Appendix 4: Updated Marine Impact Study May 2021

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Solomon Water

URBAN WATER SUPPLY & SANITATION SECTOR PROJECT

Project Readiness Financing

Updated Marine Impact Study

25th May 2021

DCCD ENGINEERING CORPORATION
CONSULTING ENGINEERS SINCE 1957

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0-- Summary

I Standards & Existing Water Quality

II- V Marine Impact Studies (Clarifications & Update)

VI Conclusions & Recommendations

I – Standards & Existing Water Quality

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Standards

- Recommended standard was the ANZECC 2000 standard as per the IEE Report. Initial simulations were based on E.Coli
  - An effective screened sewage dilution of 100:1
  - 150 EC/100ml only in 50% of cases;
  - 1000 EC/100 ml in 10% of cases, when wind currents bring the plume directly to the coast (although not clear that this is the worst case – see below)
- Now recommended to base upon ANZ 2019. This refers to a number of other standards notably:
  - Australian and New Zealand Environment and Conservation Council (ANZECC), 2000.
  - WHO 2002, Guidelines for safe recreational water environments. Vol 1 Coastal & Fresh Waters
  - Australia Guidelines for Managing Risks in Recreational Water, 2008
  - New Zealand, MoE 2003, Microbiological Water Quality Guidelines for Marine & Freshwater Recreational Use
- EU Guidelines (used for example in New Caledonia)

Indicator Values

- Both E.Coli and Enteroccoci are indicators of bacterial pollution. Generally accepted in the literature that ENT may be more indicative of bacterial pollution in marine waters and E.Coli in surface waters. Although not as clear as this
  - NZ Guidelines 2003, recommend in the case of treatment to use EC
  - Practice in France (and therefore New Caledonia) uses both with indication that E.Coli is thought to be more representative/better indicator
- Approach
  - Classify Mataniko/Foreshore into protection zones in a phased manner
  - Check existing water quality
  - Apply mixed standards in simulations to cover both ENT & EC
  - For ENT we can use a broad guideline of 40 for primary contact (Class A) and 200 counts/100 ml for secondary contact (Class B) (Australian Guidelines 2008)
  - For ECOLI use a guideline 150 in the order of 500 counts/100 ml for primary and secondary
  - Propose these aspects in the PER and also improved monitoring during early stages of implementation to reinforce the baseline and to check improvements after implementatio0

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Water Quality Objectives (of UWSSSP)

- Protect all the Mataniko downstream of Tuvaruhu from faecal pollution by connecting as many outfalls/discharges with the "interceptor" sewer (eg Chinatown area)
- Protecting as a priority the zones west of Point Cruz where contact sports/boating is practiced (Class B initially to Class A in the future in an expanded zone)
- Remove current SW discharges and connect to designed outfalls
- Pick up as much as feasible of other existing outfalls/connections along the foreshore (Classification C/D) with foreshore around city centre to Class B in the future.



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Baseline water quality

Ranadi (Silent World)

Rove Bulkshop

Point Cruz

Panatina (Marine) School

Kukum (Didao)

Kukum (Pacific Casino)

Kukum (Spice Bar)

