PRDW
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ESIA FOR EXPLORATION DRILLING IN BLOCKS 11B/12B OFFSHORE OF SOUTH AFRICA

Peer Review of Drilling Discharges Modelling Study

REV.01

09 November 2020

SLR Consulting / TOTAL E&P South Africa
B.V.
South Africa

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ANNEXURE A | CV FOR STEPHEN LUGER

1. INTRODUCTION

SLR Consulting is undertaking an Environmental and Social Impact Assessment (ESIA) for exploration drilling in Blocks 11B/12B offshore of South Africa for TOTAL E&P South Africa B.V. (TEPSA). SLR Consulting have appointed PRDW to undertake a peer review of the specialist Oil Spill and Drilling Discharges Modelling Studies undertaken by TEPSA for the ESIA. This report describes the peer review of the Drilling Discharges Modelling Studies, whilst the peer review of the Oil Spill Modelling Studies is described in a separate report.

2. PEER REVIEWER

The peer review was performed by Stephen Luger. He has 28 years of experience in the application of numerical models in the fields of coastal hydrodynamics, waves, oil spills, drill cuttings, tsunamis, sediment transport, outfalls, water quality, dredging, coastal flooding, climate change and underwater acoustics. He has undertaken 5 drilling discharges modelling studies in South Africa, Namibia and Mozambique. A detailed CV is provided in Annexure A.

3. APPROACH TO PEER REVIEW

The approach to the peer review is outlined below:

1. Kick-off meeting with SLR, TEPSA and TEPSA's modelling team on 8 April 2020.
2. Meeting to discuss the two discharge locations to be modelled with SLR, TEPSA and TEPSA's modelling team on 9 April 2020.
3. Review of the drilling discharges modelling methodology being applied by TEPSA, based on a review of the drilling discharges study performed previously by TEPSA for the Luiperd-1X well in Blocks 11B/12B. The review comments and TEPSA's responses are provided in Section 4.
4. Meeting on metocean data and model scenarios with SLR, TEPSA and TEPSA's modelling team on 25 May 2020.
5. Review of the draft drilling discharges reports. The review comments and TEPSA's responses are provided in Section 5 and have been incorporated into the final drilling discharges modelling reports.
6. Review of the final drilling discharges reports described in Section 6.

4. REVIEW OF DRILLING DISCHARGES MODELLING METHODOLOGY

The drilling discharges study performed previously by TEPSA for the Luiperd-1X well in Blocks 11B/12B was reviewed. This allowed the reviewer to provide comments on the drilling discharges modelling methodology being applied by TEPSA including any changes recommended for the current study. The peer review comments and TEPSA's responses and actions are provided in Table 4-1. The report reviewed was:

- 200302_Luiperd-1X_Drilling+Discharges_Report_final.pdf.

Table 4-1: Peer review comments on drilling discharges modelling methodology and TEPSA's responses and actions.

Report Section	Items	Peer Comment	TEPSA Response	TEPSA Action
4.1	1	Please summarise and reference validation studies where the results from DREAM/ParTrack are compared to prototype drilling impacts.	- Possibility to see with Sintef if they have some papers for model calibration	- Approach Sintef to get information about model calibration/validation
4.2	1	Please include a justification for the two discharge locations selected – refer to the meeting minutes from 9 April 2020. Please include the depths at these locations and the distance to the closest shoreline and protected areas.	- Worst case approach to be explained in the modelling and ESIA report (closest to coastlines, closest to EBSA, etc.) - TEPSA can provide assistance in the wording of this justification	- Ensure that the justification of discharge locations appears in the modelling report
	2	Please justify the type, volume and composition of the drilling muds assumed in the model. My understanding from the meeting on 8 April 2020 is that these are based on the muds that were used previously when drilling nearby wells with similar geology and that the muds have been chosen to reduce the ecological impacts. Please include supporting information such as service request forms as an annexure to the drilling discharges report.	- Input data will be part of the modeling report. - Just need to explain the assumption taken: Well program based on the last drilling program for Luiperd-1X - Not yet drilled, but optimized program from Brulpadda - TEPSA explained the work done during Luiperd: 1/ Drill Cutting modelling performed 2/ Efforts made to reduce the environmental risk by improving the volumes & chemicals used 3/ MEMO drafted by Drilling to list the improvements made. For budget reason, no modelling re-done. - For these modelling, the improvements made have been considered - Optimized program. - Philosophy to be explained in the modelling and ESIA report - TEPSA can provide assistance in the wording of this justification	- Request HES to explain the assumptions taken in the modelling report (mud & cuttings + chemicals) + calculation of cuttings quantities
4.3	1	Please include information on the grain sizes and settling velocities of the mud and cuttings.	- Generic information from ParTrack database	- Request HES to explain the assumptions taken in the modelling report (grain size & velocities)
	2	Many of the figures, e.g. Figure 8, in the Luipered-1X report are of low resolution and are difficult to read - please consider improving the resolution or using vector graphics.	- Example is only an illustration - Agreement reached to display a typical image of currents from metocean supplier with associated legend (algulhas current, eddy current, etc.)	- Recover a typical image of currents from metocean supplier with associated legend (algulhas current, eddy current, etc.) & share it with TEPSA/HQ
	3	In Figures 8 to 10 the length of the vectors makes the plots difficult to interpret. Using a constant vector length to show direction and colour to show magnitude would be preferable.	- Example is only an illustration - Agreement reached to display a typical image of currents from metocean supplier with associated legend (algulhas current, eddy current, etc.)	- Include the image of current in the modelling report
	4	A single snapshot of wind and current fields is provided. This is insufficient to confirm that the wind and currents applied in the model are realistic. Please include wind and current roses for the modelled period (e.g. 1 year) on a 1° grid of the entire model domain, with the currents provided near the surface and at two sub-surface depths.	Current: Available (Surface + 1 subsurface only available) Wind: Available Stephen agreed to use only 1 subsurface (seabed level) instead of 2	- Include the wind & current roses in the modelling reports
	5	Please provide validation of the winds and currents against measurements in the area of interest. Should this validation be done by the metocean data provider, please provide their report as an annexure to the drilling discharges report. Validation can include a time-series comparison, a drifter comparison, a rose comparison, a speed exceedance comparison, etc.	- Metocean specialist provided a MEMO detailling the model used by SatOcean & the comparison & calibration strategy	- Include the MEMO for metocean model calibration in the modelling reports

