DML 1914

REPORT OF SURVEY

Ōrākei Basin

Bathymetric Survey

Surveyed 12 June 2019

Prepared for

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Prepared by Discovery Marine Limited

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GLOSSARY

Term	Definition
BM	Bench Mark
CD	Chart Datum
DML	Discovery Marine Limited
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IT	Iron Tube, driven into ground as fixed mark for survey control
MOSS	Maritime Operator Safety System, a safety system for vessels managed by Maritime New Zealand
MSL	Mean Sea Level
QA	Quality Assurance
RL	Reduced Level
ROS	Report of Survey
RTK	Real Time Kinematic (GPS Positioning Method/System)
SBES	Single Beam Echo Sounder
SD	Sounding Datum
SVP	Sound Velocity Profile
Terramodel	Trimble 3D Civil/Survey office software
Trimble HydroPro	Hydrographic survey data acquisition and processing software

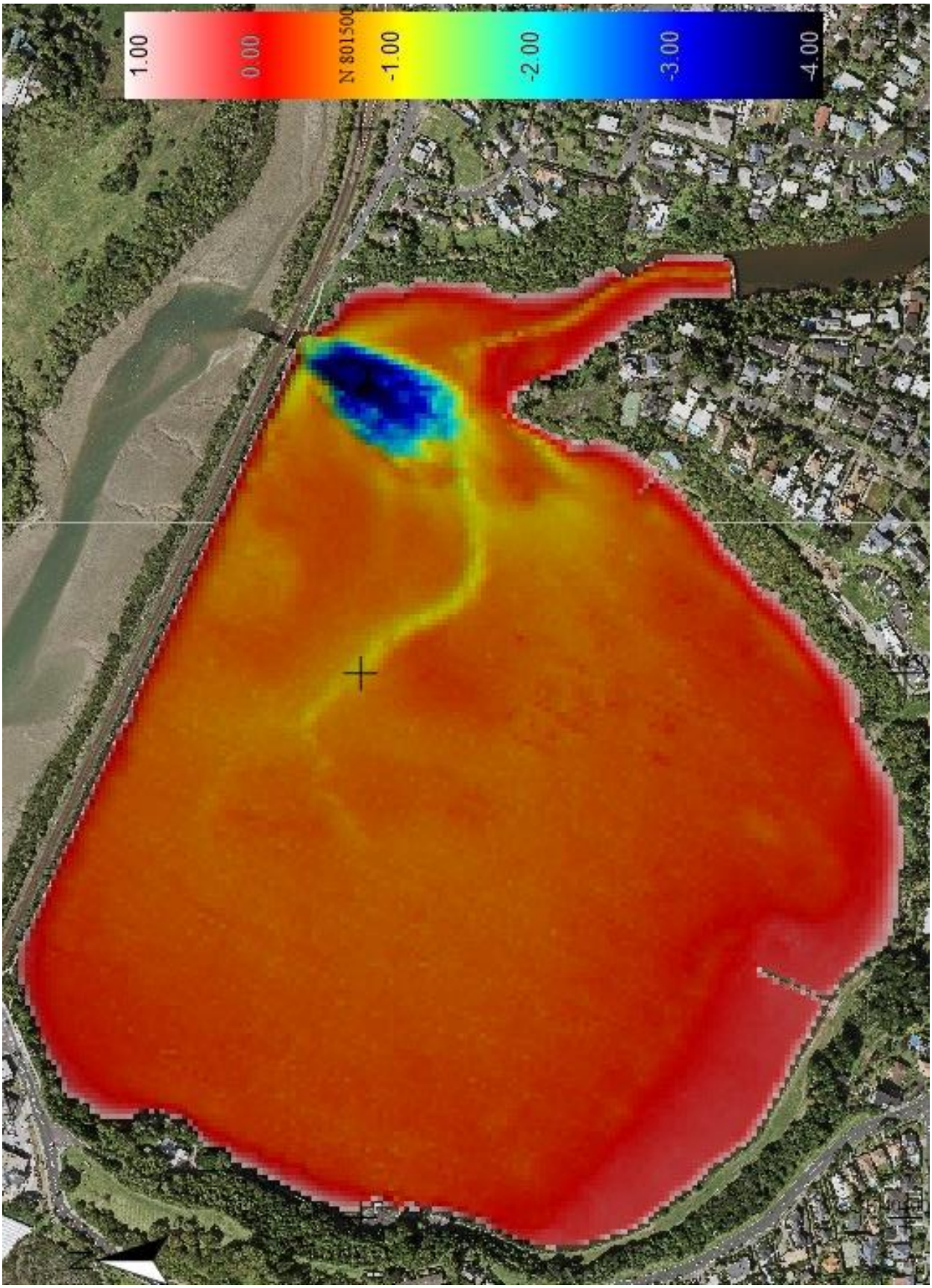

Figure 1: Ōrākei Basin 2019 Bathymetric Survey, 5m Gridded Surface

1. INTRODUCTION

Discovery Marine Limited (DML) was contracted by Auckland Council (AC) to deliver a bathymetric survey of Ōrākei Basin that forms part of the 2018/2019 Ōrākei Local Board work programme. The results of the survey providea a clear picture of the basin bathymetry and has allowed comparisons with a historic basin post dredge dataset from 2001 and 2004. The new survey also provides a baseline dataset captured using modern equipment and methodologies for any future works. Survey fieldwork was undertaken on 12 June 2019 by a team of two DML personnel utilising a single beam echosounder (SBES), Global Navigation Survey System (GNSS) equipment, and DML's 4.4m survey boat *Piper*.

1.1 PROJECT OBJECTIVES

The objectives of the survey were to:

- Survey the bathymetry of Ōrākei basin using modern equipment and methodologies;
- Compare a 5m DTM surface against an existing dataset from 2001 and 2004, and provide an estimate of volumetric change within the basin;
- Deliver Report of Survey and associated digital data

1.2 SUMMARY OF EFFORT

