



Water Quality Test Report

Dredging, Land Reclamation and Revetment Works at Gulhifalhu

Phase 2



Number: 042 Report Date: 26/12/2023 Week: 51-2023 Period: 18/12/2023 to 24/12/2023

Project : Dredging, Land Reclamation and Revetment Works at Gulhifalhu
Contract number : (AGR)471-PRIV/2021/123
Project number [MIAS] : 46-046

Document number : 46-046-WQTR-042
Contractor : Boskalis Westminster Contracting Ltd
Client : Ministry of Construction and Infrastructure
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Environmental Water Sampling Activities

Weekly water samples were taken and analysed for TSS at the following locations:

Reclamation area at 8 locations taken on 18-DEC-23 & 23-DEC-23 and analysed on 19, 20-DEC-23 & 24, 28-Dec-23.

Primary extended borrow area at 13 locations on 18-DEC-23 & 23-DEC-23 and analysed on 19, 20-DEC-23 & 24, 28-Dec-23.

Alternative A borrow area at 8 locations on 18-DEC-23 & 23-DEC-23 and analysed on 19, 20-DEC-23 & 24, 28-Dec-23.

Please note that all results of samples collected on 19,20-DEC-23 showed exceedances due to a lab technical error. As such, another batch of samples was collected on 23-DEC-23. The technical error seems to be fixed, as this batch showed no exceedances except for 4 samples.

Environmental TSS Analysis Method

Samples are obtained using a Niskin bottle and stored in bottles of transparent material. Samples are stored in a dark fridge before the determination of suspended solids. Interpret results obtained for samples that have been stored more than 2 days with caution.

Lab Methodology used is the official authorized approved British Standard BS EN 872:2005 BS 6068-2.54:2005 for the Water Quality - Determination of Suspended Solids - Method by filtration through glass fibre filters. The European Standard EN 872:2005 has the status of a British Standard. The lower limit of the determination is about 2 mg/l. No upper limit has been established.

Concentration of Suspended Solids is determined by using a vacuum filtration apparatus and glass fibre filters through which the sample is filtered. The filter is then dried at 105 °C and the mass of the residue retained on the filter is determined by weighing on a calibrated analytical balance scale.

Blank tests are performed during each analysis to check the loss of mass during filtration by running a similar procedure but using 150 ml of distilled water instead of the sample. Quality checks are performed with a reference suspension, microcrystalline cellulose, of 500 mg/L - recovery shall be between 90 % and 110%.

Equipment Summary

Niskin water sampler with a 400 g drop messenger for obtaining water samples at the surface (~1.5 m).

Transparent bottles and Cool box to transport and store samples, preferably between 1 °C and 5 °C.

Analytical balance, capable of weighing to an accuracy of at least 0,1 mg.

Borosilicate glass fibre filters.

Equipment for vacuum or pressure filtration, to accommodate the selected filters.

Graduated cylinder to accurately measure quantities in ml.

Erlenmeyer flask to collect the water from water sample.

Drying support of suitably surfaced material, to support the filters in the drying oven (5.3), e.g. Petridishes.

Drying oven, capable of maintaining a temperature of 105 °C ± 2 °C.

Limit Applicability

Maintain a threshold level for turbidity at all reefs within the atoll lagoon in proximity to the dredging site, measured as Total Suspended Solids (TSS) to a maximum of 10 mg/L not exceeding 20% of the measurements. Exceptions shall be made where background rates exceed the threshold level and in reefs where extensive reclamation work has been undertaken (including e.g. Thilafushi, Gulhifalhu, Villigili, Malé, Hulhumalé). Considerations shall also be made to account for naturally elevated levels of turbidity which may occur during storm events or bad weather.

Calibration

Analytical balance was calibrated on 19, 20-DEC-23 & 24, 28-DEC-23

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Water Sample Locations - Reclamation Area



| Location ID | Area | Type | TSS limit applicable |
|-------------|-------------|--|----------------------|
| W2 | Reclamation | Within Project direct footprint | No |
| W5 | Reclamation | Reef where extensive reclamation work has been undertake | No |
| W7 | Reclamation | Reef where extensive reclamation work has been undertake | No |
| W10 | Reclamation | Reef where extensive reclamation work has been undertake | No |
| W11 | Reclamation | Reef where extensive reclamation work has been undertake | No |
| W14 | Reclamation | Reef where extensive reclamation work has been undertake | No |
| W15 | Villigili | Within Project direct footprint | No |
| W16 | Reclamation | Reef where extensive reclamation work has been undertake | No |