4.4	1	A comprehensive set of water column and sediment results is presented including concentrations, thicknesses and risk levels. It is also left to the marine ecology specialist to comment on whether any additional model outputs are required to inform the marine ecology assessment.	- Andrea Pulfrich already reviewed the last report for Luiperd-1X. Normally, no additional outputs will be required	

TEPSA's response and actions addressed the peer review comments on the methodology and TEPSA proceeded to undertake the drilling discharges modelling for the current study on this basis.

5. REVIEW OF DRAFT DRILLING DISCHARGES REPORTS

TEPSA provided first and second draft reports. The peer review comments and TEPSA's responses to these comments are provided in Table 5-1. The Round 1 comments refer to the following two reports:

- 2020-07-03_Block 11B-12B Drilling Discharges Report.docx
- 2020-07-09_Block 11B-12B Drilling Discharges Report_Point 2-West_V01.docx.

The Round 2 comments refer to the following report:

- 2020-08-28_Block+11B-12B+Drilling+Discharge_final.docx.

Table 5-1: Peer review comments on drilling discharges modelling reports and TEPSA's response.

Report Section	Items	Peer Comment Round 1	TEPSA Response Round 1	Peer Comment Round 2	TEPSA Response Round 2
All	All	Minor grammatical and formatting issues have been noted but these are not detailed as this review is limited to technical issues. That being said, please change "Kloofpada" to "Kloofpadda".	Reference to "Kloofpadda" has been deleted in the all document as suggested in the report and agreed during meeting		
2.1.2	1	In Table 1 please confirm that the "Quantity of mud discharged" includes the seawater plus the additives. Also confirm that this is the quantity of mud that is actually discharged to sea, i.e. for the risered phase this is the mud remaining on the cuttings after the majority of the mud is separated and reused. Please provided the mass of mud discharged during the risered phase as a percentage of the total mud circulating, and confirm that this corresponds to best practise.	Yes we can confirm that the total mud in Table 1 includes chemicals (additives) + water. Yes it is definitely the estimated quantity to be discharged. I don't have the quantity of mud to be used that will enable the calculation of a percentage to be discharged but we can ask to the fluid team. Discussion about mud usage best practice should be discussed within the ESIA report, not into the modelling report but we can provide the information to allow you to elaborate the discussion	SLR to ensure that a discussion about mud usage best practice is included in the ESIA report.	
	2	In Table 3, please confirm that the "Mass" is the mass of the additives discharged, excluding the seawater, i.e. the difference between the masses in Tables 1 and 3 is the seawater in the mud.	Yes, it is the mass of the additives discharged in both Table 2 and 3		
	3	In Tables 1 and 3 the mass units for cuttings and muds are given as tons, MT and T. Please confirm this is 1000 kg and use one consistent symbol.	Done, only "t" as been kept. I can confirm "t" corresponds to 1,000 kg		
	4	In Table 2, please confirm the density units are sg for all muds and not just the HPWBM mud as indicated.	Done (confirmed)	The density of "KCL WBM" is still indicated as "?".	Already Modified
2.2.1	1	Following sentence is repeated: "Each cloud consists of an ellipsoid with a particle at its centre, and semi-axes a function of the time-history of the particle. "	Already deleted in the report - change accepted		
	2	The process diagram below Figure 3 is for oil rather than mud and cuttings and should probably be removed.	This is taken from Reed & Hetland, 2002 showing the general layout of the DREAM model. DREAM used surface oil spill model algorithms to simulate the behavior and fate of chemicals. We can take it out if you prefer		
2.2.4	1	Under the heading "2. Physical effects of suspended matter in the water column", the threshold value accepted by the marine organisms is stated to be 10,000 ppm. This seems incorrect as the expected value would be approximately 35 ppm (35 mg/l). Does this change the sediment risk result?	Section 2.2.1 has been amended on pages 18-20 to clarify model description and content. Section 2.2.3 and 2.2.4 have also been amended on pages 25-29 to clarify risk assessment approach. Physical effect of suspended matter in the water column is due to cuttings (the default value 100ppm was used and not 10,000ppm which was a typo in the report and it has been corrected in the report p28) and to weighting agent (0.115ppm). As detailed in the report changing the threshold for the cuttings from 100ppm to 35ppm won't change anything because concentration above 35ppm were reached for a very short period of time and the risk is led by weighting agent with a very conservative threshold.	OK	