The fieldwork and effort are summarised in the table below. Originally Scheduled for the 11th of June, the survey was instead conducted on the 12th of June due to an unscheduled discharge of the basin. There were no further difficulties in conducting the survey.

Table 1: Summary of Effort

Date	Effort	Weather & Sea Conditions
11 June 2019	Two personnel mobilised onsite; attempt failed due to an unnotified flushing of the basin.	N/A
12 June 2019	Vessel and two personnel mobilised onsite. Completed positioning checks and geodetics. Sounding completed. Demobilised from site.	<5 knots, variable wind direction, occasional showers.
13 June 2019	Data Processing and Reporting	N/A

2. VESSELS & EQUIPMENT

2.1 VESSELS

DML used their survey motorboat *Piper* for this survey, (refer Figure 1). The vessel is a 4.4m Kingfisher design for inshore survey and operated under the New Zealand Maritime Operator Safety System (MOSS). The boat was outfitted with RTK GNSS positioning and a high frequency digital SBES for this survey. Offsets between survey equipment were measured and all sensors fully calibrated on site. Survey data was logged directly into the hydrographic software package, QPS QINSy.

Figure 2: 4.4m Survey Boat 'Piper'

2.2 EQUIPMENT

The equipment used for this survey is listed below:

Table 2: Equipment and software used for the survey

Equipment	Item	Description
Echo Sounder	EU400 Echologger (SBES)	• Frequency: 450 kHz • Depth range: 0.2m – 20m • Beam width: 6^0 • Rated accuracy: Digital = 1mm on all ranges, Analogue = 0.025% of range
Positioning System/s	Trimble RTK GNSS	• Trimble SPS881 Base Station & Trimble SPS882 Rover • Corrections from Base Station received via UHF Radio Link. • Accuracy of RTK system, Horizontal: 10mm + 1ppm, Vertical: 20mm + 1ppm
Survey Software Applications	QPS QINSy, QIMERA	• Data acquisition, version 8.18.3, Processing version 7.6
	Trimble Terramodel 10.6	• Data processing and visualisation

3. METHODOLOGY

3.1 SURVEY PREPARATIONS / SURVEY CONTROL

The following new benchmark was established for the survey;

- **PIN1**, an alloy plug / pin set in the concrete anchor platform of a floating jetty on the edge of the basin near the boat ramp

For further details of the new benchmarks, see Table 3 below.

