

Attn:

Department of Planning, Housing and Industry

Department of Climate Change, Energy, the Environment and Water – Biodiversity Conservation Division

Resources Regulator - Subsidence Division.

Via: [Major Projects Planning Portal](#)

CHAIN VALLEY COLLIERY (SSD-5465) - BATHYMETRIC SCANNING MARCH 2024

Please find attached a report of the bathymetric survey completed above Miniwall series S2 to S5 within Lake Macquarie in March 2024. Results of the survey are provided in **Attachment A**.

Monitoring in March 2024 identified that level 1 of the Chain Valley Colliery Subsidence Management Plan Trigger Action Response Plan (**Attachment B**) of the approved Extraction Plan (S5 and NMA Pillar Extraction) was triggered. Monitoring in March 2024 indicated no observed changes from September 2023 bathymetric monitoring. Extraction of the Miniwall panel series S2-S5 was completed in August 2021.

A survey report was prepared by Astute Surveying who completed the bathymetric (hydrographic) survey in Lake Macquarie. The survey report has been included as **Attachment C**.

Table 1 Miniwalls S2-S5 Measured Subsidence Post-Extraction

Survey Month and Year	Maximum seabed height decrease observed above S2-S5 miniwalls
September 2021 ¹	450 mm
September 2022 ¹	600 mm
September 2023	500-550 mm
March 2024	500-550 mm

¹ Between March 2023 and September 2023 monitoring it was identified that the program utilised for hydrographic surveys on Lake Macquarie had a software error in the programming and altered height values by approximately 0.15m. In September 2023 modelling this correction was applied to the data set to be utilised there-after.

SUBSIDENCE REQUIREMENTS

Biodiversity	
Threatened species or endangered populations	Negligible environmental consequences
Seagrass beds	Negligible environmental consequences including: - Negligible changes in size and distribution of seagrass beds; - Negligible change in the function of seagrass beds; and



	Negligible change to the composition or distribution of seagrass species within seagrass beds.
Mine Workings	
First workings under an approved Extraction Plan beneath any feature where performance measures in this table require negligible environmental consequences.	To remain long-term stable and non-subsiding.
Second Workings	To be carried out only in accordance with an approved extraction plan.

MONITORING

Delta Coal will continue 6 monthly bathymetric surveys over the area until workings are considered to have stabilised and 3 years post-extraction (i.e. September 2024).

- Delta Coal undertakes annual foreshore monitoring at Summerland Point adjacent Miniwalls S2-S5 (monitoring lines 40 and 41). The most recent foreshore monitoring in February 2024 has indicated less than 20mm of ground movement from the baseline surveys prior to secondary extraction.
- Delta Coal has continued annual seagrass monitoring, previous monitoring undertaken in June 2023 indicated that there was no observed impact to seagrass as a result of subsidence with further monitoring scheduled for June/July 2024.
- Benthic communities monitoring undertaken in March 2024 did not identify any impact to benthic communities as a result of subsidence.

THIRD PARTY GEOTECHNICAL REVIEW

Delta Coal commissioned a third-party geotechnical review in 2023 (Byrnes Geotechnical) of the subsidence prediction based on the monitoring data:

- The review identified that there are likely issues of accuracy and precision in the bathymetric surveying, when compared to land surveying techniques.
- It was noted that the bathymetric surveys reported subsidence distant from mine workings which indicates that there is a problem with accuracy in the surveys. The geotechnical review reported that there appears to be an offset error of approximately 150mm, in that areas distant from miniwalls (and in some places where there has been no mining at all such as north east of S5) are consistently reporting deformations in excess of 150mm.
- It was noted that the bathymetric measurements have a precision of ± 100 mm, with subsidence determined by the difference between 2 measurements indicating a precision of ± 200 mm.



- The surveys transects and influence of the systems accuracy were also observed in the bathymetric survey data via the pronounced lineation in the direction of the survey distant from the mining activity.
- Corrections were applied to the bathymetric data in the geotechnical review of +150mm based upon comparisons of bathymetric results in areas of no extraction and outside of the plausible zone of influence of extraction. This indicated an S_{MAX} of ~500mm.
- Comparison of Byrnes Geotechnical predictions from September 2022 to March 2023 showed an increase in S_{MAX} from 430mm to 445mm were unable to be commented on as the 15mm was less than the resolution of the bathymetry.
- It was considered that the level 1 trigger (>500mm) had been met and there is possibly another 50mm of subsidence yet to develop with negligible chance of exceeding the level 2 trigger (>780mm).
- Review of bathymetric results in the northern mining area first workings regions noted that the reported results were greater than the 150mm offset observed and that this may be a result of either the low precision bathymetry, or, potential changes in seabed conditions.