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Water Sample Locations - Extended Primary Borrow Area



| Location ID | Area | Type | TSS limit applicable |
|-------------|----------------|----------------------------|----------------------|
| W18 | Primary Borrow | Sensitive Receiver | Yes |
| W19 | Primary Borrow | Sensitive Receiver | Yes |
| W20 | Primary Borrow | Previous Construction Site | No |
| W25 | Primary Borrow | Sensitive Receiver | Yes |
| W27 | Primary Borrow | Sensitive Receiver | Yes |
| W36 | Primary Borrow | Previous Construction Site | No |
| W38 | Primary Borrow | Sensitive Receiver | Yes |
| W40 | Primary Borrow | Within Borrow Area | No |
| W45 | Primary Borrow | Within Borrow Area | No |
| W46 | Primary Borrow | Sensitive Receiver | Yes |
| W47 | Primary Borrow | Sensitive Receiver | Yes |
| W50 | Primary Borrow | Sensitive Receiver | Yes |
| W51 | Primary Borrow | Sensitive Receiver | Yes |

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Water Sample Locations - Alternative A Borrow Area



| Location ID | Area | Type | TSS limit applicable |
|-------------|---------------------------|--------------------|----------------------|
| W22 | Alternative A Borrow Area | Sensitive Receiver | Yes |
| W24 | Alternative A Borrow Area | Sensitive Receiver | Yes |
| W26 | Alternative A Borrow Area | Sensitive Receiver | Yes |
| W38 | Alternative A Borrow Area | Sensitive Receiver | Yes |
| W50 | Alternative A Borrow Area | Sensitive Receiver | Yes |
| W53 | Alternative A Borrow Area | Sensitive Receiver | Yes |
| W55 | Alternative A Borrow Area | Sensitive Receiver | Yes |
| W56 | Alternative A Borrow Area | Sensitive Receiver | Yes |



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Daily Water Quality Results - Reclamation Area

| Sample No | Location | Sample Type | Depth | Sample date | Analysis date | Physical appearance | Test Method | Total Suspended Solids (TSS) | Unit |
|-----------|----------|-------------|---------|----------------------------|----------------------------|----------------------|----------------|------------------------------|------|
| 1 | W2 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 0,8 | mg/L |
| 2 | W5 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 0,45 | mg/L |
| 3 | W7 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 2,2 | mg/L |
| 4 | W10 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 0 | mg/L |
| 5 | W11 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 1,2 | mg/L |
| 6 | W14 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 1 | mg/L |
| 7 | W15 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 0,4 | mg/L |
| 8 | W15A | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2005 | 0,2 | mg/L |
| 9 | W16 | Sea water | Surface | Saturday, 23 December 2023 | Thursday, 28 December 2023 | Clear with particles | BS EN 872:2006 | 1,2 | mg/L |

Observations & Activities

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Daily Water Quality Results - Extended Primary Borrow Area

| Sample No | Location | Sample Type | Depth | Sample date | Analysis date | Physical appearance | Test Method | Total Suspended Solids (TSS) | Unit |
|-----------|----------|-------------|---------|--------------------------|---------------------------|----------------------|----------------|------------------------------|------|
| 10 | W18 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 2,5 | mg/L |
| 11 | W19 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 0,8 | mg/L |
| 12 | W20 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 0 | mg/L |
| 13 | W25 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 1,0 | mg/L |
| 14 | W27 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 2,3 | mg/L |
| 15 | W36 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 1,3 | mg/L |
| 16 | W38 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 0 | mg/L |
| 17 | W40 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 0,9 | mg/L |
| 18 | W45 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 2,1 | mg/L |
| 19 | W46 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 0,7 | mg/L |
| 20 | W47 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 1,6 | mg/L |
| 21 | W50 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 2,1 | mg/L |
| 22 | W51 | Sea water | Surface | Monday, 11 December 2023 | Tuesday, 12 December 2023 | Clear with particles | BS EN 872:2005 | 1,7 | mg/L |

Observations & Activities

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| Sample No | Location | Sample Type | Depth | Sample date | Analysis date | Physical appearance | Test Method | Total Suspended Solids (TSS) | Unit | |
|-----------|----------|-------------|-----------|-------------|----------------------------|--------------------------|----------------------|------------------------------|------|------|
| Results | 23 | W22 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 2,6 | mg/L |
| | 24 | W24 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 0,8 | mg/L |
| | 25 | W26 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 18 | mg/L |
| | 26 | W38 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 0 | mg/L |
| | 27 | W50 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 2,1 | mg/L |
| | 28 | W53 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 17,6 | mg/L |
| | 29 | W55 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 19,3 | mg/L |
| | 30 | W56 | Sea water | Surface | Saturday, 16 December 2023 | Sunday, 17 December 2023 | Clear with particles | BS EN 872:2005 | 30,2 | mg/L |

Observations & Activities

Exceedances at W26, W53, W55, W56 are likely to be caused by a technical error in the lab as the samples themselves were clear and in-situ measurements showed no turbidity.