3.2 BOAT SOUNDING OPERATIONS

Parameters for the survey, including pre-defined line sets, were loaded into the data acquisition software prior to the survey. During sounding, the helmsman was able to accurately steer the survey lines by means of a left/right helmsman display. The system operator continuously monitored the quality of incoming depth and position data.

The echo sounder was calibrated prior to the survey for vessel draught and sound velocity using the bar check method. Lines of sounding were run throughout the basin at 20m intervals with interlines at 10m intervals run for extra definition around the channels. Lines were run perpendicular to the main line set at 50m spacing in order to verify accuracy.

Figure 3: Predefined Navigation Lines for Ōrākei Basin

4. SURVEY CONTROL

4.1 GEODETIC CONTROL

The survey was undertaken using the following geodetic parameters:

System:	New Zealand Geodetic Datum 2000 (NZGD2000)
Projection:	Transverse Mercator (TM)
Grid:	Mount Eden 2000 (EDENTM2000)
Vertical	New Zealand Vertical Datum 2016 (NZVD16)
Geoid Model:	New Zealand Geoid 2016 (NZGEOID16)

4.2 HORIZONTAL AND VERTICAL CONTROL

Table 3: Marks Used for Control of the Survey

Mark Name (LINZ CODE)	Northing (EDENTM2000)	Easting (EDENTM2000)	Height (NZVD16)	Comments
C66U	801718.413	404015.584	20.810	Existing Control
CCG4	801239.614	404979.232	32.230	Existing Control
EFXA	801175.125	403972.645	16.090	Existing Control
PIN1	801478.976	404005.290	2.033	New check benchmark installed for survey

5. DATA

5.1 EDITING & PROCESSING

All sounding data was initially edited and processed in the QPS Qimera Processing suite. Corrections for RTK height were applied to the depths and then each survey line was then visually inspected for outlying points, which were removed from the dataset.

Edited data was exported into Terramodel software, from which the final depth data set has been compiled. An A1 Standard Sounding Sheet at scale 1:1750 accompanies this report and is colour contoured at 0.5m intervals. Soundings on this sheet have been thinned to approximately 5m intervals for plotting using a minimum depth bias. A high resolution 2D colour graded GeoTIFF image and Google Earth KML file, as depicted in Figure 1 and Figure 5 below also accompanies this report.