	2	Under the heading "6.Oxygen depletion in the sediment" it is stated that PNEC oxygen = 20% of initial rate of O_2. Clarify whether "initial rate" is the initial concentration or the saturation concentration of O_2.	Section 2.2.1 has been amended on pages 18-20 to clarify model description and content. Section 2.2.3 and 2.2.4 have also been amended on pages 25-29 to clarify risk assessment approach. We can confirm initial rate is the initial O2 concentration in the water		
	3	If the results in Section 3 are compared to the Risk Assessment in Section 2.2.4 there appear to be some potential risks that have not been are a number of missing results included in the results section: 1. Toxicity of chemicals in the water column: Included 2. Physical effects of suspended matter in the water column: Missing 3. Toxicity of chemicals in sediment: Missing 4. Burial of organisms in the sediment: Included 5. Change in the sediment structure - grain size: Included 6. Oxygen depletion in the sediment: Missing	We can confirm that the risk from the suspended sediments is being calculated. As explained in section 2.2.1 “Chemical concentrations in the water column are computed from the time- and space-variable distribution of pseudo-Lagrangian particles. These particles are of two types, those representing dissolved substances, and those representing droplets composed of less soluble chemical components or solid particulate matter in the release.” So when you design the discharge composition, you have two choices: chemicals (dissolved particles in the model) or particles (solid particles in the model). Solid particles of different types are used (cuttings particles and weighting agent particle: Barite…) We confirmed that both were included. By the way we also confirm that a PNEC of 100ppm was used for cuttings particles and a PNEC of 0.44ppm/0.115ppm was used for Barite particles For the second part of the question, it has already been discussed previously, to avoid multiplying number of figures, major contributors to the risk have been included in the report. 1. I guess you meant concentration: Ok: we have included a figure with the total discharge, and one for Barite only 2. Not really, included within the total discharge but we can add a figure focussing on cuttings only on top of what is already included in the report 3. I guess you meant concentration: Not really, included within the total discharge. What is already included in the report is Total discharge and total particulates (cuttings + barite + baracarb)– but we can add a figure focussing on chemicals (without or with barite) 6. Section 2.2.1 (page 18-20 in the report) and Section 2.2.3 & 2.2.4 (p25-29) have been updated to explain how oxygen depletion is calculated and what contributes to it.		
2.2.5	1	Please add a figure showing an example of the spatial variation in surface and bottom current vectors. Refer Section 4.3 Items 2 and 3 in "ESIA Modelling - Peer Review Comments.xlsx" received 8 May 2020.	Ok, included (figure 8)		

2.2.9	1	"...calculations are done on layers which could be ± large…". Presumably a number needs to be inserted before ±.	Ok included (page 47)		
3.1.1.1.2	1	The maximum water column concentrations in ppm are presented, but the associated risk is seemingly not assessed by comparing these to the PNEC for suspended matter in the water column.	What is provided in section 3.1.1.1.2 is the total discharge concentration in the water column (cuttings + chemicals) = there is no PNEC for the TOTAL. PEC/PNEC is calculated for each component (for suspended matter, it is the combination of cuttings + weighting agent = cuttings and barite max concentration are included in the synthetic table 10 page 84)-	OK	
3.1.3	1	The maximum water column concentrations in ppm are presented, but the associated risk is seemingly not assessed by comparing these to the PNEC for suspended matter in the water column.	What is provided in section 3.1.1.1.2 is the total discharge concentration in the water column (cuttings + chemicals) = there is no PNEC for the TOTAL. PEC/PNEC is calculated for each component - detail has been included in the synthetic table (page 84) as agreed during meeting.	OK	
	2	In Table 9 the EIF of 1119 for Scenario 4 looks too low (Discharge number 1 only).	Table 9 is now table 10 and EIF has been included (max instantaneous EIF). Another line with the time average EIF has also been included		
	3	In Table 9, suggest to add a row showing the Maximum Risk (%).	Might be confusing because this kind of information is not easy to use/interprete with only one number. Maximum risk where? By the way to our point of view, using an apporach which is already very conservative, what matter is the extend of the risk not really the maximum risk in term of %.	OK	
3.2.1.1.2	1	"Figure 46 shows that grain size variation on the sediments change over the time. No more risk corresponding to this contributor is observed after approximately 1500 days." What is the physical process that changes the grain size distribution over 1500 days - if this is due to resuspension or background sediment transport I would expect this to happen faster due to the Agulhas Current.	Agree. Ecosystem recovery calculation is described in section 2.2.4 (page 29) Default value were used because no other accurate information were available. Statement has been included on page 137.		
3.2.3	1	In Table 10, "Max risk % (EIF)" should not have the "%" unit.	Table 10 is now table 11. change has been made.		
	2	In Table 10, suggest to add a row showing the Maximum Risk (%).	Might be confusing because this kind of information is not easy to use/interpret with only one number. Maximum risk where? By the way to our point of view, using an approach which is already very conservative, what matter is the extend of the risk not really the maximum risk in term of %.	OK	
	3	In Table 10, as per comment above, please confirm the 1500 day duration.	Table 10 is now Table 11. Yes we confirm		
	4	In Table 10, "Max. total discharge concentration at the end of the operations" is missing units of g/L and should also mention that this is a sediment and not a water column concentration.	Already changed in the doc		