CONCLUSIONS

There was no observable change in bathymetric results between September 2023 and March 2024 indicating stabilisation of subsidence resulting from secondary extraction in miniwalls S2-S5. In-line with geotechnical predictions made in the third-party geotechnical review, a maximum of 500-550 mm of vertical subsidence has been observed over the S2-S5 panels. Further bathymetric scanning will be conducted in September 2024.

Please contact me on (02) 4358 0800 or at lmcwha@deltacoal.com.au if you have any questions or wish to discuss.

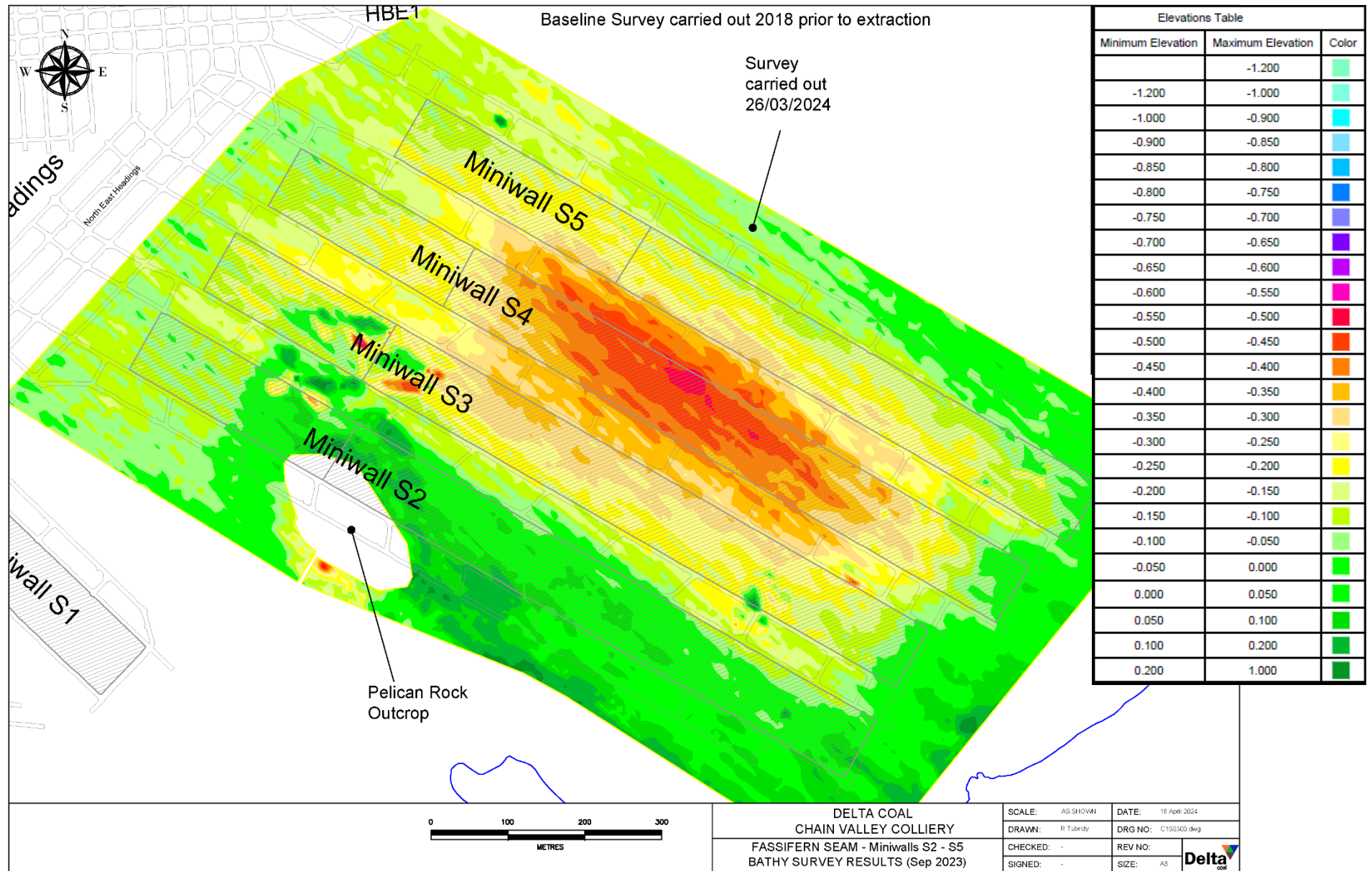
Yours sincerely

Lachlan McWha – Delta Coal Environmental Compliance and Approvals Coordinator

22/05/2024



ATTACHMENT A – BATHYMETRIC SURVEY RESULTS MARCH 2024





ATTACHMENT B – MINIWALL S5 AND NMA SUBSIDENCE MANAGEMENT TRIGGER ACTION RESPONSE PLAN

		CHAIN VALLEY COLLIERY- SUBSIDENCE MANAGEMENT TRIGGER ACTION RESPONSE PLAN (TARP) SUBSIDENCE MANAGEMENT NORTHERN MINING AREA DOMAIN (S5 and Northern Pillar Area)					Revision 3 - 8/3/2021
		DETAILED PERFORMANCE INDICATORS	MONITORING REQUIREMENTS	CONTAINMENT / REMEDIATION MEASURES	ADAPTIVE MANAGEMENT MEASURES	CONTINGENCY PLANS	
	SUBSIDENCE PARAMETERS (Bathymetric Survey)	Normal Subsidence ≤ 500mm	As per Subsidence Monitoring (SM) Program				
		Trigger Level 1 Subsidence > 500mm to ≤ 780mm	6 monthly surveys until subsidence stabilises, then as per SM Program		Update subsidence predictions based on monitoring data Identify controlling mechanisms Review potential change in impact on natural and built features & update management plans if required Implement further controls as applicable from review	Review ability to limit further increases based on understood mechanisms including: Extraction heights, panel widths, panel recovery	
		Trigger Level 2 Subsidence >780mm	6 monthly until subsidence stabilises then as per SM Program	Review if increase likely to create impact at foreshore/seagrass or exceed final subsidence prediction Notify immediately DPIE if incident and within 7 days for non-compliance Notify RR, BCD, affected landholders or infrastructure owner	Update subsidence predictions based on monitoring data Update impact assessment on natural and built features	Immediately review mine plan including panel width, pillar widths, extraction height and panel length Consult with DPIE and RR	
		Normal <20mm recorded movement	Monitoring as per SM Program				
