25.26	22.90	6.98	80.213	7.452	818.524	23.178	872.414	24.704
82.91	25.27	22.93	6.99	80.385	7.468	821.173	23.253	875.063	24.779
82.94	25.28	22.97	7.00	80.568	7.485	823.786	23.327	877.676	24.853
82.97	25.29	23.00	7.01	80.740	7.501	826.435	23.402	880.325	24.928
83.01	25.30	23.03	7.02	80.912	7.517	829.083	23.477	882.973	25.003
83.04	25.31	23.06	7.03	81.084	7.533	831.767	23.553	885.657	25.079
83.07	25.32	23.10	7.04	81.257	7.549	834.416	23.628	888.306	25.154
83.10	25.33	23.13	7.05	81.418	7.564	837.100	23.704	890.990	25.230
83.14	25.34	23.16	7.06	81.590	7.580	839.748	23.779	893.638	25.305
83.17	25.35	23.20	7.07	81.752	7.595	842.432	23.855	896.322	25.381
83.20	25.36	23.23	7.08	81.913	7.610	845.116	23.931	899.006	25.457
83.23	25.37	23.26	7.09	82.075	7.625	847.835	24.008	901.726	25.534
83.27	25.38	23.29	7.10	82.236	7.640	850.519	24.084	904.409	25.610
83.30	25.39	23.33	7.11	82.398	7.655	853.203	24.160	907.093	25.686
83.33	25.40	23.36	7.12	82.559	7.670	855.922	24.237	909.813	25.763

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
83.37	25.41	23.39	7.13	82.721	7.685	858.642	24.314	912.532	25.840
83.40	25.42	23.43	7.14	82.882	7.700	861.361	24.391	915.251	25.917
83.43	25.43	23.46	7.15	83.043	7.715	864.080	24.468	917.970	25.994
83.46	25.44	23.49	7.16	83.205	7.730	866.799	24.545	920.690	26.071
83.50	25.45	23.52	7.17	83.356	7.744	869.519	24.622	923.409	26.148
83.53	25.46	23.56	7.18	83.517	7.759	872.273	24.700	926.163	26.226
83.56	25.47	23.59	7.19	83.668	7.773	875.028	24.778	928.918	26.304
83.60	25.48	23.62	7.20	83.829	7.788	877.747	24.855	931.637	26.381
83.63	25.49	23.65	7.21	83.991	7.803	880.501	24.933	934.392	26.459
83.66	25.50	23.69	7.22	84.152	7.818	883.256	25.011	937.146	26.537
83.69	25.51	23.72	7.23	84.314	7.833	886.046	25.090	939.936	26.616
83.73	25.52	23.75	7.24	84.475	7.848	888.800	25.168	942.691	26.694
83.76	25.53	23.79	7.25	84.626	7.862	891.590	25.247	945.480	26.773
83.79	25.54	23.82	7.26	84.787	7.877	894.345	25.325	948.235	26.851
83.83	25.55	23.85	7.27	84.949	7.892	897.135	25.404	951.025	26.930
83.86	25.56	23.88	7.28	85.110	7.907	899.925	25.483	953.815	27.009
83.89	25.57	23.92	7.29	85.272	7.922	902.714	25.562	956.605	27.088
83.92	25.58	23.95	7.30	85.422	7.936	905.540	25.642	959.430	27.168
83.96	25.59	23.98	7.31	85.584	7.951	908.329	25.721	962.220	27.247
83.99	25.60	24.02	7.32	85.734	7.965	911.155	25.801	965.045	27.327
84.02	25.61	24.05	7.33	85.896	7.980	913.944	25.880	967.835	27.406
84.06	25.62	24.08	7.34	86.047	7.994	916.770	25.960	970.660	27.486
84.09	25.63	24.11	7.35	86.197	8.008	919.595	26.040	973.485	27.566
84.12	25.64	24.15	7.36	86.348	8.022	922.420	26.120	976.310	27.646

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
84.15	25.65	24.18	7.37	86.499	8.036	925.280	26.201	979.171	27.727
84.19	25.66	24.21	7.38	86.649	8.050	928.106	26.281	981.996	27.807
84.22	25.67	24.25	7.39	86.800	8.064	930.966	26.362	984.856	27.888
84.25	25.68	24.28	7.40	86.951	8.078	933.791	26.442	987.682	27.968
84.28	25.69	24.31	7.41	87.101	8.092	936.652	26.523	990.542	28.049
84.32	25.70	24.34	7.42	87.252	8.106	939.512	26.604	993.403	28.130
84.35	25.71	24.38	7.43	87.403	8.120	942.373	26.685	996.263	28.211
84.38	25.72	24.41	7.44	87.554	8.134	945.269	26.767	999.159	28.293
84.42	25.73	24.44	7.45	87.704	8.148	948.129	26.848	1002.019	28.374
84.45	25.74	24.48	7.46	87.855	8.162	951.025	26.930	1004.915	28.456
84.48	25.75	24.51	7.47	88.016	8.177	953.885	27.011	1007.776	28.537
84.51	25.76	24.54	7.48	88.167	8.191	956.781	27.093	1010.671	28.619
84.55	25.77	24.57	7.49	88.329	8.206	959.677	27.175	1013.567	28.701
84.58	25.78	24.61	7.50	88.490	8.221	962.573	27.257	1016.463	28.783
84.61	25.79	24.64	7.51	88.651	8.236	965.469	27.339	1019.359	28.865
84.65	25.80	24.67	7.52	88.813	8.251	968.400	27.422	1022.290	28.948
84.68	25.81	24.70	7.53	88.974	8.266	971.331	27.505	1025.221	29.031
84.71	25.82	24.74	7.54	89.147	8.282	974.227	27.587	1028.117	29.113
84.74	25.83	24.77	7.55	89.308	8.297	977.158	27.670	1031.048	29.196
84.78	25.84	24.80	7.56	89.470	8.312	980.089	27.753	1033.979	29.279
84.81	25.85	24.84	7.57	89.642	8.328	983.020	27.836	1036.910	29.362
84.84	25.86	24.87	7.58	89.803	8.343	985.986	27.920	1039.877	29.446
84.88	25.87	24.90	7.59	89.975	8.359	988.918	28.003	1042.808	29.529
84.91	25.88	24.93	7.60	90.158	8.376	991.884	28.087	1045.774	29.613

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
84.94	25.89	24.97	7.61	90.341	8.393	994.850	28.171	1048.741	29.697
84.97	25.90	25.00	7.62	90.524	8.410	997.817	28.255	1051.707	29.781
85.01	25.91	25.03	7.63	90.707	8.427	1000.783	28.339	1054.674	29.865
85.04	25.92	25.07	7.64	90.890	8.444	1003.750	28.423	1057.640	29.949
85.07	25.93	25.10	7.65	91.063	8.460	1006.751	28.508	1060.642	30.034
85.10	25.94	25.13	7.66	91.235	8.476	1009.753	28.593	1063.643	30.119
85.14	25.95	25.16	7.67	91.407	8.492	1012.720	28.677	1066.610	30.203
85.17	25.96	25.20	7.68	91.568	8.507	1015.721	28.762	1069.612	30.288
85.20	25.97	25.23	7.69	91.741	8.523	1018.723	28.847	1072.613	30.373
85.24	25.98	25.26	7.70	91.913	8.539	1021.760	28.933	1075.650	30.459
85.27	25.99	25.30	7.71	92.074	8.554	1024.762	29.018	1078.652	30.544
85.30	26.00	25.33	7.72	92.247	8.570	1027.799	29.104	1081.689	30.630
85.33	26.01	25.36	7.73	92.419	8.586	1030.836	29.190	1084.726	30.716
85.37	26.02	25.39	7.74	92.580	8.601	1033.873	29.276	1087.763	30.802
85.40	26.03	25.43	7.75	92.753	8.617	1036.910	29.362	1090.800	30.888
85.43	26.04	25.46	7.76	92.914	8.632	1039.947	29.448	1093.838	30.974
85.47	26.05	25.49	7.77	93.075	8.647	1042.984	29.534	1096.875	31.060
85.50	26.06	25.52	7.78	93.237	8.662	1046.057	29.621	1099.947	31.147
85.53	26.07	25.56	7.79	93.388	8.676	1049.129	29.708	1103.019	31.234
85.56	26.08	25.59	7.80	93.538	8.690	1052.166	29.794	1106.056	31.320
85.60	26.09	25.62	7.81	93.700	8.705	1055.239	29.881	1109.129	31.407
85.63	26.10	25.66	7.82	93.850	8.719	1058.311	29.968	1112.201	31.494
85.66	26.11	25.69	7.83	94.001	8.733	1061.419	30.056	1115.309	31.582
85.70	26.12	25.72	7.84	94.152	8.747	1064.491	30.143	1118.381	31.669