6. REVIEW OF FINAL DRILLING DISCHARGES REPORTS

The final drilling discharges reports provided for review were:

- 2020-10-05_Block 11B-12B _1Drilling Discharges Report_final.docx
- 2020-10-05_Block 11B-12B_2 Drilling Discharges Report_final.docx.

These final reports adequately address all the peer review comments on the draft reports as detailed in Table 5-1.

7. CONCLUSIONS

The drilling discharges modelling studies undertaken by TEPSA for Blocks 11B/12B have been peer reviewed and are considered to follow best international practise. The results can therefore be considered reliable and can be used to inform the ESIA.

ANNEXURE A | CV FOR STEPHEN LUGER

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Curriculum Vitae
25-02-2020

STEPHEN LUGER
Technical Director

OFFICE LOCATION	Cape Town, South Africa
NATIONALITY	South African
DATE OF BIRTH	12 January 1967
SPECIALISATION	Numerical modelling of coastal hydrodynamics, waves, tsunamis, sediment transport, outfalls, water quality, dredging, oil spills and flooding
QUALIFICATIONS	Registered Professional Engineer, South Africa (1998) (Number: 980442) BSc(Eng) Civil Engineering, University of Cape Town (1988) MSc(Eng) Civil Engineering, University of Cape Town (1991)
PROFESSIONAL SOCIETIES	Member, South African Institution of Civil Engineers (1991)
LANGUAGES	English, Afrikaans

SUMMARY

Stephen Luger received an MSc in Civil Engineering from the University of Cape Town in 1991. He was then employed by the Council for Scientific and Industrial Research (CSIR) for 16 years as a coastal modelling specialist. For the past 14 years he has been employed by PRDW Consulting Port and Coastal Engineers as a coastal modelling specialist and currently holds the post of Technical Director. He has 28 years of experience in the application of numerical models in the fields of coastal hydrodynamics, waves, tsunamis, sediment transport, outfalls, water quality, dredging, oil spills, coastal flooding, climate change and underwater acoustics. These modelling studies have been conducted for feasibility studies, environmental impacts studies, nuclear safety studies and detailed engineering design. The countries where the studies have been conducted include South Africa, Namibia, Gabon, Nigeria, Kenya, Mauritius, Seychelles, Guinea, Mozambique, Madagascar, Cameroon, Angola, Egypt, Bahrain, Qatar, United Arab Emirates, Jordan, Israel, Ireland, Chile, Peru, Brazil, St Helena, Timor and Australia. He is the author or co-author of over 20 articles in scientific journals, chapters in books and conference proceedings, over 100 technical reports for external contract clients, and has presented over 20 papers at local and international conferences.

RELEVANT PROFESSIONAL EXPERIENCE

WAVES

- Spectral wave modelling for sediment transport at Big Bay, Cape Town (2018)
- Spectral wave modelling to establish design waves at Small Bay, Cape Town (2018)
- Boussinesq and refraction modelling for a new port at Chancay, Peru (2018)
- Modelling waves and run-up in evaporation dams at the Olympic Dam mine, Australia (2018)
- Boussinesq and refraction modelling for LNG berth in Saldanha, Ngqura and Richards Bay (2016)
- Refraction modelling for LPG mooring in Saldanha Bay (2015)
- Wave refraction modelling and vessel downtime assessment in Walvis Bay (2013)
- Boussinesq and refraction modelling for Port of Durban (2013)
- Boussinesq and refraction modelling for proposed port at Valparaiso, Chile (2013)
- Boussinesq and refraction modelling for proposed port at Micaune, Mozambique (2013)