		Trigger Level 1 <20mm recorded movement with slow (3-5mm/month) creep	Validate increase with additional monthly survey/s then as per SM program		Update subsidence predictions based on monitoring data Identify controlling mechanisms Review potential change in impact on natural and built features & update management plans if reqd		
		Trigger Level 2 >20mm recorded movement (associated with mining)	Implement Ecological Monitoring program for HWMSB exceedance Increase frequency of subsidence parameter monitoring to until rates stabilises. Then as per SM program	Cease extraction in panel in question until review conducted in consultation with DPIE and DRE Notify immediately DPIE if incident and within 7 days for non-compliance Notify RR, OEH, affected landholders or infrastructure owner	Investigate cause of exceedance (ie validate impact due to FAS extraction or not). Update subsidence predictions based on monitoring data Update impact assessment on natural and built features	Provide offsets for any ecological communities or threatened species in the HWMSB if impacts detected Immediately review mine plan including panel width, pillar widths, extraction height in consultation. Consult with DPIE and RR	
	BUILT FEATURES	Normal No damage requiring remediation	Monitoring as per Subsidence Monitoring Program				
		Trigger Level 1 Subsidence parameters exceeded such that Fassifern workings indicated to have potential impact on foreshore Private bore capacity reduced	RMS routine monitoring navigation markers Monitoring as per BFMP (Built Feature Management Plan)	Review navigational marker freeboard and notify Transport for NSW if impacted Notify immediately DPIE if incident and within 7 days for non-compliance Notify RR and potentially affected landholders or infrastructure owner. Provide temporary water if required.		Develop BFMP in conjunction with owner for built features surrounding potential impact area	
		Trigger Level 2 Impact to built feature	Monitoring as per BFMP	Cease extraction in panel in question until review conducted in consultation with DPIE and RR Assist owner with information to aid in Subsidence Advisory NSW claim in accordance with BFMP	Update impact assessment based on observed damage	Immediately review mine plan including panel width, pillar widths Consult with DPIE and RR Review and update Extraction Plan	