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
85.73	26.13	25.75	7.85	94.303	8.761	1067.599	30.231	1121.489	31.757
85.76	26.14	25.79	7.86	94.453	8.775	1070.671	30.318	1124.561	31.844
85.79	26.15	25.82	7.87	94.604	8.789	1073.779	30.406	1127.669	31.932
85.83	26.16	25.85	7.88	94.755	8.803	1076.886	30.494	1130.777	32.020
85.86	26.17	25.89	7.89	94.916	8.818	1079.994	30.582	1133.884	32.108
85.89	26.18	25.92	7.90	95.067	8.832	1083.137	30.671	1137.027	32.197
85.93	26.19	25.95	7.91	95.217	8.846	1086.245	30.759	1140.135	32.285
85.96	26.20	25.98	7.92	95.357	8.859	1089.353	30.847	1143.243	32.373
85.99	26.21	26.02	7.93	95.508	8.873	1092.496	30.936	1146.386	32.462
86.02	26.22	26.05	7.94	95.659	8.887	1095.639	31.025	1149.529	32.551
86.06	26.23	26.08	7.95	95.799	8.900	1098.782	31.114	1152.672	32.640
86.09	26.24	26.12	7.96	95.949	8.914	1101.925	31.203	1155.815	32.729
86.12	26.25	26.15	7.97	96.100	8.928	1105.068	31.292	1158.958	32.818
86.15	26.26	26.18	7.98	96.240	8.941	1108.211	31.381	1162.101	32.907
86.19	26.27	26.21	7.99	96.391	8.955	1111.389	31.471	1165.279	32.997
86.22	26.28	26.25	8.00	96.541	8.969	1114.567	31.561	1168.457	33.087
86.25	26.29	26.28	8.01	96.692	8.983	1117.710	31.650	1171.600	33.176
86.29	26.30	26.31	8.02	96.843	8.997	1120.889	31.740	1174.779	33.266
86.32	26.31	26.35	8.03	96.983	9.010	1124.067	31.830	1177.957	33.356
86.35	26.32	26.38	8.04	97.133	9.024	1127.245	31.920	1181.135	33.446
86.38	26.33	26.41	8.05	97.284	9.038	1130.459	32.011	1184.349	33.537
86.42	26.34	26.44	8.06	97.435	9.052	1133.637	32.101	1187.527	33.627
86.45	26.35	26.48	8.07	97.586	9.066	1136.851	32.192	1190.741	33.718
86.48	26.36	26.51	8.08	97.736	9.080	1140.029	32.282	1193.919	33.808

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
86.52	26.37	26.54	8.09	97.887	9.094	1143.243	32.373	1197.133	33.899
86.55	26.38	26.57	8.10	98.027	9.107	1146.456	32.464	1200.347	33.990
86.58	26.39	26.61	8.11	98.178	9.121	1149.670	32.555	1203.560	34.081
86.61	26.40	26.64	8.12	98.328	9.135	1152.919	32.647	1206.809	34.173
86.65	26.41	26.67	8.13	98.479	9.149	1156.133	32.738	1210.023	34.264
86.68	26.42	26.71	8.14	98.630	9.163	1159.382	32.830	1213.272	34.356
86.71	26.43	26.74	8.15	98.780	9.177	1162.595	32.921	1216.485	34.447
86.75	26.44	26.77	8.16	98.931	9.191	1165.844	33.013	1219.734	34.539
86.78	26.45	26.80	8.17	99.082	9.205	1169.093	33.105	1222.983	34.631
86.81	26.46	26.84	8.18	99.232	9.219	1172.342	33.197	1226.232	34.723
86.84	26.47	26.87	8.19	99.383	9.233	1175.626	33.290	1229.517	34.816
86.88	26.48	26.90	8.20	99.534	9.247	1178.875	33.382	1232.766	34.908
86.91	26.49	26.94	8.21	99.674	9.260	1182.160	33.475	1236.050	35.001
86.94	26.50	26.97	8.22	99.824	9.274	1185.409	33.567	1239.299	35.093
86.98	26.51	27.00	8.23	99.975	9.288	1188.693	33.660	1242.583	35.186
87.01	26.52	27.03	8.24	100.126	9.302	1191.977	33.753	1245.867	35.279
87.04	26.53	27.07	8.25	100.276	9.316	1195.261	33.846	1249.152	35.372
87.07	26.54	27.10	8.26	100.438	9.331	1198.546	33.939	1252.436	35.465
87.11	26.55	27.13	8.27	100.589	9.345	1201.865	34.033	1255.755	35.559
87.14	26.56	27.17	8.28	100.750	9.360	1205.149	34.126	1259.040	35.652
87.17	26.57	27.20	8.29	100.901	9.374	1208.469	34.220	1262.359	35.746
87.20	26.58	27.23	8.30	101.051	9.388	1211.789	34.314	1265.679	35.840
87.24	26.59	27.26	8.31	101.202	9.402	1215.108	34.408	1268.998	35.934
87.27	26.60	27.30	8.32	101.353	9.416	1218.428	34.502	1272.318	36.028

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
87.30	26.61	27.33	8.33	101.493	9.429	1221.747	34.596	1275.638	36.122
87.34	26.62	27.36	8.34	101.644	9.443	1225.067	34.690	1278.957	36.216
87.37	26.63	27.40	8.35	101.783	9.456	1228.422	34.785	1282.312	36.311
87.40	26.64	27.43	8.36	101.923	9.469	1231.741	34.879	1285.632	36.405
87.43	26.65	27.46	8.37	102.063	9.482	1235.096	34.974	1288.987	36.500
87.47	26.66	27.49	8.38	102.192	9.494	1238.451	35.069	1292.341	36.595
87.50	26.67	27.53	8.39	102.332	9.507	1241.806	35.164	1295.696	36.690
87.53	26.68	27.56	8.40	102.472	9.520	1245.161	35.259	1299.051	36.785
87.57	26.69	27.59	8.41	102.601	9.532	1248.516	35.354	1302.406	36.880
87.60	26.70	27.62	8.42	102.741	9.545	1251.906	35.450	1305.796	36.976
87.63	26.71	27.66	8.43	102.871	9.557	1255.261	35.545	1309.151	37.071
87.66	26.72	27.69	8.44	103.011	9.570	1258.651	35.641	1312.541	37.167
87.70	26.73	27.72	8.45	103.140	9.582	1262.041	35.737	1315.932	37.263
87.73	26.74	27.76	8.46	103.269	9.594	1265.432	35.833	1319.322	37.359
87.76	26.75	27.79	8.47	103.398	9.606	1268.822	35.929	1322.712	37.455
87.80	26.76	27.82	8.48	103.527	9.618	1272.212	36.025	1326.102	37.551
87.83	26.77	27.85	8.49	103.646	9.629	1275.602	36.121	1329.493	37.647
87.86	26.78	27.89	8.50	103.775	9.641	1278.992	36.217	1332.883	37.743
87.89	26.79	27.92	8.51	103.904	9.653	1282.418	36.314	1336.308	37.840
87.93	26.80	27.95	8.52	104.022	9.664	1285.808	36.410	1339.698	37.936
87.96	26.81	27.99	8.53	104.141	9.675	1289.234	36.507	1343.124	38.033
87.99	26.82	28.02	8.54	104.259	9.686	1292.659	36.604	1346.550	38.130
88.02	26.83	28.05	8.55	104.388	9.698	1296.085	36.701	1349.975	38.227
88.06	26.84	28.08	8.56	104.507	9.709	1299.510	36.798	1353.401	38.324

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
88.09	26.85	28.12	8.57	104.625	9.720	1302.936	36.895	1356.826	38.421
88.12	26.86	28.15	8.58	104.744	9.731	1306.361	36.992	1360.252	38.518
88.16	26.87	28.18	8.59	104.862	9.742	1309.822	37.090	1363.712	38.616
88.19	26.88	28.22	8.60	104.980	9.753	1313.248	37.187	1367.138	38.713
88.22	26.89	28.25	8.61	105.109	9.765	1316.709	37.285	1370.599	38.811
88.25	26.90	28.28	8.62	105.228	9.776	1320.134	37.382	1374.024	38.908
88.29	26.91	28.31	8.63	105.346	9.787	1323.595	37.480	1377.485	39.006
88.32	26.92	28.35	8.64	105.465	9.798	1327.056	37.578	1380.946	39.104
88.35	26.93	28.38	8.65	105.572	9.808	1330.517	37.676	1384.407	39.202
88.39	26.94	28.41	8.66	105.691	9.819	1333.977	37.774	1387.868	39.300
88.42	26.95	28.44	8.67	105.809	9.830	1337.474	37.873	1391.364	39.399
88.45	26.96	28.48	8.68	105.917	9.840	1340.934	37.971	1394.825	39.497
88.48	26.97	28.51	8.69	106.035	9.851	1344.395	38.069	1398.286	39.595
88.52	26.98	28.54	8.70	106.143	9.861	1347.891	38.168	1401.782	39.694
88.55	26.99	28.58	8.71	106.261	9.872	1351.388	38.267	1405.278	39.793
88.58	27.00	28.61	8.72	106.380	9.883	1354.848	38.365	1408.739	39.891
88.62	27.01	28.64	8.73	106.487	9.893	1358.345	38.464	1412.235	39.990
88.65	27.02	28.67	8.74	106.606	9.904	1361.841	38.563	1415.731	40.089
88.68	27.03	28.71	8.75	106.724	9.915	1365.337	38.662	1419.227	40.188
88.71	27.04	28.74	8.76	106.832	9.925	1368.868	38.762	1422.759	40.288
88.75	27.05	28.77	8.77	106.950	9.936	1372.365	38.861	1426.255	40.387
88.78	27.06	28.81	8.78	107.069	9.947	1375.861	38.960	1429.751	40.486
88.81	27.07	28.84	8.79	107.176	9.957	1379.392	39.060	1433.282	40.586
88.85	27.08	28.87	8.80	107.295	9.968	1382.888	39.159	1436.779	40.685