China Town New Bridge

NRH

China Town Old Bridge

Tvaruhu Outlet

Tuvaruhu Up Stream

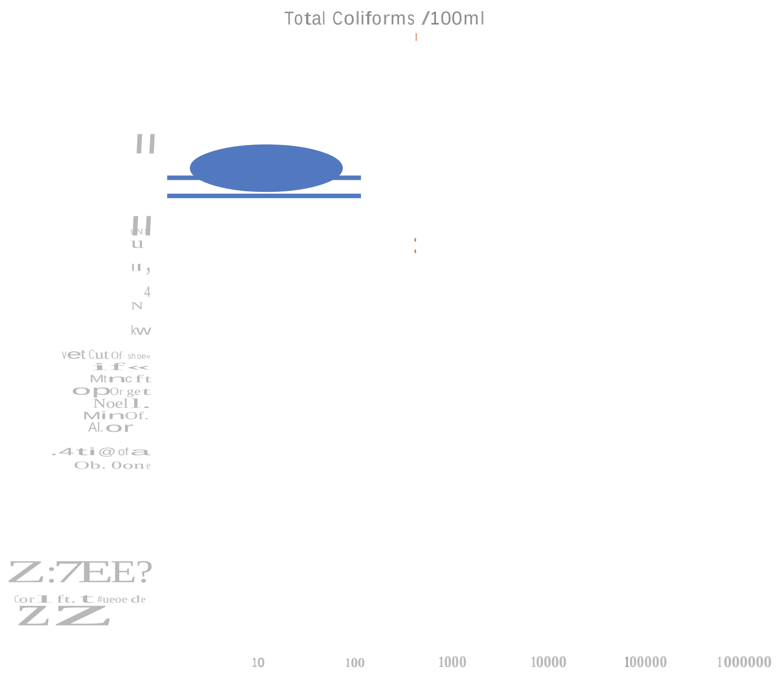
500 0 500 1000 1500 2000 m

- Samples collected November 2019
  - Mataniko River, upstream of Tuvaruhu and in downstream locations
  - Very close to the foreshore/outfalls at a number of locations
  - Range of parameters – including E-Coli as an indicator of bacterial contamination taken
  - Variable results for some parameters

Monitoring Results {This & Previous Studies}

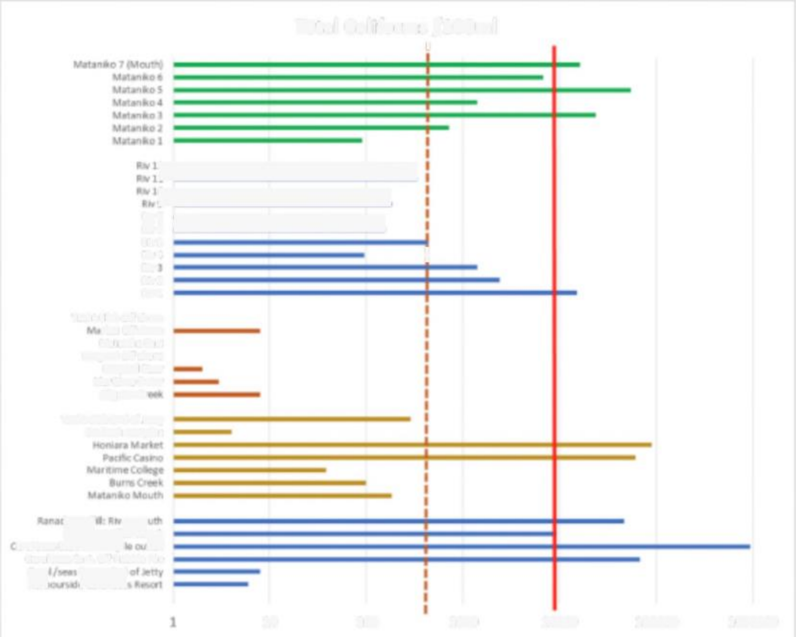
- Broad Results in terms of bacterial water quality (E Coli) – Mataniko River
  - Upstream of SW outlets water quality can be considered to be Very Good/Good (EC 106 FC/100 ml)
  - Immediately downstream of Tuvaruhu water quality can be considered Poor/Very Poor (EC 482 FC/100 ml)
  - Improvements further downstream at Old Mataniko Bridge

    (Fair to Poor)
  - Near new bridge seem to be impacted by sea water/tides (also receiving direct discharges from NRH via storm water system)