		CHAIN VALLEY COLLIERY- SUBSIDENCE MANAGEMENT TRIGGER ACTION RESPONSE PLAN (TARP) SUBSIDENCE MANAGEMENT NORTHERN MINING AREA DOMAIN (S5 and Northern Pillar Area)				
		DETAILED PERFORMANCE INDICATORS	MONITORING REQUIREMENTS	CONTAINMENT / REMEDIATION MEASURES	ADAPTIVE MANAGEMENT MEASURES	CONTINGENCY PLANS
Triggers	PUBLIC SAFETY (Foreshore area and steep slopes)	Normal No impact	Monitoring as per SM Program and Public Safety MP			
		Trigger Level 1 Subsidence parameters exceeded such that Fassifern workings indicated to have potential impact on foreshore	Increase visual inspection of foreshore to daily until public safety risk quantified as low Inspect foreshore in vicinity of steep slopes and retaining walls for signs of movement ASAP. Implement TARP as required.		Review potential of flooding and drainage impacts about foreshore or stability concerns at steep slopes/ retaining walls. Undertake appropriate risk assessments	
		Trigger Level 2 Area around foreshore becomes unstable / shows signs of mining induced impact Flooding or drainage impacts considered likely as result of Fassifern extraction	Visual inspections frequency to be commensurate with level of risk (ie increase until controls put in place) Inspect foreshore in vicinity of other steep slopes and retaining walls for signs of movement ASAP. Implement TARP as required.	Cease extraction in panel in question until review conducted in consultation with DPIE and RR Immediately implement temporary safety controls (barricades and signage available from mine site). Arrange for assistance and stay at site if immediate risk to public exists Inform ECC as to result of inspection Geotechnical Engineer to inspect area immediately. Notify LMCC and Transport for NSW Notify BCD, DPIE and RR	Implement longer term safety controls	Foreshore stabilisation of unsafe areas in consultation with LMCC/CC Council and RR as soon as possible Flooding and drainage rectification works in consultation with infrastructure owner as soon as possible
	BENTHIC COMMUNITIES	Normal ANOVA/ANOSIM >5%	Monitoring as per Benthic MP			
		Trigger Level 1 ANOVA/ANOSIM level is approaching 5%	Liaise with monitoring consultant & undertake internal review to determine if impacts are related to mining Arrange a peer review of the monitoring results and statistical analysis			
		Trigger Level 2 ANOVA/ANOSIM <5%	Undertake toow up monitoring at affected sites to obtain confirmation of impacts. Incident Report to be completed and distributed to relevant agencies	Notify DPIE-Fisheries, LMCC and DPIE Notify immediately DPIE if incident and within 7 days for non-compliance	Consult with relevant authorities about monitoring and management controls	Consult with relevant authorities to identify if offsets are required and how these are to be implemented.
	SEAGRASS	Normal Negligible impact	Monitoring as per Seagrass MP			
		Trigger Level 1 Approaching 20% decline in condition Approaching 20mm of additional mine induced subsidence within mapped seagrass	Liaise with monitoring consultant & undertake internal review to determine if impacts are related to mining		Review if variation is within broader background variation range for the site.	
		Trigger Level 2 >20% decline in conditions from year baseline survey >150mm of additional mine induced subsidence at survey location	Incident Report to be completed and distributed to relevant agencies	Notify immediately DPIE if incident and within 7 days for non-compliance Notify DPIE-Fisheries and LMCC	Consult with relevant authorities about monitoring and management controls	Consult with relevant authorities to identify if offsets are required and how these are to be implemented.
	THREATENED SPECIES AND ENDANGERED POPULATIONS	Normal Negligible environmental consequences	Monitoring as per Subsidence Monitoring Program, Benthic Communities Management Plan and Seagrass Management Plan			
		Trigger Level 1 As per Seagrass and Benthic Community Management Plans Monitoring Level 1 Triggers	Liaise with monitoring consultant & undertake internal review to determine if impacts are related to mining and greater than negligible environmental consequences.		Review if variation is within broader background variation range for the site.	
		Trigger Level 2 As per Seagrass and Benthic Community Management Plans Monitoring Level 2 Triggers >780mm subsidence	Incident Report to be completed and distributed to relevant agencies	Notify immediately DPIE if incident and within 7 days for non-compliance Notify DPIE-Fisheries and LMCC	Initiate ecological monitoring program to assess the impacts to ecological communities and threatened species. Consult with relevant authorities about monitoring and management controls	Consult with relevant authorities to identify if offsets or rehabilitation is required and how this is to be implemented.
	WATER INFLOW	Ongoing monitoring of water inflows and site water management through operational Water Management and Monitoring TARP process				



		Revision 3 - 8/03/2021 CHAIN VALLEY COLLIERY- SUBSIDENCE MANAGEMENT TRIGGER ACTION RESPONSE PLAN (TARP) SUBSIDENCE MANAGEMENT NORTHERN MINING AREA DOMAIN (S5 and Northern Pillar Area)
Responsibilities	Environment Compliance Coordinator	Coordinate and undertake all environmental monitoring as outlined in TARP Implement TARP actions in consultation with regulatory agencies as/required Notify the relevant Government agencies and other affected parties of exceedance of performance measures Coordinate Subsidence Review as a part of Annual Environmental Reporting Arrange for subsidence prediction and impact updates as required Update Extraction Plan as required Audit public safety controls regularly
	Mine Surveyor	Coordinate subsidence monitoring as outlined in TARP Review subsidence monitoring results against TARP triggers Inform relevant stakeholders as to subsidence monitoring trends and exceedances
	Mine Manager	Ensure adequate financial and personnel resources are made available for implementation of this plan Review and approve required mine plan changes