- Refraction modelling for LPG berth in Saldanha Bay (2012)
- Refraction modelling at Inhambane (2011)
- Refraction modelling for Matola terminal in Maputo (2011)
- Refraction modelling for PetroSA SPM at Ngqura (2010)
- Boussinesq wave modelling for dig-out port, Durban (2010)
- Boussinesq wave modelling for Port of Ngqura (2009)
- Boussinesq wave modelling for Eden Island, Seychelles (2008)
- Wave refraction study for SBM in Algoa Bay (2008)
- Refraction and Boussinesq wave modelling for proposed Eskom Nuclear power stations (2008)
- Wave refraction study for St Helena Bay SBM (2007)
- Boussinesq wave modelling for proposed dig-out port, Durban (2007)
- Wave refraction modelling for Cape Town Container Terminal expansion (2006)
- Modelling of proposed harbour extensions in Saldanha Bay: wave resonance (1997)

HYDRODYNAMICS

- Impact of tidal pool on coastal hydrodynamics at Port St Johns, South Africa (2016)
- Impact of tidal pool on coastal hydrodynamics at Tinley Manor, South Africa (2016)
- Impact of reclamation on 3D currents at Valparaiso, Chile (2015)
- Current and wave modelling to establish design conditions in Abu Dhabi (2014)
- Cyclone modelling for proposed port at Micaune, Mozambique (2013)
- Modelling sediment, stormwater and brine plumes for Anadarko LNG plant, Mozambique (2012)
- Cyclone modelling for Matola terminal in Maputo (2011)
- Cyclone modelling for export jetty neat Inhambane, Mozambique (2011)
- Modelling cross-currents at the Port of San Antonio, Chile (2010)
- Hydrodynamic modelling of the currents in the entrance channel of San Antonio Port, Chile (2010)
- Tidal propagation in the Port of Durban (2009)
- Wave and current modelling for a proposed Eskom nuclear power station (2008-09)
- Wave, current and sediment transport modelling for Cape Town Container Terminal expansion (2006)
- Hydrodynamic modelling at Beira and Nacala for the proposed Moatize Coal Terminal (2005)
- Hydrodynamic modelling of the Victoria and Alfred Canal, Cape Town (2005)
- Hydrodynamic modelling of Northern Irish Loughs for sustainable mariculture project (2005)
- Hydrodynamic modelling of Maputo Bay for catchment to coast project (2004)
- Hydrodynamics and water quality for Bahrain Financial Harbour (2003)
- Hydrodynamic decision support system for Namdeb inshore diamond mining (2002)
- Modelling hydrodynamics and water quality in the Gabon Estuary (2001)
- Modelling of proposed harbour extensions in Saldanha Bay (1997)
- Simulation of current patterns due to geometric changes to East London breakwater (1996)

TSUNAMIS

- Modelling tsunamis at Mejillones, Chile (2010)
- Tsunami modelling for a proposed Eskom nuclear power station (2008-2009)
- Modelling tsunamis at Mejillones, Chile (2008)
- Modelling tsunamis at Bayovar, Peru (2006)

SEDIMENT TRANSPORT

- Modelling of shoreline morphology and sediment bypass at Chancay, Peru (2019)
- Modelling of 2D sediment transport at Big Bay, Cape Town (2018)
- Beach planar and cross-shore stability modelling at Jalmudah, Saudi Arabia (2018)

- Beach planar and cross-shore stability modelling at Al Sahel, Bahrain (2017)
- Beach planar stability modelling at Al Mirfa, UAE (2017)
- 2D sediment transport at the port of Punta Arenas, Chile (2017)
- 2D sediment transport at the port of San Antonio, Chile (2016)
- 2D sediment transport in Bushmans River Estuary, Kenton-on-Sea, South Africa (2016)
- 2D sediment transport for maintenance dredging requirements in entrance channel to Port of Maputo, Mozambique (2016)
- Modelling 2D sediment transport for VIP development at Swakopmund, Namibia (2015)
- Mauritius Turtle Bay Beach Restoration Study (2015)
- Modelling sedimentation for proposed southern channel in Maputo Bay, Mozambique (2014)
- Modelling waves and sediment transport at Emu Point, Australia (2013)
- Modelling 2D sediment transport in Rupert's Bay, St Helena Island (2013)
- Shoreline and 2D modelling of sediment transport for proposed port at Micaune, Mozambique (2013)
- Shoreline modelling for Pampa de Pongo jetty, Peru (2013)
- Modelling sedimentation for Bauxite Export Port in Guinea (2012)
- Modelling impact of port reclamation and dredging on stability of Table Bay coastline (2012)
- Modelling sedimentation at Barquito jetty, Chile (2011)
- Modelling fate of sediment disposed offshore for proposed Eskom nuclear power station (2011)
- Sediment transport modelling for intake basins for proposed Eskom nuclear power station (2008 - 2009)
- Sediment transport modelling for proposed a fixed sand bypass system at Richards Bay (2008)
- Morphodynamic modelling for a fixed sand bypass system at Durban (2007)
- Morphodynamic modelling for the Durban Small Craft Harbour (2006)
- Dredging impacts in Table Bay: hydrodynamics, waves, shoreline stability and dredge plumes (2003)
- Morphodynamic modelling of beach erosion at Langebaan (2003 - 2004)
- Modelling morphodynamics on Egypt's northshore (2002)
- Modelling morphodynamics (beach protection measures) at Bar Beach, Lagos, Nigeria (2000)
- Modelling diamond distributions on West Coast for De Beers (2000)