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
88.88	27.09	28.90	8.81	107.413	9.979	1386.420	39.259	1440.310	40.785
88.91	27.10	28.94	8.82	107.521	9.989	1389.951	39.359	1443.842	40.885
88.94	27.11	28.97	8.83	107.628	9.999	1393.483	39.459	1447.373	40.985
88.98	27.12	29.00	8.84	107.736	10.009	1397.014	39.559	1450.904	41.085
89.01	27.13	29.04	8.85	107.844	10.019	1400.546	39.659	1454.436	41.185
89.04	27.14	29.07	8.86	107.962	10.030	1404.077	39.759	1457.967	41.285
89.07	27.15	29.10	8.87	108.070	10.040	1407.644	39.860	1461.534	41.386
89.11	27.16	29.13	8.88	108.177	10.050	1411.175	39.960	1465.066	41.486
89.14	27.17	29.17	8.89	108.285	10.060	1414.742	40.061	1468.632	41.587
89.17	27.18	29.20	8.90	108.392	10.070	1418.274	40.161	1472.164	41.687
89.21	27.19	29.23	8.91	108.500	10.080	1421.840	40.262	1475.731	41.788
89.24	27.20	29.27	8.92	108.608	10.090	1425.407	40.363	1479.297	41.889
89.27	27.21	29.30	8.93	108.715	10.100	1428.974	40.464	1482.864	41.990
89.30	27.22	29.33	8.94	108.812	10.109	1432.541	40.565	1486.431	42.091
89.34	27.23	29.36	8.95	108.920	10.119	1436.108	40.666	1489.998	42.192
89.37	27.24	29.40	8.96	109.028	10.129	1439.674	40.767	1493.565	42.293
89.40	27.25	29.43	8.97	109.135	10.139	1443.276	40.869	1497.167	42.395
89.44	27.26	29.46	8.98	109.232	10.148	1446.843	40.970	1500.733	42.496
89.47	27.27	29.49	8.99	109.329	10.157	1450.445	41.072	1504.336	42.598
89.50	27.28	29.53	9.00	109.426	10.166	1454.012	41.173	1507.902	42.699
89.53	27.29	29.56	9.01	109.533	10.176	1457.614	41.275	1511.504	42.801
89.57	27.30	29.59	9.02	109.630	10.185	1461.216	41.377	1515.107	42.903
89.60	27.31	29.63	9.03	109.727	10.194	1464.818	41.479	1518.709	43.005
89.63	27.32	29.66	9.04	109.824	10.203	1468.421	41.581	1522.311	43.107

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
89.67	27.33	29.69	9.05	109.921	10.212	1472.023	41.683	1525.913	43.209
89.70	27.34	29.72	9.06	110.029	10.222	1475.625	41.785	1529.515	43.311
89.73	27.35	29.76	9.07	110.125	10.231	1479.227	41.887	1533.117	43.413
89.76	27.36	29.79	9.08	110.222	10.240	1482.829	41.989	1536.719	43.515
89.80	27.37	29.82	9.09	110.319	10.249	1486.466	42.092	1540.357	43.618
89.83	27.38	29.86	9.10	110.427	10.259	1490.068	42.194	1543.959	43.720
89.86	27.39	29.89	9.11	110.524	10.268	1493.706	42.297	1547.596	43.823
89.90	27.40	29.92	9.12	110.621	10.277	1497.343	42.400	1551.234	43.926
89.93	27.41	29.95	9.13	110.717	10.286	1500.981	42.503	1554.871	44.029
89.96	27.42	29.99	9.14	110.814	10.295	1504.618	42.606	1558.508	44.132
89.99	27.43	30.02	9.15	110.911	10.304	1508.256	42.709	1562.146	44.235
90.03	27.44	30.05	9.16	111.008	10.313	1511.893	42.812	1565.783	44.338
90.06	27.45	30.09	9.17	111.105	10.322	1515.530	42.915	1569.421	44.441
90.09	27.46	30.12	9.18	111.202	10.331	1519.168	43.018	1573.058	44.544
90.12	27.47	30.15	9.19	111.299	10.340	1522.805	43.121	1576.695	44.647
90.16	27.48	30.18	9.20	111.396	10.349	1526.478	43.225	1580.368	44.751
90.19	27.49	30.22	9.21	111.482	10.357	1530.115	43.328	1584.006	44.854
90.22	27.50	30.25	9.22	111.579	10.366	1533.788	43.432	1587.678	44.958
90.26	27.51	30.28	9.23	111.675	10.375	1537.461	43.536	1591.351	45.062
90.29	27.52	30.31	9.24	111.772	10.384	1541.098	43.639	1594.988	45.165
90.32	27.53	30.35	9.25	111.869	10.393	1544.771	43.743	1598.661	45.269
90.35	27.54	30.38	9.26	111.955	10.401	1548.444	43.847	1602.334	45.373
90.39	27.55	30.41	9.27	112.052	10.410	1552.116	43.951	1606.007	45.477
90.42	27.56	30.45	9.28	112.149	10.419	1555.824	44.056	1609.715	45.582

FRL

Elevation (MSL, ft)	Elevation (MSL, m)	Depth of water from D.W.L/O.S.L		Area (M.sq.ft)	Area (M.sq.m)	Live Capacity		Gross Capacity Total (Live + Dead)	
		ft	m			Volume (M.cu.ft)	Volume (M.cu.m)	Volume (M.cu.ft)	Volume (M.cu.m)
90.45	27.57	30.48	9.29	112.235	10.427	1559.497	44.160	1613.387	45.686
90.49	27.58	30.51	9.30	112.332	10.436	1563.170	44.264	1617.060	45.790
90.52	27.59	30.54	9.31	112.429	10.445	1566.843	44.368	1620.733	45.894
90.55	27.60	30.58	9.32	112.515	10.453	1570.551	44.473	1624.441	45.999

Annexure - 2

Mobilisation and Calibration Report

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 thirteen reservoirs in the Saurashtra & northern Gujarat region; namely Bhadar-1, Bhadar-2, Brahmani-1, Und-1, Machhu-1, Machhu-2, Khodiyar, Aji-1, Nara, Tappar, Rudramata, Mitti and Fatehghadh.

This report documents the mobilisation and calibrations carried out by OSaS for the topographic survey and on board SBM OSaS for the bathymetric survey of Nara reservoir at Kutch (Northern Gujarat) region, Gujarat.

The survey team arrived at the survey site on 5th June 2021. TBM-01 and TBM-02 was established at the site on 5th June. DGPS observations were carried out at each of these points for about 2 hours. The levelling of these TBMs was carried out with respect to the known level of FRL (27.43m above MSL) provided by the client. The topographic survey commenced on the 6th June at Nara reservoir and completed on 23rd June 2021.

The mobilisation of the survey boat SMB OSaS was carried out on 16th June 2021 while the boat was near the valve tower of Nara reservoir. Initial system preparation and equipment checks were completed on the same day. Bar check was carried out every day before commencing the bathymetric survey. Bathymetric survey commenced on 17th June and was completed on 20th June. The survey boat was demobilised on 22nd June 2021.

1.2 HSE Checks

A safety induction was given by the Party Chief prior to survey, detailing personnel responsibilities in the event of 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, hardhats and cover-all's for all personnel involved in back deck operations.