ATTACHMENT C – ASTUTE SURVEYING BATHYMETRIC SURVEY REPORT MARCH 2024



HYDROGRAPHIC SURVEY REPORT

Lake Macquarie

NSW

For

Delta Coal

Surveyed on 18-20 March 2024

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General Information

Survey Class	IHO S44 – Special Order
Hydrographic Surveyors	Ben Gray CPHS1 Paul Davies
Survey Date	18-20 March 2024
Purpose of Survey	Hydrographic Survey
Port	Lake Macquarie
Regional Harbour Master	None
Survey Areas	Delta Coal

Reference documents

Rev No	Issue Date	Revision Details	Prepared By	Reviewed By	Approved By
0	27/03/2024	For review	Ben Gray	Paul Davies	Ben Gray

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ABBREVIATIONS

The following abbreviations may be used in this document

AAPMA	Association of Australian Port and Marine Authorities
AGD	Australian Geodetic Datum
AHD	Australian Height Datum
AHSCP	Australasian Hydrographic Surveyors Certification Panel
AMG	Australian Map Grid
BM	Bench Mark
CD	Chart Datum
CoG	Vessel Centre of Gravity
CoR	Vessel Centre of Rotation
CPHS1	Certified Practicing Hydrographic Surveyor Level 1
DGPS	Differential Global Positioning System
DTM	Digital Terrain Model
GAMS	GPS Azimuth Measurement Subsystem
GDA94	Geodetic Datum Australia 1994
GDA2020	Geodetic Datum Australia 2020
GNSS	Global Navigation Satellite System
HAT	Highest Astronomical Tide
ICSM	Intergovernmental Committee on Surveying and Mapping
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
kHz	Kilohertz
LAT	Lowest Astronomical Tide
MBES	Multi Beam Echo Sounder
MGA94	Mapping Grid of Australia 1994
MSL	Mean Sea Level
MRU	Motion Reference Unit
PDOP	Position Dilution of Precision
POSMV	Position Orientation System for Marine Vessel
PSM	Permanent Survey Mark
PTA	Performance Test Area
RL	Reduced Level
RMSE	Root Mean Square Error
RMS	Refer Manufacturer Specifications
RTK GPS	Real Time Kinematic Global Positioning System
SSSI	Surveying and Spatial Sciences Institute
SBES	Single Beam Echo Sounder
SSM	State Survey Mark (PSM)
SVP	Sound Velocity Profile
SVS	Sound Velocity Sensor
TBM	Tidal Bench Mark / Temporary Benchmark
UPS	Uninterruptible Power Supply
UTM	Universal Transverse Mercator
VDOP	Vertical Dilution of Precision
VRF	Vessel Reference Frame
WGS84	World Geodetic System 1984

1 INTRODUCTION

Astute Surveying Pty Ltd has been contracted by Delta Coal to undertake hydrographic monitoring surveys on Lake Macquarie, NSW. This report covers the GNSS control used, vessel, equipment, survey method and checks conducted while undertaking the surveys.

This survey was undertaken in accordance with and exceeds the IHO S-44 Standards for Hydrographic Surveys and the AAPMA - Standards for Hydrographic Surveys within Australian Waters.

2 STANDARDS

This survey complies with the latest versions of relevant codes and standards for:

- IHO S-44 - Standards for Hydrographic Surveys
- AAPMA - Standards for Hydrographic Surveys within Australian Waters
- ICSM - Australian Tides Manual - Special Publication No.9

3 PROJECT PARTICULARS

3.1 Client

Delta Coal

3.2 Project Details

Delta Coal Mine Site in the navigable waters of Lake Macquarie

The hydrographic surveys were carried out in compliance with the standards above.

4 PERSONEL

Surveys were directly supervised on-site by a CPHS Level 1 Surveyor.

Ben Gray (Supervising)
CPHS Level 1 (SSSI AHCP) MSSSI
Bachelor of Spatial Sciences MSQ
Astute Surveying Pty Ltd
18+ Years of continuous hydrographic survey operations

Paul Davies (Surveyor)
Survey Technician / Coxswain
15 + Years working in the hydrographic and spatial industry

5 PROJECT HORIZONTAL AND VERTICAL DATUM

5.1 Horizontal Datum

The project horizontal datum used is the Geocentric Datum of Australia 94 (GDA94) with coordinates projected onto the Map Grid of Australia 94 (MGA94) Zone 56.

Table 2 below lists the key settings for the datum.