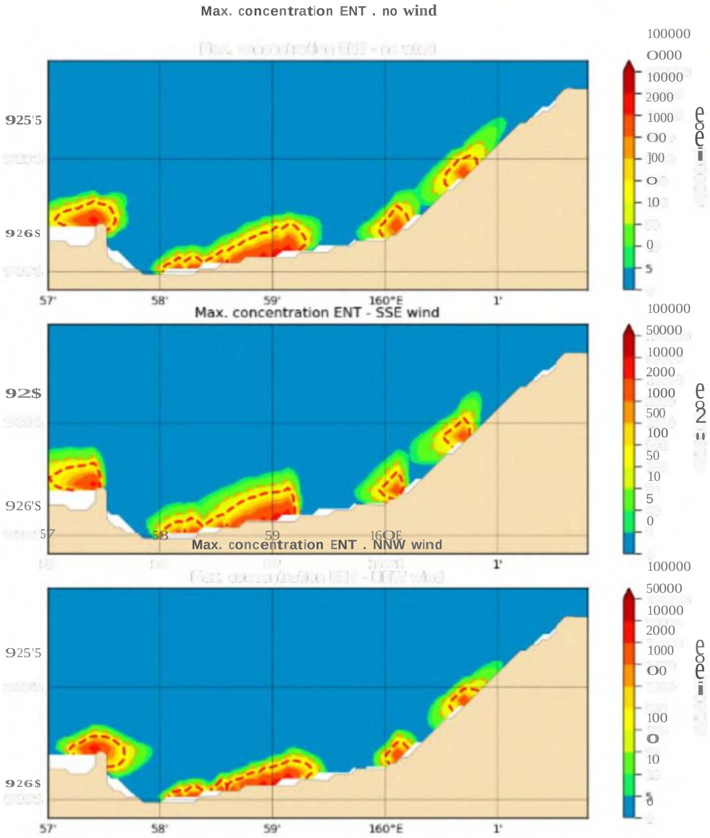


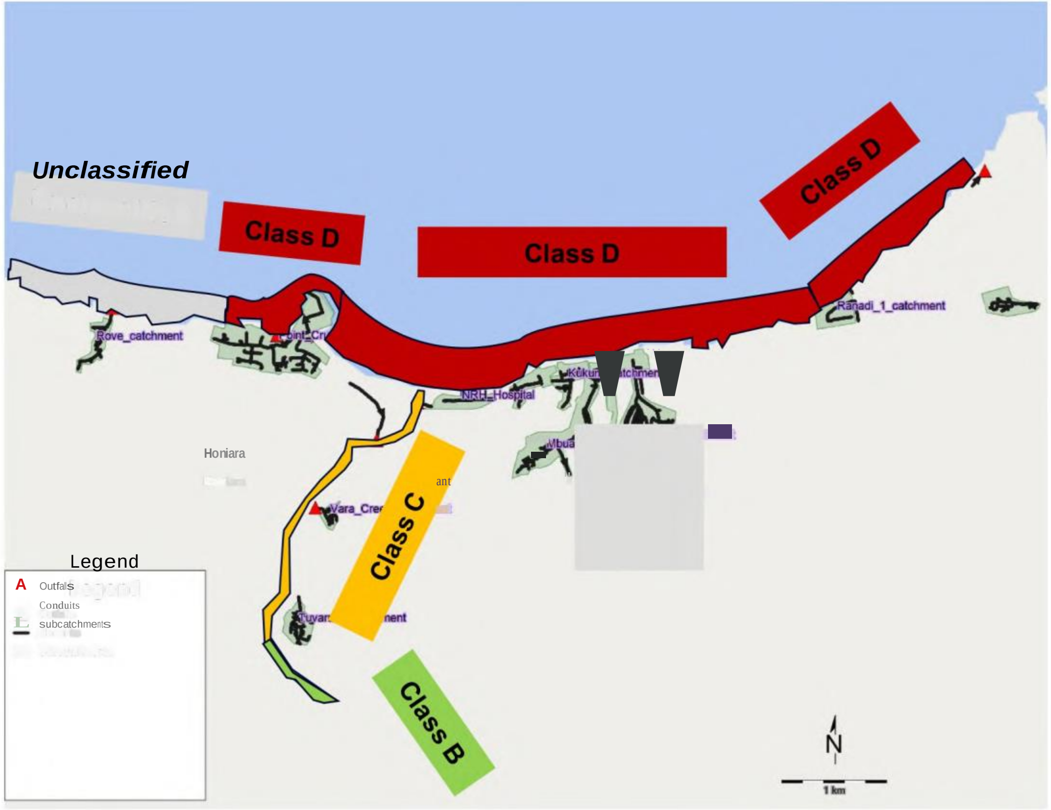
- Foreshore Water Quality -- Varied results but using previous E Coli grading high values observed (EC > 500FC/100 ml) at Point Cruz, NRH and Kukum in a number of point most likely related to outfalls including those of SW. Other values not so high in terms of E.Coli