1.3 Survey Equipment list on SMB OSaS

1.3.1 Navigation and Positioning

Item	Quantity
Hemisphere DGPS system with cables	1
Navigation computer with Hypack software	1
Moxa8-port cable	4
Hemisphere GPS S320 GNSS 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
TSS HS50	2

1.3.3 Levelling equipment

Item	Quantity
Geomax auto level complete with all accessories	1 set

1.3.4 Power Systems

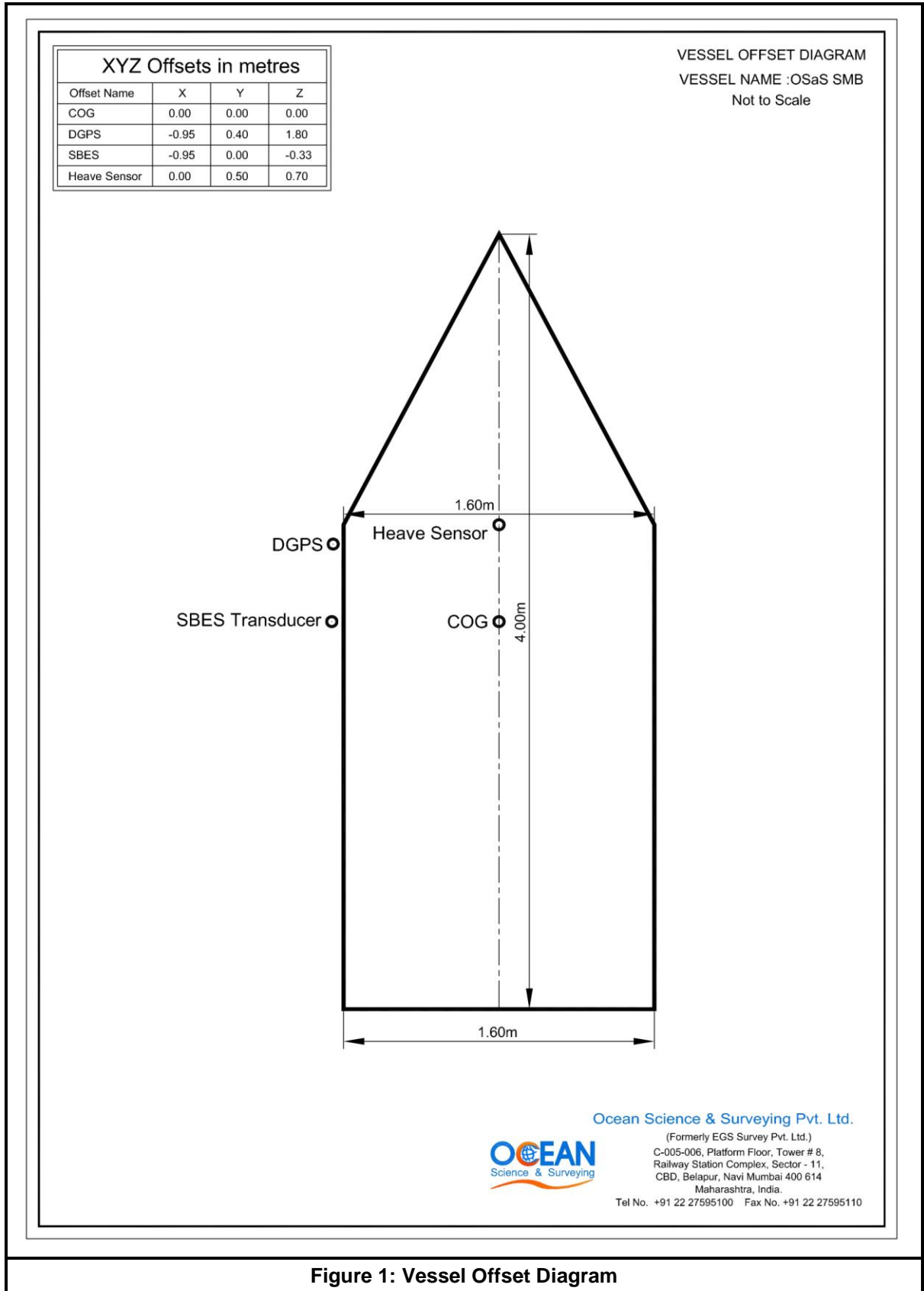
Item	Quantity
2KVA Stabilizer	2
1KVA generator	2
24V power supply	4
Exide battery 100Ah	1
Invertor	1
12V External battery	3
12V External battery charger	3

1.3.5 Miscellaneous

Item	Quantity
LCD monitors	8
Laptop	2
Helmets / life jackets	8
Tool box	1
Tripod and Tribatch	4 & 3
Ranging Rod	3
Antenna T-Section	2 Sets
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 OSaS are shown in the figure below:



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 walkway to the valve tower of the dam approximately 10m 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 27.43m above MSL, provided by the client. The base stations of the Hemisphere GPS S320 GNSS 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-NA-TBM-01 and OSaS-NA-TBM-02 are provided in **Table 1** and **Table 2**

Station Number:	OSaS-NA-TBM-01	Latitude:	23° 38' 29.532" N
Locality:	Nara, Gujarat	Longitude:	69° 7' 19.869" E
Geodetic Datum:	WGS84	Northing:	2614545.91 m N
Projection:	Universal Transverse Mercator	Easting:	512461.85 m E
Date:	5 th June 2021	Elevation:	30.696 m above MSL
Station Description:	A circle with text OS-TBM-1 is drawn with yellow paint on the walkway to the valve tower from the top of the dam.		
Access:	Road to the top of the reservoir. The TBM-01 is situated on the walkway to the valve tower from the top of the dam.		

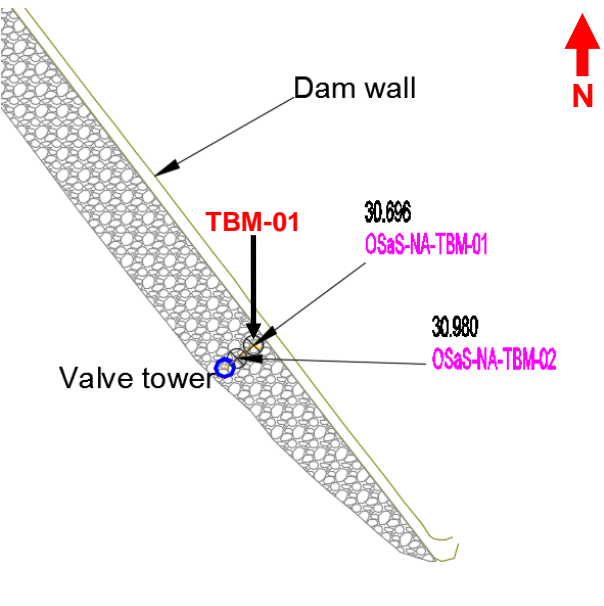

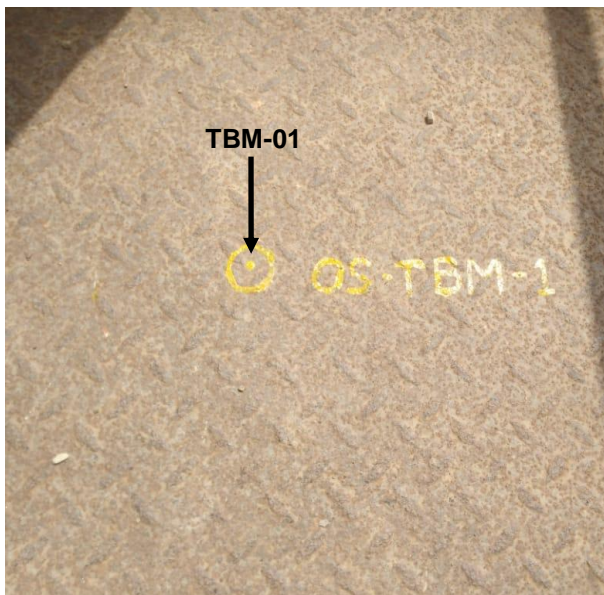
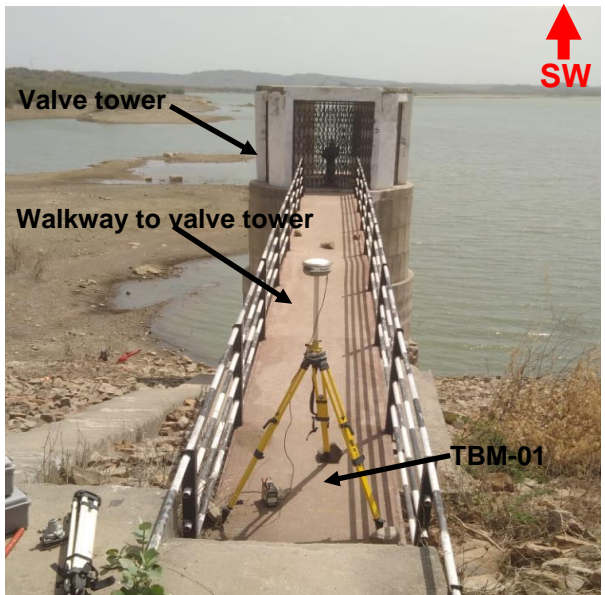
Sketch:	Map:
	
Photo:	Photo:
	

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

Station Number:	OSaS-NA-TBM-02	Latitude:	23° 38' 29.331" N
Locality:	Nara, Gujarat	Longitude:	69° 7' 19.592" E
Geodetic Datum:	WGS84	Northing:	2614539.73 m N
Projection:	Universal Transverse Mercator	Easting:	512453.99 m E
Date:	5 th June 2021	Elevation:	30.980 m above MSL
Station Description:	A circle with text OS-TBM-2 is drawn with yellow paint on the walkway to the valve tower from the top of the dam.		
Access:	Road to the top of the reservoir. The TBM-02 is situated 10m southwest of TBM1 on the walkway to the valve tower from top of the dam.		