PARAMETER	VALUE
Datum	Geocentric Datum of Australia 94 (GDA94)
Reference Frame	International Terrestrial Reference Frame 1992 (ITRF1992)
Ellipsoid	GRS80
Semi Major Axis	6,378,137.0 meters
Inverse flattening	298.257222101
Projection	Map Grid of Australia 94 (MGA94)
Projection Method	Universal Transverse Mercator (UTM),
Zone	56
Latitude of Origin	0° S
Longitude of Origin	153° E
Scale factor at Origin	0.9996
False Easting	500,000m
False Northing	10,000,000m

Table 1: MGA94 parameters

5.2 Vertical Datum

Depths were determined relative to the GDA94 ellipsoid, Australian Height Datum

Ausgeoid09 was utilised.

6 SURVEY CONTROL

The existing Smartnetaus (MNPk) GPS Base Station located at Mannering Park was used as the Primary RTK GPS Base Station.

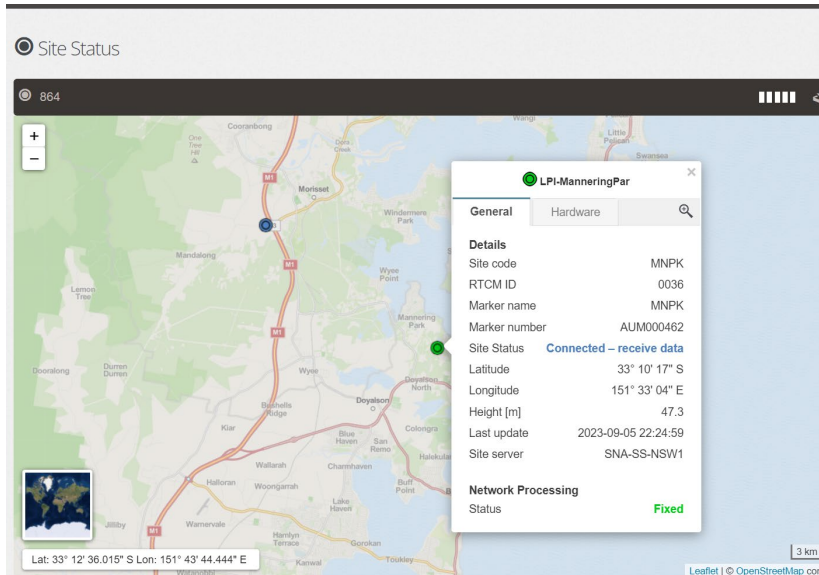


Table 2: GNSS base station details

7 SURVEY EQUIPMENT

Primary Survey Equipment and Software

7.1 Survey Vessel

The hydrographic survey was carried out from Astute Surveying's survey vessel "Coastal Explorer".

Type:	Aluminium Single hull. Enclosed cabin
Survey:	Class 2C – EX40
Length:	6m
Beam:	2.5m
Draft:	0.3m
Propulsion:	200hp Suzuki outboard
Registration:	AHF540C

7.2 Bathymetry Systems

Type:	Norbit i77h
Transducer Frequencies:	200 to 400 kHz (400 kHz used)
Beams:	512 Beams of 1.0° x 1.0° (at 400 kHz)
Motion Compensation:	POSMV Ocean Master
Pitch/Roll Stabilisation:	Roll stabilised

Ping Rate:	26.6 per sec @ 20 m Range Setting
Beam Mode:	Equi-distant
Installation:	Over the Side
Limiting Sea Conditions:	Primarily aeration of transducers at > 1.5m swell

The MBES sonar head is mounted on an over the side pole located on the port side, close to midship and 1.3m from the centreline. The pole and mounting arrangement is designed to minimize flex and utilises specialised brackets on the side of the hull to ensure the pole locates to an identical position each time it is attached. The mount has been tested (by subsequent bar checks and patch tests) to accurately fit back to its original position each time the vessel is used for survey.

7.2.1 Position and motion sensor

- PosMV Oceanmaster
- RTK GPS primary antenna mounted on the cabin roof with the secondary antenna mounted on the opposite side of the cabin roof, both with unimpeded access to satellites.

7.2.2 RTK Rover

- Trimble SPS 985 RTK Receiver

7.2.3 Radio RTK correction data receiver

- 4G

7.2.4 Sound Velocity Probe

- AML Base X SVP – direct Sound Velocity profile measurement
- AML Micro-X SVP at the MBES Transducer

7.2.5 Acquisition and Processing Software

Hysweep 2023 is a powerful and specialised package by Hypack for multibeam data collection and processing. It allows users to design a survey, for both single and multibeam data, collect and edit the data, and post process it to create contours, cross-sections, volumes, TIN Models etc.

7.2.6 Calibration

Prior to any survey work the following checks were made to ensure the equipment was returning the correct information to the survey software. The data entered in the software was also checked by carrying out these tests.

7.2.7 Base Station

The Base Station used for the survey was the Mannering Park. The RTK correction service was Smartnetaus

The base station operation was checked by measuring with a Trimble SPS985 RTK receiver at known high order bench mark using constrained centring and logging for a minimum 180 epochs. This was to test the

horizontal and vertical position of the Mannering Park Base (MNPB). An accurate result proved the integrity of the Base Station and GPS rover unit.