OUTFALLS / DISPERSION

- Brine dispersion modelling in the Victoria &Alfred Waterfront, South Africa (2019)
- Dispersion of fish factory effluent for CWDP compliance at West Point Processors in St Helena Bay (2018)
- Mining effluent dispersion from an outfall at the Ambatovy mine in Madagascar (2018)
- Aquaculture, brine, thermal and sewage effluent dispersion from proposed pipeline servitude at Coega (2017)
- Dispersion modelling for proposed finfish farming in Saldanha Bay (2017)
- Thermal plume modelling for Department of Energy and Transnet's proposed gas to power projects at Saldanha Bay, Coega and Richards Bay (2016)
- Temperature, chemical and radionuclide dispersion at Koeberg, South Africa (2015)
- Heating water dispersion from FSRU vessel in Walvis Bay (2015)
- Brine dispersion modelling at Volwaterbaai, South Africa (2014)
- Brine dispersion modelling at Cabo Delgado, Mozambique (2012)
- Brine dispersion modeling at Nacala, Mozambique (2010)
- Brine dispersion modelling for Swartkops desalination plant, Port Elizabeth (2010)

- Thermal plume modelling for a proposed Eskom nuclear power station (2008 - 2009)
- Modelling desalination brine dispersion for proposed Eskom nuclear power station (2008)
- Thermal plume modelling for Nampower power station, Walvis Bay (2008)
- Brine dispersion modeling at Cannon Rocks, South Africa (2007)
- Modelling of brine dispersion in Durban Port (2007)
- Near-field modelling for Huntsman Tioxide pipeline, Durban (2003)
- Modelling marine impacts of discharges into the Port of Ngqura for Aluminium Pechiney (2002)
- Modelling impacts of effluents and runoff from the Mozal site on the Matola River (1999)
- Design of a sewage outfall monitoring program using predictive modelling of hydrodynamics and water quality for East London (1999)
- Second Mombasa and coastal water supply, engineering and rehabilitation project: three-dimensional numerical modelling of plume from marine outfall (1997)
- South Dunes Coal Terminal EIA: specialist study on stormwater discharge into Richards Bay Harbour (1997)
- Assessment of effluent surfacing and design of diffuser for AOS and Tioxide marine pipelines (1997)
- Southern Metro Wastewater Disposal Study: modelling of marine disposal options for Durban (1997)
- Dispersion modelling for extension of the Sappi Saiccor pipeline near Durban (1997)
- Three-dimensional modelling of thermal plume in Saldanha Bay due to proposed seawater cooling system (1997)
- Southern Metro Wastewater Disposal Study: Preliminary numerical modelling of currents and dispersion of effluents (1997)
- Dispersion of zinc and fluoride in Richards Bay harbour (1996)
- Baie du Tombeau Sewerage Project, Mauritius: Numerical modelling of currents and effluents (1996)

DREDGING

- Dredge plume modelling for Matola port expansion, Mozambique (2016)
- Dredge plume modelling for oil export pipeline at Temane, Mozambique (2016)
- Modelling fate and dispersion of dredge plumes in Maputo Bay, Mozambique (2012)
- Modelling fate and dispersion of dredge plumes at Cabo Delgado, Mozambique (2012)
- Modelling fate and dispersion of excavation spoil for a proposed Eskom nuclear power station (2009)
- Modelling fate and dispersion of dredge spoil for new offshore dumpsite at Durban (2007)
- Modelling of dredge plumes at Luanda (2007)
- Dredging impacts in Table Bay: hydrodynamics, waves, shoreline stability and dredge plumes (2003)
- Modelling fate of coal dust particles in Richards Bay (2000)
- Modelling plume from proposed dredging of Berth 306 in Richards Bay (1999)
- Simulation of tailings from exploration oil drilling off Angola (1997)
- Numerical modelling of hydrodynamics and dredging-induced turbidity in Saldanha Bay (1996)

OIL SPILLS AND DRILL CUTTINGS

- Oil spill modelling for Debmarine Namibia's Diamond Mining in Atlantic 1, Namibia (2020)
- Oil spill modelling for Anadarko's LNG Project in Palma Bay, Mozambique (2020)
- Modelling oil spills and drill cuttings for GALP's proposed offshore exploration well drilling in PEL82 and PEL83, Namibia (2019)
- Independent reviewer for oil spill modelling by ERM/eni offshore Durban, South Africa (2018)