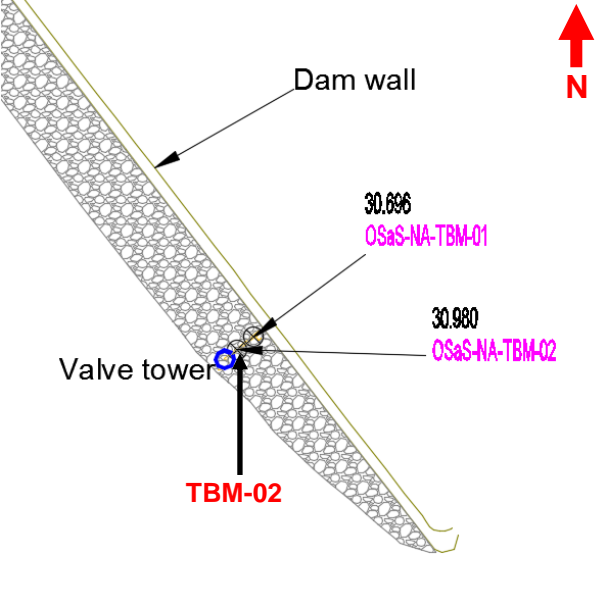

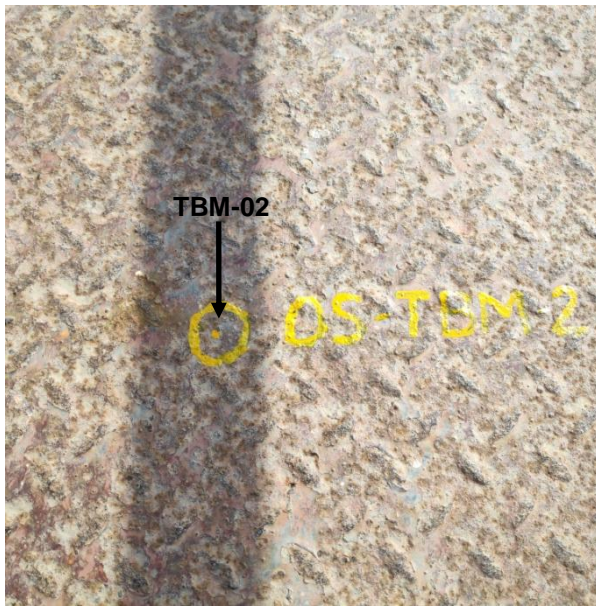
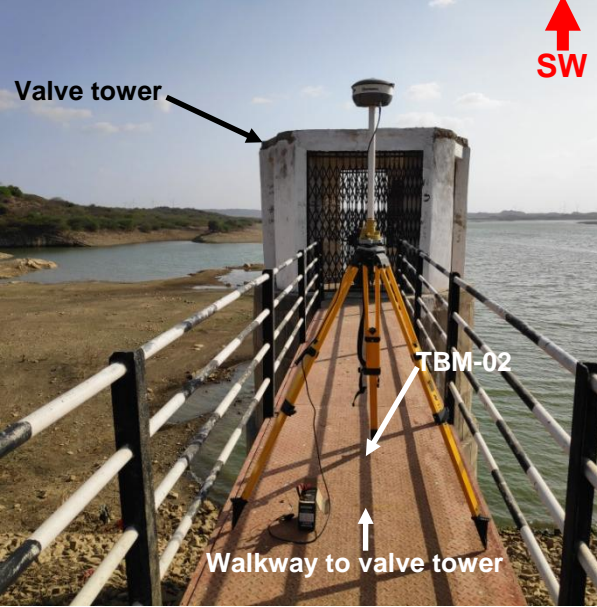
Sketch:	Map:
	
Photo:	Photo:
	

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

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 OSaS.

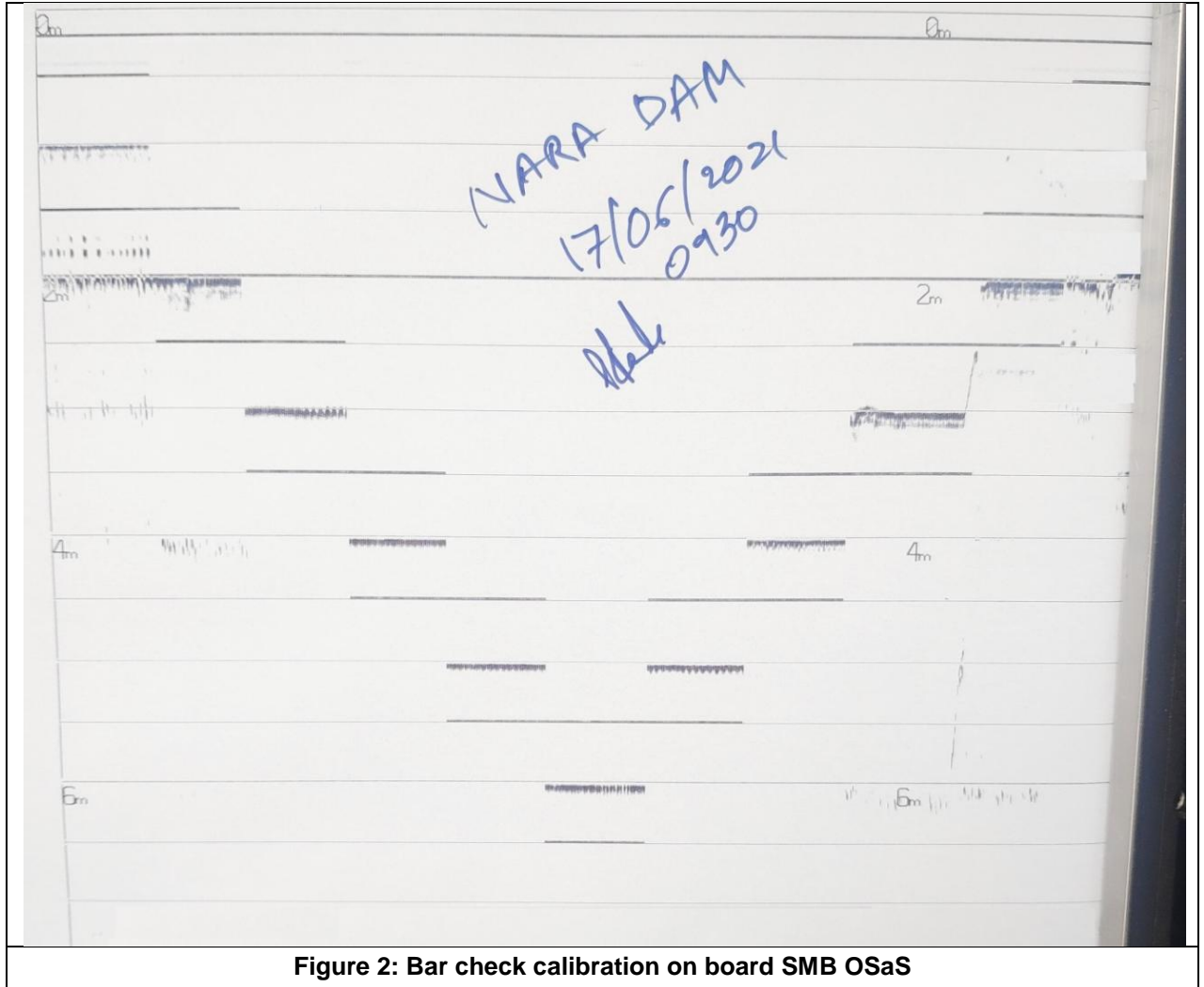


Figure 2: Bar check calibration on board SMB OSaS

3 CONCLUSIONS

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

Annexure - 3
Previous Data –1986
Nara Reservoir

The following documents provided by the client, consists of capacity details of silt survey conducted in Nara dam in 1986. The capacity data have been extracted from the provided document at intervals of 0.5m from 14m above MSL to 27.43m (FRL) above MSL for calculation purposes.

Nara Irrigation Scheme							
Area Capacity Table							
Datum Level :12.00 mt.				Dead Storage : 1.49 Mcum.			
O.S.L. :18.28 M.				Live Storage : 38.21 Mcum.			
F.R.L. :27.43 M.				Gross Storage : 39.70 Mcum			
Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
1	2	3	4	5	6	7	8
49	Nara	14.00	0.046	1.624	0.000	0.000	
49	Nara	14.10	0.054	1.896	0.000	0.000	
49	Nara	14.20	0.061	2.168	0.000	0.000	
49	Nara	14.30	0.069	2.440	0.000	0.000	
49	Nara	14.40	0.077	2.712	0.000	0.000	
49	Nara	14.50	0.085	2.984	0.000	0.000	
49	Nara	14.60	0.092	3.256	0.000	0.000	
49	Nara	14.70	0.100	3.528	0.000	0.000	
49	Nara	14.80	0.108	3.800	0.000	0.000	
49	Nara	14.90	0.115	4.072	0.000	0.000	
49	Nara	15.00	0.123	4.344	0.000	0.000	
49	Nara	15.10	0.140	4.955	0.000	0.000	
49	Nara	15.20	0.158	5.566	0.000	0.000	
49	Nara	15.30	0.175	6.177	0.000	0.000	
49	Nara	15.40	0.192	6.788	0.000	0.000	
49	Nara	15.50	0.210	7.398	0.000	0.000	

Nara Irrigation Scheme

Area Capacity Table

Datum Level :12.00 mt.	Dead Storage : 1.49 Mcum.
O.S.L. :18.28 M.	Live Storage : 38.21 Mcum.
F.R.L. :27.43 M.	Gross Storage : 39.70 Mcum

Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
49	Nara	15.60	0.227	8.009	0.000	0.000	
49	Nara	15.70	0.244	8.620	0.000	0.000	
49	Nara	15.80	0.261	9.231	0.000	0.000	
49	Nara	15.90	0.279	9.842	0.000	0.000	
49	Nara	16.00	0.296	10.453	0.000	0.000	
49	Nara	16.10	0.330	11.643	0.000	0.000	
49	Nara	16.20	0.363	12.833	0.000	0.000	
49	Nara	16.30	0.397	14.024	0.000	0.000	
49	Nara	16.40	0.431	15.214	0.000	0.000	
49	Nara	16.50	0.465	16.404	0.000	0.000	
49	Nara	16.60	0.498	17.594	0.000	0.000	
49	Nara	16.70	0.532	18.784	0.000	0.000	
49	Nara	16.80	0.566	19.974	0.000	0.000	
49	Nara	16.90	0.599	21.164	0.000	0.000	
49	Nara	17.00	0.633	22.354	0.000	0.000	
49	Nara	17.10	0.690	24.378	0.000	0.000	
49	Nara	17.20	0.748	26.401	0.000	0.000	
49	Nara	17.30	0.805	28.425	0.000	0.000	
49	Nara	17.40	0.862	30.449	0.000	0.000	

Nara Irrigation Scheme

Area Capacity Table

Datum Level :12.00 mt.	Dead Storage : 1.49 Mcum.
O.S.L. :18.28 M.	Live Storage : 38.21 Mcum.
F.R.L. :27.43 M.	Gross Storage : 39.70 Mcum

Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
49	Nara	17.50	0.920	32.472	0.000	0.000	
49	Nara	17.60	0.977	34.496	0.000	0.000	
49	Nara	17.70	1.034	36.519	0.000	0.000	
49	Nara	17.80	1.091	38.543	0.000	0.000	
49	Nara	17.90	1.149	40.566	0.000	0.000	
49	Nara	18.00	1.206	42.590	0.000	0.000	
49	Nara	18.10	1.307	46.172	0.000	0.000	
49	Nara	18.20	1.409	49.754	0.000	0.000	
49	Nara	18.28	1.490	52.619	0.000	0.000	O.S.L. 18.28 M.
49	Nara	18.30	1.511	53.354	0.021	0.735	
49	Nara	18.40	1.615	57.028	0.125	4.408	
49	Nara	18.50	1.719	60.702	0.229	8.082	
49	Nara	18.60	1.823	64.375	0.333	11.756	
49	Nara	18.70	1.927	68.049	0.437	15.430	
49	Nara	18.80	2.031	71.723	0.541	19.103	
49	Nara	18.90	2.135	75.397	0.645	22.777	
49	Nara	19.00	2.239	79.070	0.749	26.451	
49	Nara	19.10	2.374	83.838	0.884	31.218	
49	Nara	19.20	2.509	88.605	1.019	35.986	

Nara Irrigation Scheme

Area Capacity Table

Datum Level :12.00 mt.	Dead Storage : 1.49 Mcum.
O.S.L. :18.28 M.	Live Storage : 38.21 Mcum.
F.R.L. :27.43 M.	Gross Storage : 39.70 Mcum

Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
49	Nara	19.30	2.644	93.373	1.154	40.754	
49	Nara	19.40	2.779	98.140	1.289	45.521	
49	Nara	19.50	2.914	102.908	1.424	50.289	
49	Nara	19.60	3.049	107.675	1.559	55.056	
49	Nara	19.70	3.184	112.443	1.694	59.824	
49	Nara	19.80	3.319	117.210	1.829	64.591	
49	Nara	19.90	3.454	121.978	1.964	69.359	
49	Nara	20.00	3.589	126.746	2.099	74.126	
49	Nara	20.10	3.771	133.173	2.281	80.554	
49	Nara	20.20	3.953	139.600	2.463	86.981	
49	Nara	20.30	4.135	146.028	2.645	93.408	
49	Nara	20.40	4.317	152.455	2.827	99.836	
49	Nara	20.50	4.499	158.882	3.009	106.263	
49	Nara	20.60	4.681	165.310	3.191	112.690	
49	Nara	20.70	4.863	171.737	3.373	119.117	
49	Nara	20.80	5.045	178.164	3.555	125.545	
49	Nara	20.90	5.227	184.592	3.737	131.972	
49	Nara	21.00	5.409	191.019	3.919	138.399	
49	Nara	21.10	5.649	199.494	4.159	146.875	

Nara Irrigation Scheme

Area Capacity Table

Datum Level :12.00 mt.	Dead Storage : 1.49 Mcum.
O.S.L. :18.28 M.	Live Storage : 38.21 Mcum.
F.R.L. :27.43 M.	Gross Storage : 39.70 Mcum

Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
49	Nara	21.20	5.889	207.970	4.399	155.351	
49	Nara	21.30	6.129	216.446	4.639	163.826	
49	Nara	21.40	6.369	224.921	4.879	172.302	
49	Nara	21.50	6.609	233.397	5.119	180.777	
49	Nara	21.60	6.849	241.872	5.359	189.253	
49	Nara	21.70	7.089	250.348	5.599	197.729	
49	Nara	21.80	7.329	258.824	5.839	206.204	
49	Nara	21.90	7.569	267.299	6.079	214.680	
49	Nara	22.00	7.809	275.775	6.319	223.155	
49	Nara	22.10	8.152	287.888	6.662	235.269	
49	Nara	22.20	8.495	300.001	7.005	247.382	
49	Nara	22.30	8.838	312.114	7.348	259.495	
49	Nara	22.40	9.181	324.227	7.691	271.608	
49	Nara	22.50	9.524	336.340	8.034	283.721	
49	Nara	22.60	9.867	348.453	8.377	295.834	
49	Nara	22.70	10.210	360.566	8.720	307.947	
49	Nara	22.80	10.553	372.679	9.063	320.060	
49	Nara	22.90	10.896	384.792	9.406	332.173	
49	Nara	23.00	11.239	396.905	9.749	344.286	

Nara Irrigation Scheme

Area Capacity Table

Datum Level :12.00 mt.	Dead Storage : 1.49 Mcum.
O.S.L. :18.28 M.	Live Storage : 38.21 Mcum.
F.R.L. :27.43 M.	Gross Storage : 39.70 Mcum

Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
49	Nara	23.10	11.694	412.959	10.204	360.340	
49	Nara	23.20	12.148	429.014	10.658	376.394	
49	Nara	23.30	12.603	445.068	11.113	392.449	
49	Nara	23.40	13.057	461.122	11.567	408.503	
49	Nara	23.50	13.512	477.176	12.022	424.557	
49	Nara	23.60	13.967	493.230	12.477	440.611	
49	Nara	23.70	14.421	509.285	12.931	456.665	
49	Nara	23.80	14.876	525.339	13.386	472.720	
49	Nara	23.90	15.330	541.393	13.840	488.774	
49	Nara	24.00	15.785	557.447	14.295	504.828	
49	Nara	24.10	16.323	576.447	14.833	523.827	
49	Nara	24.20	16.861	595.446	15.371	542.827	
49	Nara	24.30	17.399	614.446	15.909	561.826	
49	Nara	24.40	17.937	633.445	16.447	580.826	
49	Nara	24.50	18.475	652.445	16.985	599.825	
49	Nara	24.60	19.013	671.444	17.523	618.825	
49	Nara	24.70	19.551	690.444	18.061	637.824	
49	Nara	24.80	20.089	709.443	18.599	656.824	
49	Nara	24.90	20.627	728.443	19.137	675.823	

Nara Irrigation Scheme

Area Capacity Table

Datum Level :12.00 mt.	Dead Storage : 1.49 Mcum.
O.S.L. :18.28 M.	Live Storage : 38.21 Mcum.
F.R.L. :27.43 M.	Gross Storage : 39.70 Mcum

Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
49	Nara	25.00	21.165	747.442	19.675	694.823	
49	Nara	25.10	21.854	771.785	20.364	719.165	
49	Nara	25.20	22.544	796.127	21.054	743.508	
49	Nara	25.30	23.233	820.470	21.743	767.851	
49	Nara	25.40	23.922	844.812	22.432	792.193	
49	Nara	25.50	24.612	869.155	23.122	816.536	
49	Nara	25.60	25.301	893.498	23.811	840.878	
49	Nara	25.70	25.990	917.840	24.500	865.221	
49	Nara	25.80	26.679	942.183	25.189	889.564	
49	Nara	25.90	27.369	966.526	25.879	913.906	
49	Nara	26.00	28.058	990.868	26.568	938.249	
49	Nara	26.10	28.815	1017.591	27.325	964.972	
49	Nara	26.20	29.571	1044.314	28.081	991.695	
49	Nara	26.30	30.328	1071.037	28.838	1018.418	
49	Nara	26.40	31.085	1097.760	29.595	1045.140	
49	Nara	26.50	31.842	1124.483	30.352	1071.863	
49	Nara	26.60	32.598	1151.205	31.108	1098.586	
49	Nara	26.70	33.355	1177.928	31.865	1125.309	
49	Nara	26.80	34.112	1204.651	32.622	1152.032	

Nara Irrigation Scheme

Area Capacity Table

Datum Level		:12.00 mt.		Dead Storage		: 1.49 Mcum.	
O.S.L.		:18.28 M.		Live Storage		: 38.21 Mcum.	
F.R.L.		:27.43 M.		Gross Storage		: 39.70 Mcum	
Scheme ID	Scheme Name	Water Level RL in Mt.	Gross Storage Capacity MCM	Gross Storage Capacity MCFT	Live storage capacity in Mcum.	Live storage capacity in MCFT	Remarks.
49	Nara	26.90	34.868	1231.374	33.378	1178.755	
49	Nara	27.00	35.625	1258.097	34.135	1205.478	
49	Nara	27.10	36.572	1291.523	35.082	1238.904	
49	Nara	27.20	37.518	1324.949	36.028	1272.330	
49	Nara	27.30	38.465	1358.375	36.975	1305.756	
49	Nara	27.40	39.411	1391.801	37.921	1339.182	
49	Nara	27.43	39.700	1402.006	38.210	1349.386	F.R.L. 27.43 M.