Bench Mark	MGA2020 East	MGA2020 North	AHD71
pm44792	363630.294	6331082.071	13.369
pm44792_stkd	363630.251	6331082.067	13.342
Difference	-0.043	-0.004	-0.027

Table 3: Benchmark position check results

As can be seen from the results above, the Mannering Park Base Station was outputting the correct RTK corrections.

7.2.8 Heading Check

A GPS Azimuth Measurement Subsystem (GAMS) test was carried out on the system before surveys commenced.

7.2.9 Position Check

Position checks were carried out on the reference point of the IMU using the calibrated RTK Rover.

These checks were used to test the positioning, the application of the heading and the measurement of the vessel offsets.

Easting from Hysweep	Northing from Hysweep	Easting from Rover	Northing from Rover	Difference East	Difference North
363512.14	6331664.28	363512.175	6331664.318	0.035	0.038
			average	0.035	0.038

Table 4: IMU position and heading check.

7.2.10 Patch test

Prior to the survey, patch tests were run in a suitably deep area within survey area.

DATE	LATENCY	ROLL	PITCH	YAW
18/03/2024	0°	0.20°	0.00°	0.00°

Table 5: Patch Test Results

7.2.11 Bar Check

Bar checks were carried out on the beams close to the nadir of the Norbit Wing Head Multibeam using a stainless-steel plate lowered over the side of the vessel directly below the transducer to a measured distance.

A MBES measurement was taken over six different measurements all at 2m depth.

Bar depth below waterline (m)	Bar RL	Processed data RL	Diff
2	1.965	1.95	0.015
2	1.992	1.98	0.012
2	1.96	1.97	-0.01
		Average Difference	0.006

Table 6: Bar Check Summary of Results

7.2.12 Sound Velocity Profile (SVP)

Manual SVP was compared with the sound velocity sensor (SVS) on the MBES Transducer. Regular consistency between the SVP and SVS was noted. There was satisfactory correlation between the down cast and up cast. In this depth, the system was considered adequate when the difference between SVP and SVS was less than 2m/s.

8 SURVEY METHOD

The survey was carried out to meet the following requirements:

- Horizontal Uncertainty $\pm 0.5\text{m}$ @ 95% confidence
- Vertical Uncertainty $\pm 0.15\text{m}$ @ 95% confidence
- 0.5m object detection (minimum of 3 hits in the along track direction)
- 100% coverage over the survey area in depths below 5m