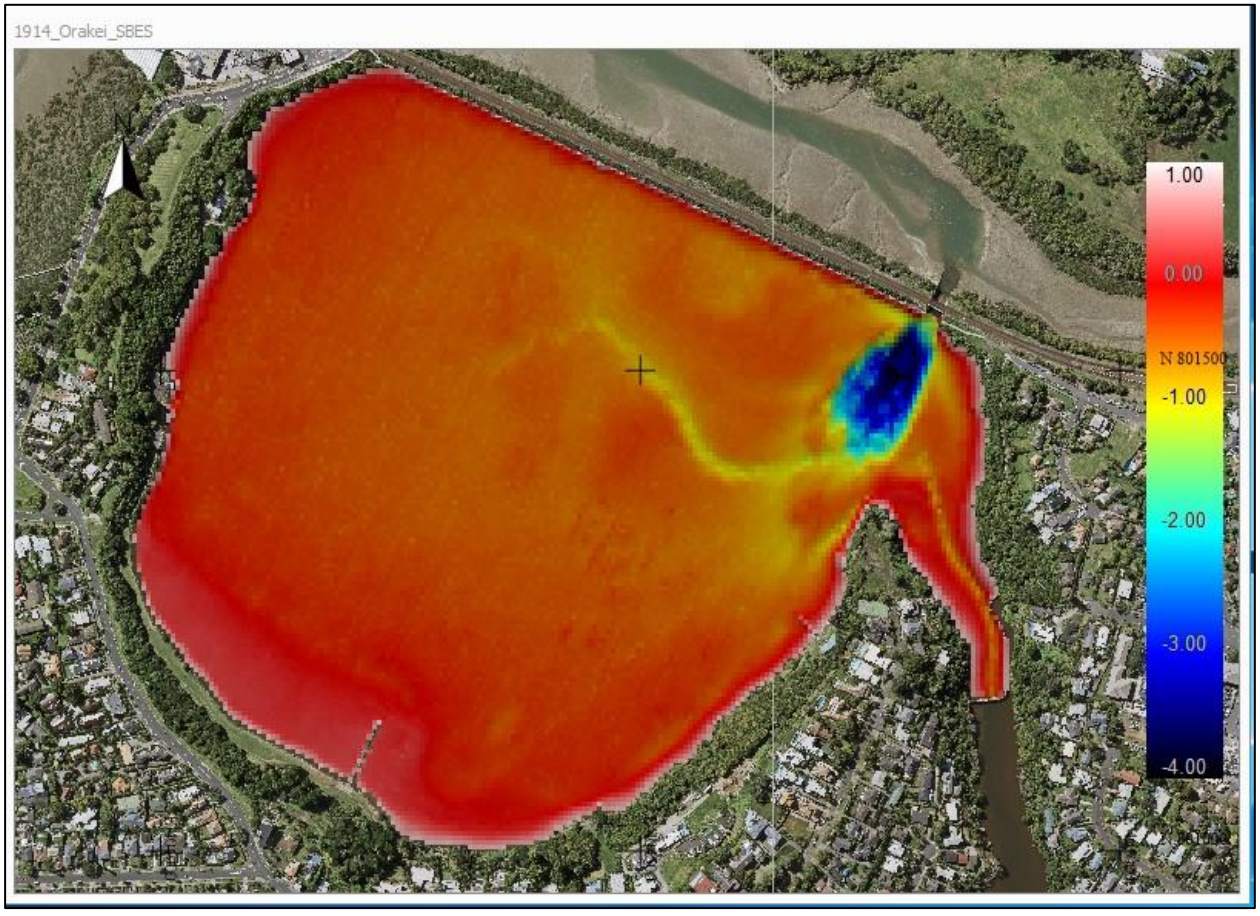

Figure 4: Ōrākei Basin 2019 Bathymetric Survey, 5m Gridded Surface

5.2 ACCURACY OF SURVEY DATA

Accuracy of the depth data has been checked via comparisons with the cross lines. Spot checks of the depth data confirmed that final soundings generally agreed to within +/-0.05m at the 95% confidence level.

5.3 RETENTION OF DATA

DML will retain copies of the project deliverables, including source data files, on its servers for a period of 12 months from completion of the project. The data will then be archived to a digital medium and retained for 5 years. After the initial 12-month period client requests to access and supply project data will incur a fee.

6. COMPARISON WITH HISTORIC DATA

6.1 2004 SURVEY DATA

Bathymetric data from previous DML surveys in 2001 and 2004 have been combined to create a DTM for comparison with the 2019 dataset. The previous surveys were undertaken on the Mount Eden Circuit 1949, and Auckland MSL datums, and have been converted to Mount Eden 2000 (EDENTM2000) and New Zealand Vertical Datum 2016 (NZVD16) for direct comparison. The combined DTM was used to generate a 5m gridded surface, which is displayed in Figure 5 below as a 2D colour graded image. Areas of dredging are clearly depicted on the western and northern edges of the basin. Some data artefact is evident around the central channels, most likely caused by areas of sparse data.