The following documents provided by the client, consist of capacity and area data of the silt survey conducted in Nara dam in 1986 at intervals of 1m. Areas at preferred elevations have been extracted from the provided document for the preparation of area-capacity curves.

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KACHCHH IRRIGATION DIVISION, BHUJ.

Nara Irrigation Scheme:

Area Capacity table as per New Survey.

R.L. in Mt.	Area in Hsqm.	Vol. (By use of prismoidal formula) M ³	Cumulative capacity M ³	Remarks.
1	2	3	4	5
12	0.00	-	-	
13	0.02	0.006	0.006	
14	0.05	0.040	0.046	
15	0.11	0.083	0.129	
16	0.25	0.167	0.296	
17	0.42	0.343	0.639	
18	0.80	0.567	1.206	O.S.L. R.L. 18
19	1.20	1.039	2.245	Capacity=1.4
20	1.55	1.344	3.589	= 52.87 Mett
21	2.11	1.826	5.413	
22	2.85	2.454	7.869	
23	4.00	3.376	11.245	
24	4.90	4.54	15.785	
25	6.18	5.386	21.171	
26	7.20	6.867	28.038	
27	8.40	7.573	35.631	
27-45	9.30	4.069	39.700	

Gross storage at F.R.L. as per P.R. = 1450 Mett.

" " " as per present survey. = $\frac{1402}{43}$ "

∴ Total silt deposited.

% sedimentation = $\frac{43}{1450} \times 100$

= 3.31

Sd/-
A.S. Bharti,
Executive Engineer,
Kachchh Irrigation
Division, Bhuj.


Annexure - 4

Daily Progress Reports

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

Nara Dam


DPR No. 001

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	05-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Arsh Mansuri	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0800	0830	Transit Gausala to Nara Dam site.			
0830	1600	Observations by DGPS for reference stations TBM-1 & TBM-2.			
1600	1630	Observations completed and secured.			
1630	1715	Survey team returned to Gausala at Nara village.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.000sq.km	Line km: 0.000	Topo: 0.000sq.km	Line km: 0.000
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK topo survey.					
Remarks: F R L is 27.43m as given by client.					
					
Party Chief			Client Representative		

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

Nara Dam


DPR No. 002

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	06-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Arsh Mansuri	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0810	0840	Transit Gausala to Nara dam site.			
0840	1130	Land survey started.			
1130	1245	Vertical datum established by level transfer from existing reference shown by Mr. Kanjibhai (Nara dam department) to the newly established reference station (Temporary Benchmark).			
1245	1745	Land survey terminated and reference station secured.			
1745	1845	Land survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.041sq.km	Line km: 1.640	Topo: 0.041 sq.km	Line km: 1.640
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours: Continue with RTK topo survey.					
Remarks:					
					
Party Chief			Client Representative		

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

Nara Dam


DPR No. 003

Client:	Narmada Water Resources, Water Supply & Kalpsar Department			Project No:	P34320	
Vessel:	OSAS SMB			Date:	07-06-2021	
Location:	Nara Dam			Sheet No:	1 of 1	
Party Chief: Mansuri M. I.				Client Rep.		
Survey Personnel:						
1. Prasant Panda		2. Gaurav Sharma		3. Arsh Mansuri		
4.		5.		6.		
7.		8.		9.		
10.						
Equipment	RTK System		SBES System		Auto Level	
	Water Level Meter		Bar Check		Generator	
	Computer				Heave sensor	
				Hypack		
Time (hrs)		Activities				
0800	0830	Transit Gausala to Nara dam site.				
0830		Land survey started.				
	1900	Land survey terminated and reference station secured.				
1900	1945	Land survey team returned to Gausala.				
		Today's coverage			Cumulative coverage	
		Bathymetry: 0.00 sq.km		Line km: 0.00		Bathymetry: 0.00 sq.km
		Line km: 20.951		Topo: 0.565 sq.km		Line km: 22.591
		Topo: 0.524 sq.km		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours
Plan for next 24 hours : Continue with RTK topo survey.						
Remarks:						
						
Party Chief				Client Representative		

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

Nara Dam


DPR No. 004

Client:	Narmada Water Resources, Water Supply & Kalpsar Department			Project No:	P34320
Vessel:	OSAS SMB			Date:	08-06-2021
Location:	Nara Dam			Sheet No:	1 of 1
Party Chief: Mansuri M. I.				Client Rep.	
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Arsh Mansuri	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System		SBES System	Auto Level	
	Water Level Meter		Bar Check	Generator	
	Computer			Heave sensor	
				Hypack	
Time (hrs)		Activities			
0800	0815	Transit Gausala to Nara Dam site.			
0815		Land survey started.			
	1900	Land survey terminated and reference station secured.			
1900	1945	Land Survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.315sq.km	Line km: 12.600	Topo: 0.860 sq.km	Line km: 35.191
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours: Continue with RTK topo survey.					
Remarks: Client representative Mr. Sivyesh Chaudhri visited Nara dam site at 15:45 hrs.					
					
Party Chief			Client Representative		

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		Approved By	PKT

Nara Dam


DPR No. 005

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	09-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Arsh Mansuri	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level		Heave sensor
	Water Level Meter	Bar Check	Generator		Hypack
	Computer				
Time (hrs)		Activities			
0800	0815	Transit Gausala to Nara Dam site.			
0815		Land survey started.			
	1850	Land survey terminated and reference station secured.			
1850	1945	Land Survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.176sq.km	Line km: 7.040	Topo: 1.056sq.km	Line km: 42.231
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey .					
Remarks:					
					
Party Chief			Client Representative		

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		Date:	11/07/2014
		Approved By	PKT

Nara Dam


DPR No. 006

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	10-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Arsh Mansuri	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level		Heave sensor
	Water Level Meter	Bar Check	Generator		Hypack
	Computer				
Time (hrs)		Activities			
0700	0800	Transit Gausala to Nara Dam site.			
0800		Land survey started.			
	1845	Land survey terminated and reference station secured.			
1845	1935	Land Survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.439sq.km	Line km: 17.560	Topo: 1.495sq.km	Line km: 59.791
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey .					
Remarks:					
					
Party Chief			Client Representative		

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		Approved By	PKT

Nara Dam


DPR No. 007

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	11-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Arsh Mansuri	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0750	0800	Transit Gausala to Nara Dam site.			
0800		Land survey started.			
	1800	Land survey terminated and reference station secured.			
1800	1915	Land Survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.230sq.km	Line km: 9.225	Topo: 1.725sq.km	Line km: 69.016
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey .					
Remarks:					
					
Party Chief			Client Representative		

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		Approved By	PKT

Nara Dam


DPR No. 008

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	12-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3.	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0820	0900	Transit Gausala to Nara Dam site.			
0900		Land survey started.			
	1800	Land survey terminated and reference station secured.			
1800	1905	Land Survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.170sq.km	Line km: 6.800	Topo: 1.895sq.km	Line km: 75.816
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey .					
Remarks : west side of Nara dam's Both side river bank RTK survey completed, up to RL 28.0m of Water fall.					
					