- Oil spill modelling for petroSA's proposed condensate import SBM in Mossel Bay (2017)
- Oil spill modelling for Sasol's proposed oil export pipeline at Temane, Mozambique (2016)
- Oil spill modelling for Department of Energy and Transnet's proposed gas to power projects at Saldanha Bay, Coega and Richards Bay (2016)
- Oil spill modelling in Totoralillo Bay, Chile (2015)
- Modelling oil spills and drill cuttings for Murphy's proposed exploration drilling in Block 2613 off the coast of Namibia (2015)
- Modelling oil spills and drill cuttings for Cairn's proposed exploration drilling in Block 1 off the west coast of South Africa (2014)
- Modelling oil spills and drill cuttings for Thombo's proposed exploration drilling in Block 2B off the west coast of South Africa (2014)
- Modelling oil spills and drill cuttings for Shell's proposed exploration drilling in the Orange Basin deep water licence area off the west coast of South Africa (2013)
- Oil spill risk assessment for Nacala-a-Velha Port Development (2010)
- Oil spill modelling for PetroSA SPM at Ngqura (2009)
- Hydrodynamic and oil spill modelling at Temane, Mozambique (2004)

MARINAS

- Eutrophication modelling for Ayla Oasis, Jordan (2010)
- Water quality modelling for Eden Island, Seychelles (2010)
- Hydrodynamic and water quality modelling for Durban Port expansion (2007)
- Water quality modelling for Roche Noir marina, Mauritius (2007)
- Hydrodynamic and water quality modelling for Luanda Waterfront (2006)
- Hydrodynamic modelling of the Victoria and Alfred Canal, Cape Town (2005)
- Water quality modelling for marina at Al Khawr, Qatar (2004)
- Water quality modelling for Arabian Peninsula Project at Jiddah, Saudi Arabia (2004)
- Water quality modelling for marina at Aqaba, Jordan (2004)

TROPICAL CYCLONES

- Modelling tropical cyclones for pipeline stability at Ambatovy, Madagascar (2018).
- Modelling tropical cyclones for coastal protection in Mauritius (2017).
- Modelling tropical cyclones for pipeline stability at Ambatovy, Mozambique (2016-17).

COASTAL ZONE MANAGEMENT

- Assessment and design of solutions for beach erosion at Milnerton, Cape Town (2018)
- Modelling impact of climate change on beach erosion at Big Bay, Cape Town (2018)
- Beach and dune erosion assessment at Big Bay, Cape Town (2016)
- Coastal protection studies for 13 sites in in Mauritius (2017-18).
- Flood hazard assessment along the South African coastline (2011-14)
- Impact of climate change on flooding at the Salt River mouth, Cape Town (2010)
- Flood line assessment for Eskom nuclear power stations (2009)
- Assessment of climate change effects on coastal engineering design for a proposed Eskom nuclear power station (2008-18)
- Determining wave run-up levels for a proposed Eskom nuclear power station (2008-18)
- Modelling beach protection measures at Langebaan (2003-2004)
- Modelling beach protection measures at Bar Beach, Lagos, Nigeria, (2000)

DATA MANAGEMENT

- Processing, analysis and archiving of water level, wave, current, wind, seawater temperature, bathymetry, beach profile and satellite data for Nuclear Site Safety Studies (2008-18)

UNDERWATER ACOUSTICS

- Case study: sound propagation from Trailing Suction Hopper Dredger in Palma Bay, Mozambique (2016)

- Case study: sound propagation from seismic air canon offshore Swakopmund, Namibia (2016)

PUBLICATIONS

Numerical Modelling to Understand the Causes of the Beach Erosion at Big Bay, Bloubergstrand. SAICE Civil Engineering Magazine, May 2019 Issue. (co-author: Hugo, P). 2019.

Morphological modelling of the response to a shipwreck – a case study at Cape Town. 33rd Int Conf. Coastal Engineering, Santander, Spain. (co-authors: Kristensen, SE; Deigaard, R; Fredsoe, J). 2012.

Potential Impact of Climate Change on Coastal Flooding: A Case Study of the Salt River, Cape Town. In: Cartwright, A; Parnell, S; Oelofse, G and Ward, S (eds). Climate Change at the City Scale. Impacts, Mitigation and Adaptation in Cape Town. Routledge. ISBN 978-0-415-52758-3. (co-authors: Harris, R; Sutherland, C and Tadross, M). 2012.

Modelling tsunamis generated by earthquakes and submarine slumps using MIKE 21. International MIKE by DHI Conference 2010, Copenhagen. (co-author: Harris, RL). 2010.

Maputo Bay hydrodynamics. In: P.M.S Monteiro and M. Marchand (eds.) Catchment2Coast: A Systems Approach to Coupled River-Coastal Ecosystem Science and Management. Vol 2. (1) pp 28-35. Amsterdam: Deltares Selected Series. IOS Press. ISBN 978-1-60750-030-8. (co-authors: Simpson, J; Lencart, J; Monteiro, P; Harcourt-Baldwin, J and Hoguane, A). 2009.

Fate of fine sediment from dredger-based mining in a wave-dominated environment at Chameis Bay, Namibia. Journal of Coastal Research, 23(6). (co-authors: Smith, GG; Weitz, N; Soltau, C; Viljoen, A and Maartens, L). 2008.

Morphological modelling for design of a beach restoration project, Proc. 30th Int Conf Coastal Engineering, San Diego, USA. (co-authors: Prestedge, GK; McClarty, AA; Soltau, C; Schoonees, JS and Fleming, C). 2006.