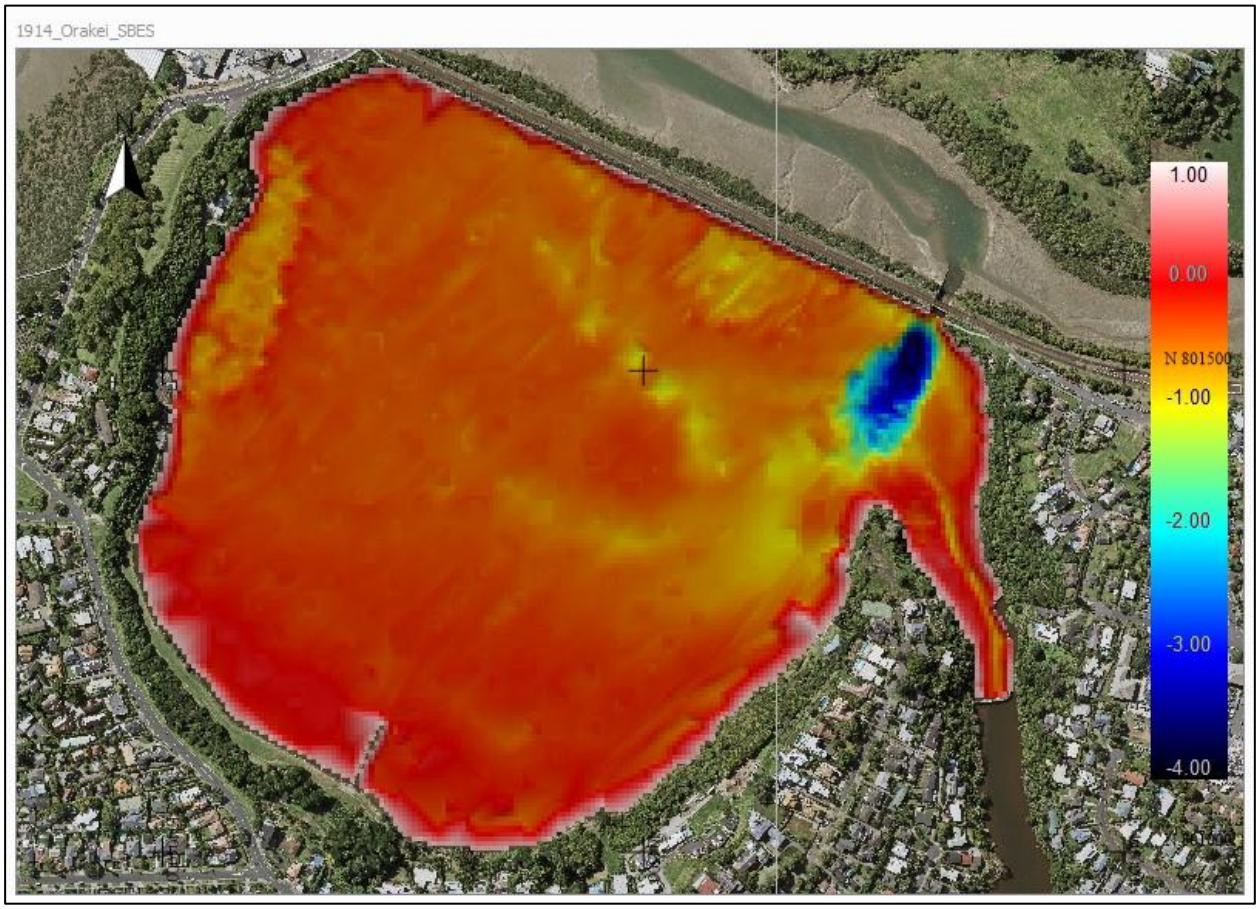

Figure 5: Ōrākei Basin combined 2001 and 2004 surveys by DML, 5m Gridded surface.

The 2004 dataset has been used as a reference layer to create a Surface Difference image, comparing sedimentation and erosion against the 2019 dataset. The Surface Difference image is depicted in Figure 6 below.

Sedimentation in the areas of dredging is clear on the western and northern edge, as well as general shoaling on the southern side. The image also depicts some scouring and expansion of the deep area near the sluice gate and redistribution of material from the basin centre to the edges.

While best efforts have been made to accurately compare the two surfaces, there is some variability due to the quality of the GPS positioning available at the time of the previous surveys, the methodology of the previous surveys and data gridding artefact on the extremities of the surfaces.