Party Chief			Client Representative		

 <p style="text-align: center;">DAILY PROGRESS REPORT</p>	Form No.:	Sy01R
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	Date:	11/07/2014
	Approved By	PKT

Nara Dam


DPR No. 009

Client:	Narmada Water Resources, Water Supply & Kalpsar Department			Project No:	P34320
Vessel:	OSAS SMB			Date:	13-06-2021
Location:	Nara Dam			Sheet No:	1 of 1
Party Chief: Mansuri M. I.				Client Rep.	
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3.	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0810	0900	Transit Gausala to Nara Dam site.			
0900		Land survey started.			
	1815	Land survey terminated and reference station secured.			
1815	1915	Land Survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.141sq.km	Line km: 5.640	Topo: 2.036sq.km	Line km: 81.456
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey .					
Remarks :					
					
Party Chief			Client Representative		

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

Nara Dam


DPR No. 010

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	14-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3.	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0800	0830	Transit Gausala to Nara Dam site.			
0830		Land survey started.			
	1830	Land survey terminated and reference station secured.			
1830	1930	Land survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.215sq.km	Line km: 8.600	Topo: 2.251 sq.km	Line km: 90.056
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey.					
Remarks :					
					
Party Chief			Client Representative		

	DAILY PROGRESS REPORT	Form No.:	Sy01R
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		Approved By	PKT

Nara Dam


DPR No. 011

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	15-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3.	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level		Heave sensor
	Water Level Meter	Bar Check	Generator		Hypack
	Computer				
Time (hrs)		Activities			
0810	0845	Transit Gausala to Nara Dam site.			
0845		Land survey started.			
	1815	Land survey terminated and reference station secured.			
1815	1915	Land Survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.457sq.km	Line km: 18.280	Topo: 2.708 sq.km	Line km: 108.336
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey .					
Remarks :					
					
Party Chief			Client Representative		

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

Nara Dam


DPR No. 012

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	16-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Two local assistants	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0800	0845	Transit Gausala to Nara Dam site.			
0845		Land survey started.			
	1815	Land survey terminated and reference station secured.			
1815	1915	Land survey team returned to Gausala.			
1000	1025	Transit Gausala to boat landing point, Nara Dam site.			
1025		Equipment loaded in boat and mobilisation started.			
	1700	Mobilisation completed and boat survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 0.000 sq.km	Line km: 0.000
		Topo: 0.648sq.km	Line km: 25.912	Topo: 3.356 sq.km	Line km: 134.248
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey & bathy survey .					
Remarks : Survey boat mobilised.					
					
Party Chief			Client Representative		

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

Nara Dam


DPR No. 013

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	17-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Two local assistants	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0835	0910	Transit Gausala to Nara Dam site.			
0910		Land survey started.			
	1830	Land survey terminated and reference station secured.			
1830	1905	Land survey team returned to Gausala.			
0800	0825	Transit Gausala to boat landing point, Nara Dam site.			
0825		Bathy survey started.			
	1900	survey terminated and reference station secured.			
1900	1930	Bathy survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.754sq.km	Line km: 30.173	Bathymetry: 0.754 sq.km	Line km: 30.173
		Topo: 0.758sq.km	Line km: 30.320	Topo: 4.114 sq.km	Line km: 164.568
		Weather downtime today: 0 hours		Cumulative weather downtime: 0 hours	
Plan for next 24 hours : Continue with RTK Topo survey & Bathy survey .					
Remarks : Survey boat mobilised.					
					
Party Chief			Client Representative		

 <p style="text-align: center;">DAILY PROGRESS REPORT</p>	Form No.:	Sy01R
	Revision:	01
	Date:	11/07/2014
	Approved By	PKT

Nara Dam


DPR No. 014

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	18-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Two local assistants	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0830	0910	Transit Gausala to Nara Dam site.			
0910		Land survey started.			
	1530	Land survey terminated due to heavy rain and reference station secured.			
1530	1715	Waiting for clear weather at site.			
1715	1810	Land survey team returned to Gausala.			
0800	0830	Transit Gausala to boat landing point, Nara Dam site.			
0830		Bathy survey started.			
	1540	Bathy survey terminated due to heavy rain and reference station secured.			
1540	1830	Waiting for clear weather at site.			
1830	1915	Bathy survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.693sq.km	Line km: 27.730	Bathymetry: 1.447 sq.km	Line km: 57.903
		Topo: 0.301sq.km	Line km: 12.040	Topo: 4.415sq.km	Line km: 176.608
		Weather downtime today: 2 hours		Cumulative weather downtime: 2 hours	
Plan for next 24 hours : Continue with RTK topo survey & bathy survey .					
Remarks :					
					
Party Chief			Client Representative		

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		Revision:	01
		Date:	11/07/2014
		Approved By	PKT

Nara Dam


DPR No. 015

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	19-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Two local assistants	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0800	0845	Transit Gausala to Nara Dam site.			
0845		Land survey started.			
	1830	Land survey terminated and reference station secured.			
1830	1905	Land survey team returned to Gausala.			
0900	0920	Transit Gausala to boat landing point, Nara Dam site.			
0920		Bathy survey started.			
	1815	Bathy survey terminated and reference station secured.			
1815	1930	Bathy survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.777sq.km	Line km: 31.087	Bathymetry: 2.224 sq.km	Line km: 88.990
		Topo: 1.070sq.km	Line km: 42.800	Topo: 5.485 sq.km	Line km: 219.408
		Weather downtime today: 2 hours		Cumulative weather downtime: 2 hours	
Plan for next 24 hours : Continue with RTK topo survey & bathy survey .					
Remarks :					
					
Party Chief			Client Representative		

 <p style="text-align: center;">DAILY PROGRESS REPORT</p>	Form No.:	Sy01R
	Revision:	01
	Date:	11/07/2014
	Approved By	PKT

Nara Dam


DPR No. 016

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	20-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3. Two local assistants	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0800	0830	Transit Gausala to Nara Dam site.			
0830		Land survey started.			
	1900	Land survey terminated and reference station secured.			
1900	1945	Land survey team returned to Gausala.			
0900	0920	Transit Gausala to boat landing point, Nara Dam site.			
0920		Bathy survey started.			
	1845	Bathy survey terminated and reference station secured.			
1845	2015	Bathy survey team returned to Gausala.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.382sq.km	Line km: 15.261	Bathymetry: 2.606 sq.km	Line km: 104.251
		Topo: 0.955sq.km	Line km: 38.200	Topo: 6.440 sq.km	Line km: 257.608
		Weather downtime today: 2 hours		Cumulative weather downtime: 2 hours	
Plan for next 24 hours : Continue with RTK topo survey & bathy survey .					
Remarks : Bathy survey completed.					
					
Party Chief			Client Representative		

 <p style="text-align: center;">DAILY PROGRESS REPORT</p>	Form No.:	Sy01R
	Revision:	01
	Date:	11/07/2014
	Approved By	PKT

Nara Dam


DPR No. 017

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	21-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3.	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level		Heave sensor
	Water Level Meter	Bar Check	Generator		Hypack
	Computer				
Time (hrs)		Activities			
0800	0830	Transit Gausala to Nara dam site.			
0830		Land survey started.			
	1845	Land survey terminated and reference station secured.			
1845	1930	Land survey team returned to Gausala.			
		Note: bathymetric survey completed yesterday.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 2.606 sq.km	Line km: 104.251
		Topo: 0.447sq.km	Line km: 17.880	Topo: 6.875 sq.km	Line km: 275.488
		Weather downtime today: 0 hours		Cumulative weather downtime: 2 hours	
Plan for next 24 hours : Continue with RTK Topo survey.					
Remarks :					
					
Party Chief			Client Representative		

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

Nara Dam


DPR No. 018

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	22-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Prasant Panda		2. Gaurav Sharma		3.	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0800	0830	Transit Gausala to Nara dam site.			
0830		Land survey started.			
	1845	Land survey terminated and reference station secured.			
1845	1930	Land survey team returned to Gausala.			
		Bathy equipment demobbed from survey boat.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 2.606 sq.km	Line km: 104.251
		Topo: 0.728sq.km	Line km: 29.120	Topo: 7.615 sq.km	Line km: 304.608
		Weather downtime today: 0 hours		Cumulative weather downtime: 2 hours	
Plan for next 24 hours : Continue with RTK Topo survey.					
Remarks : Salman and Binu kumar arrived 11:00hrs.					
 Party Chief			 Client Representative		

 <p style="text-align: center;">DAILY PROGRESS REPORT</p>	Form No.:	Sy01R
	Revision:	01
	Date:	11/07/2014
	Approved By	PKT

Nara Dam

DPR No. 019

Client:	Narmada Water Resources, Water Supply & Kalpsar Department		Project No:	P34320	
Vessel:	OSAS SMB		Date:	23-06-2021	
Location:	Nara Dam		Sheet No:	1 of 1	
Party Chief: Mansuri M. I.			Client Rep.		
Survey Personnel:					
1. Salman		2. Binu kumar		3.	
4.		5.		6.	
7.		8.		9.	
10.					
Equipment	RTK System	SBES System	Auto Level	Heave sensor	
	Water Level Meter	Bar Check	Generator	Hypack	
	Computer				
Time (hrs)		Activities			
0810	0830	Transit Gausala to Nara dam site.			
0830		Land survey started.			
	1800	Land survey terminated and reference station secured.			
1800	1845	Land survey team returned to Gausala.			
		Topo survey completed.			
		Today's coverage		Cumulative coverage	
		Bathymetry: 0.000sq.km	Line km: 0.000	Bathymetry: 2.606 sq.km	Line km: 104.251
		Topo: 0.588sq.km	Line km: 13.920	Topo: 8.191sq.km	Line km: 319.248
		Weather downtime today: 0 hours		Cumulative weather downtime: 2 hours	
Plan for next 24 hours : Recce survey for Rudramata Reservoir, Bhuj.					
Remarks : Arsh Mansuri arrived 11:00hrs.					
					
Party Chief			Client Representative		