8.1 Survey Coverage

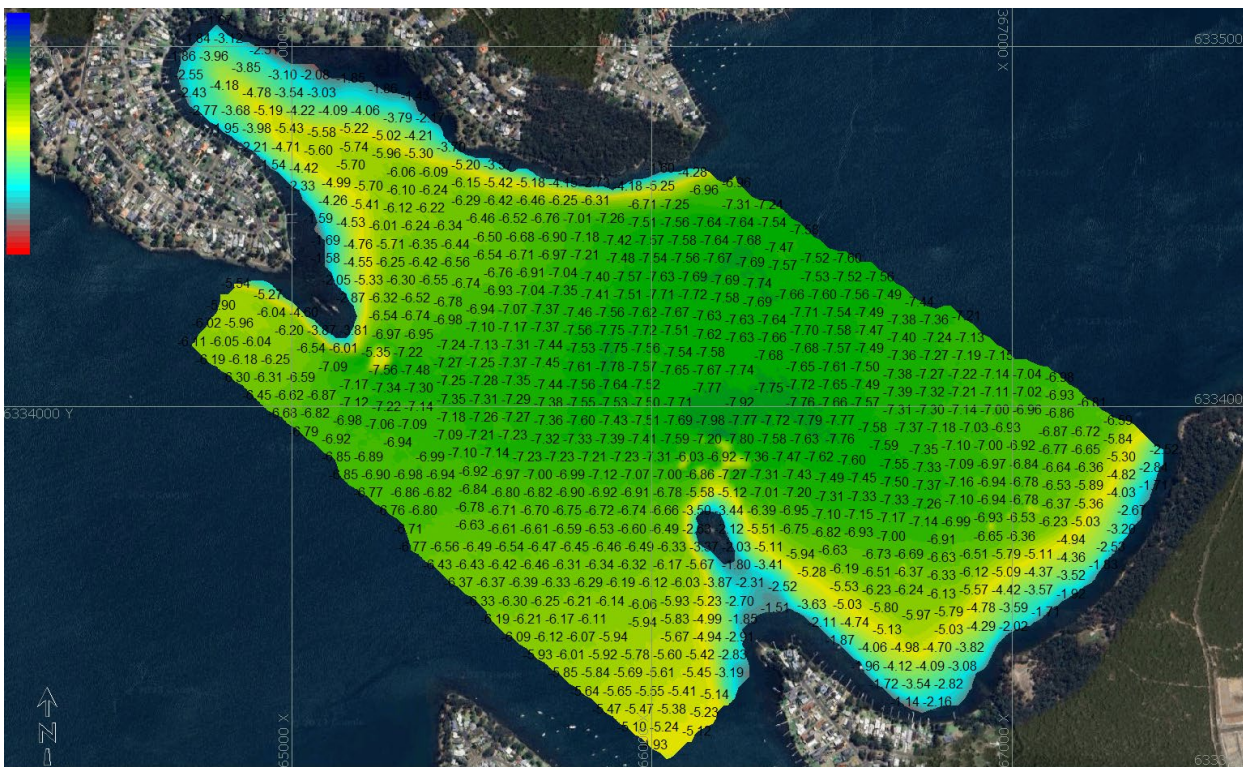


Figure 1: Lake Macquarie Survey Area

8.2 Line Spacing

20m transects were undertaken.

8.3 Sounding Speed

The minimum ping rate during the surveys was 20Hz which can be set in the software. The vessel speed during survey was less than 6 knots (~3m/s). This meant the minimum number of pings from one pass in the along track direction is 3.333 pings per 0.5m.

8.4 Multibeam Settings

The MBES was setup to achieve the most accurate result utilising a 120-degree swath,

This had the effect of:

- Minimising the inaccuracies in the outer beams
- Concentrating the soundings over a shorter distance for better resolution
- Increasing the ping rate

Depth filters were utilised for the survey acquisition. This eliminated all returns that were clearly out of range thus allowing the MBES a more thorough acquisition of the seabed features. No other filters were applied as there is the possibility that some spot features could be eliminated by the software if aggressive filters were used.

8.5 Online Checks

During the survey, the system was checked by monitoring certain aspects.

In the surveyor's geographical display, we can plot the seabed depths (mean, Shallowest or Deepest), the Hit count per cell or the 95% confidence data layer. By monitoring these different layers, we can assess if there are discrepancies in the data.

POSview software allowed RTK accuracy and quality to be monitored independently of the Hypack survey system. This was used to assess the integrity of the results.

Any issues were examined, and additional survey lines were run to verify the data if necessary. All actions noted on the logs.

8.6 Rejection Criteria for Position Data

The following standards were used to ensure correct position reliability was maintained:

Minimum Satellite Elevation:	15°
Min Satellite Count:	6

Maximum HDOP:	4
Maximum VDOP:	4
Maximum Age of Corrections:	2 seconds

Data storage would have ceased had this criterion been exceeded

8.7 Online Software Alarms

All the equipment linked to the survey system was monitored for communication errors.

- The PPS time synchronisation signal was monitored for integrity.
- The RTK system timeout -2 seconds.
- VDOP limit alarm - 3
- IMU updates to the system
- MBES functions
- MBES head Sound Velocity compared to currently loaded Sound Velocity profile - 2m/s

If any of these systems fell outside the accepted limits then an alarm would have been raised in the system, and investigated by the survey team.

9 DATA REDUCTION

All bathymetry data was logged with Hysweep multibeam data collection and editing module within Hypack.

The same module was used to edit the data and carry out QC and performance testing.

The data was:

- Initially processed to remove any obvious data spikes using a broad filter deleting all points above a specified minimum depth and below a maximum acceptable depth.
- The data was then assessed manually and all spurious data removed.
- Once the dataset was finalised it was checked for hit count, coverage, and statistical acceptance. Any areas requiring more information to comply with the survey requirements were resurveyed.

A statistically derived surface was created with a grid spacing of 1m. This surface was used as the base for the 10m grid output.

10 HEIGHT DIFFERENCE TO PREVIOUS SURVEYS

Some time ago it was discovered that the project that we had been using for the hydrographic surveys on Lake Macquarie had a software error in the programming and altered our height values by approximately 0.15m. This correction has been applied to this data set.

11 DATA DELIVERABLES

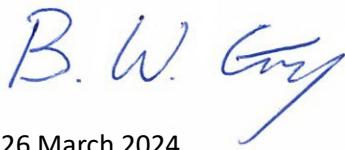
All processed data is delivered in the following formats:

Digital XYZ

20240320 – Delta Coal MGA94_AHD 10m grid.xyz

12 HYDROGRAPHIC SURVEYOR APPROVAL

Survey Report and Deliverables Approved By

A handwritten signature in blue ink, reading "B. W. Gray". The signature is written in a cursive style with a long, sweeping underline.

26 March 2024

Ben Gray
Certified Professional Hydrographic Surveyor Level 1