Morphological modelling under an event-driven wave climate. Proc. 29th Int Conf. Coastal Engineering, Lisbon, Spain. (co-authors: Diedericks, GPJ; Smith, GG). 2004.

Minimising the impacts of reclamation dredging at Cape Town. Proc. 29th Int. Conf. Coastal Engineering, Lisbon, Spain. (co-authors: Smith, GG and Schoonees, JS). 2004.

A Decision Support System for Optimising Engineering and Operational Design of Nearshore Mining Operations Based on Numerical Simulations of Nearshore Waves, Currents and Water Levels. 8th Int. Conf. Estuarine and Coastal Modeling, Monterey, California, United States. (co-authors: Van Ballegooyen, RC; Smith, GG; van der Westhuysen, A and Patel, SR). 2003.

Solving a harbour-induced erosion problem at Bar Beach, Lagos, Nigeria. Proc. 28th Int. Conf. Coastal Engineering, Cardiff, United Kingdom. (co-authors: Van Tonder, A; Smith, G; Bartels, A and Kapp, F). (2002).

Optimising the disposal of dredge spoil using numerical modelling. Proc. 28th Int. Conf. Coastal Engineering, Cardiff, United Kingdom. (co-authors: Schoonees, JS and Theron, A). (2002).

Hydrodynamic and sediment transport modelling to address erosion problems at Bar Beach, Nigeria. Delft3D User Conference, Delft, The Netherlands. (2001).

Application of DELFT3D for optimising the disposal of dredge spoil. Delft3D User Conference, Delft, The Netherlands, 2000.

Assessment of a potential thermal discharge in a coastal embayment using a three dimensional hydrodynamic model. Proc. 5th In.t Conf. on Coastal and Port Engineering in Developing Countries, Cape Town, South Africa, Vol. 3, pp2018-2027. (co-author: van Ballegooyen, RC). 1999.

Predictive modelling of hydrodynamics and marine water quality: Three applications along the South African coastline. 3rd Int. Conf. on Environmental Problems in Coastal Regions III, pp 281-290. (co-author: van Ballegooyen, RC). 1999.

Delft3D as an integrated system for port design based on hydrodynamic, water quality, sediment transport and wave resonance considerations. Delft3D User Conference, Delft, The Netherlands. (co-author: van Ballegooyen, RC and Monteiro, P). 1999.

Predictive modelling of marine water quality. IAIA SA 98, pp 198-207. (co-authors: Monteiro, PMS; Van Ballegooyen, RC and Pretorius, PJ). 1998.

Predicting and evaluating turbidity caused by dredging in the environmentally sensitive Saldanha Bay. Proc. 26th Int Conf Coastal Engineering, Copenhagen, Denmark, pp 3561-3572. (co-authors: Schoonees, JS; Mocke, GP and Smit, F). 1998.

Results of extensive field monitoring of dolos breakwaters. Proc. 24th Int Conf Coastal Engineering, Kobe, Japan, pp1511-1525. (co-authors: Phelp, D; Holzthausen, AH). 1994.

Increased dolos strength by shape modification. Proc. 24th Int. Conf. Coastal Engineering, Kobe, Japan, pp 1388-1396. (co-authors: Phelp, DT, Van Tonder, A and Holzthausen, AH). 1994.

ACADEMIC

FEBRUARY 2012	Impact of climate change on Salt River (Cape Town) and an offshore jetty design (Mozambique). Presented at Short Course & Seminar on Coastal Engineering within Climate Change, University of Stellenbosch, February 2012.
FEBRUARY 2011	Numerical Modelling for Port Design. Presented at Short Course & Seminar on Port Engineering, University of Stellenbosch, February 2011.
OCTOBER 2010	Wave Overtopping at Seawalls and Impacts on Setback Lines. Presented at Setback Lines for Coastal Developments, University of Stellenbosch, October 2010.
FEBRUARY 2010	Numerical Modelling in the Coastal Environment. Presented at Short Course & Seminar on Coastal Engineering, University of Stellenbosch, February 2010.
FEBRUARY 2009	Numerical Modelling of Waves, Currents, Sediment Transport and Water Quality. Presented at Short Course & Seminar on Port Engineering, University of Stellenbosch, February 2009.
FEBRUARY 2008	Numerical Modelling of Waves, Currents, Sediment Transport and Water Quality. Presented at Short Course on Port and Coastal Engineering, University of Stellenbosch, February 2008.
FEBRUARY 2007	Numerical Modelling of Waves, Currents, Sediment Transport and Water Quality. Presented at Short Course on Port and Coastal Engineering, University of Stellenbosch, February 2007.

APPOINTMENTS

2010 TO PRESENT	Technical Director, PRDW, Cape Town, South Africa
2008 - 2009	Associate, Prestedge Retief Dresner Wijnberg (Pty) Ltd, Cape Town, South Africa
2006 - 2007	Engineer, Prestedge Retief Dresner Wijnberg (Pty) Ltd, Cape Town, South Africa
1990 - 2006	Engineer, Council for Scientific and Industrial Research (CSIR), Stellenbosch, South Africa