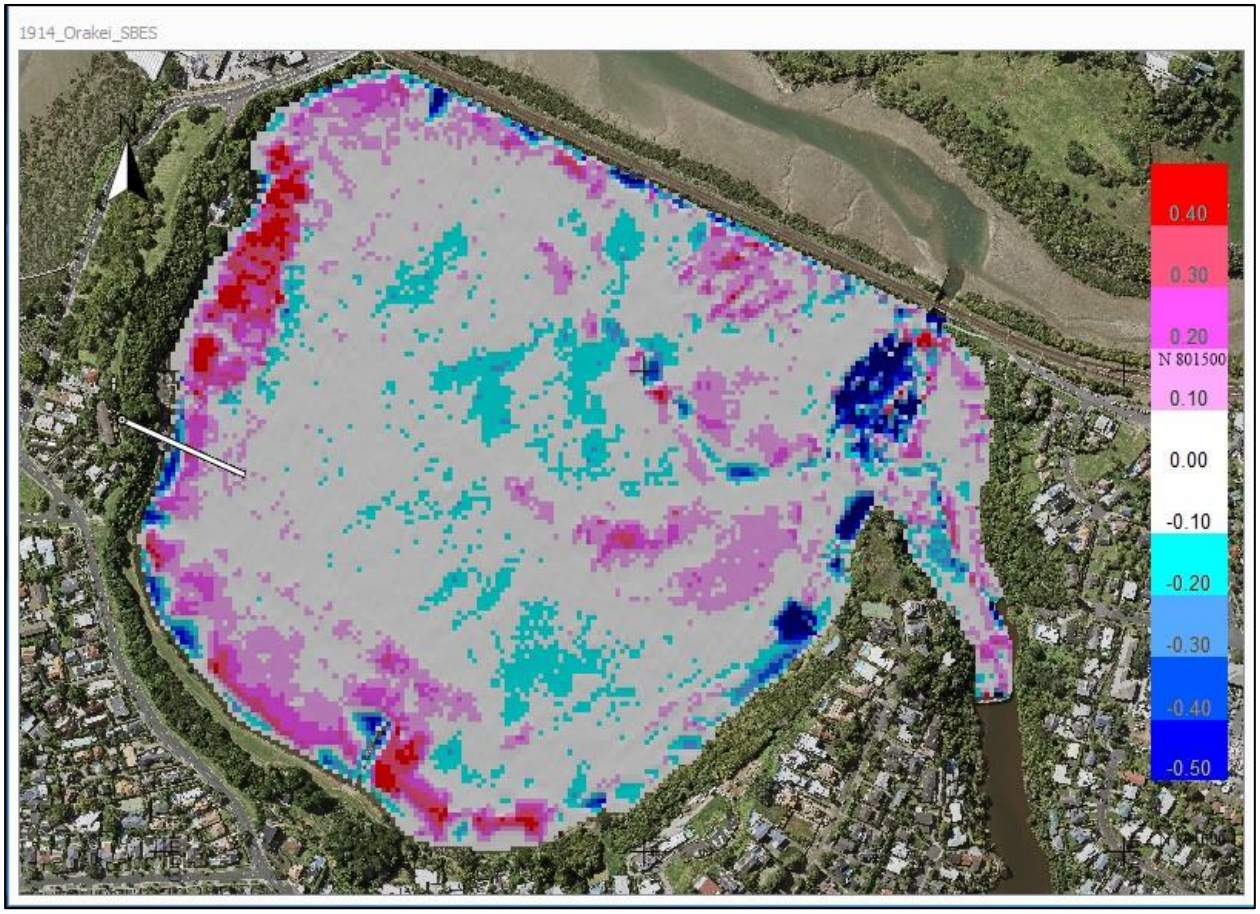

Figure 6: 2019 vs 2004 Surface Difference Image

6.2 VOLUME CACLULATION

The two 5m gridded surfaces have been used to calculate a volumetric difference and results are tabulated below.

Table 4: Volume Calculations

Area	Net Volumetric Difference (m³)	Above 2004 Data Volume (m³)	Below 2004 Data Volume (m³)	Difference Mean Layer
Ōrākei Basin	5333	27969	22636	0.01

The volume calculation indicates 27,969 m³ above (sedimentation) the 2004 surface and 22,636 m³ (erosion) below the 2004 surface, resulting in a net difference of 5,333 m³ of sedimentation in the basin. This roughly equates to 355 m³ annually.

7. SUMMARY

Excellent results were obtained from the survey and all equipment operated well. There were no significant issues to report.

Appendix A List of Survey Deliverables

A.1 Digital Deliverables via DropBox link

- 5m Grid_XYZ
- CAD DTM
- GeoTIFF and KML
- Images
- PDF Survey Sheet
- Raw Data_XYZ
- Volume Report
- DML ROS 1914 Orakei Basin.pdf