- Comparison with studies from the 1970s to 1990s show situation worsening



Modelling Results & Existing Baseline





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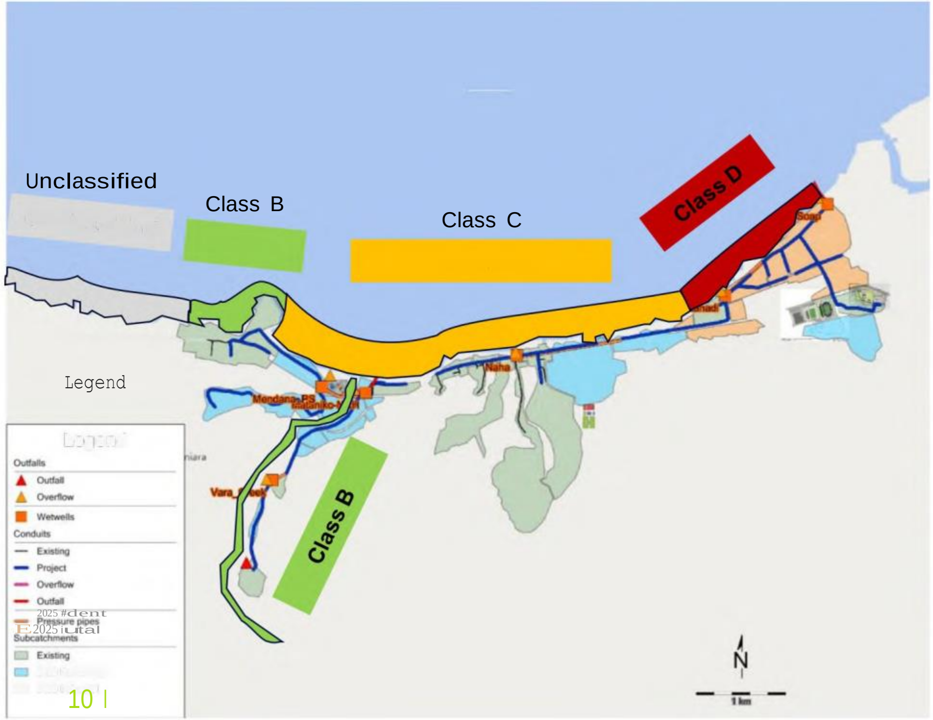
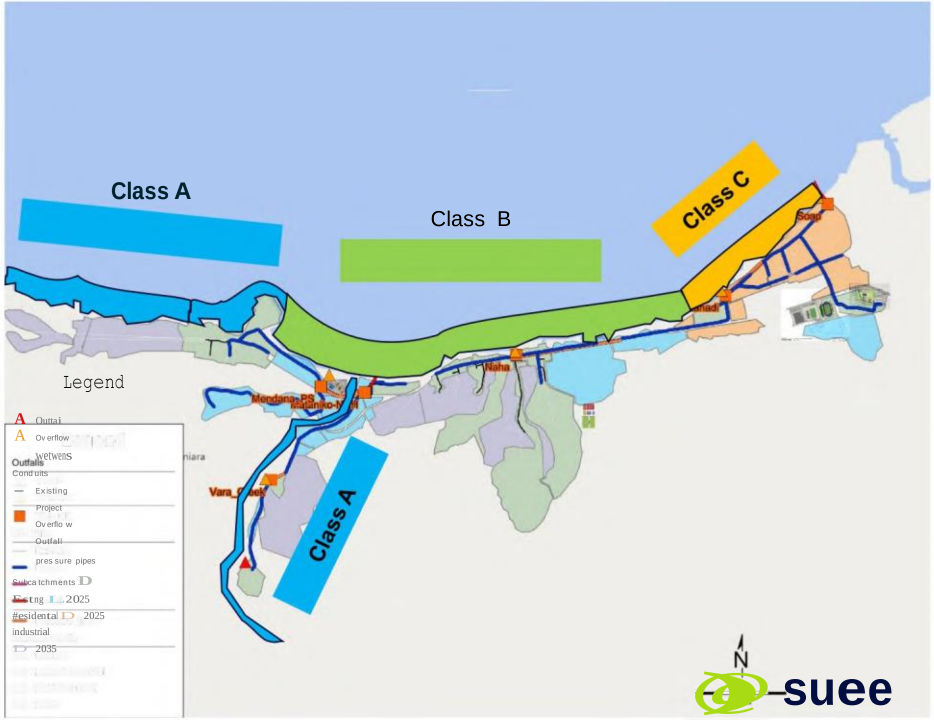
Maps showing phased approach to regulations/protection zones from Short to Long Term

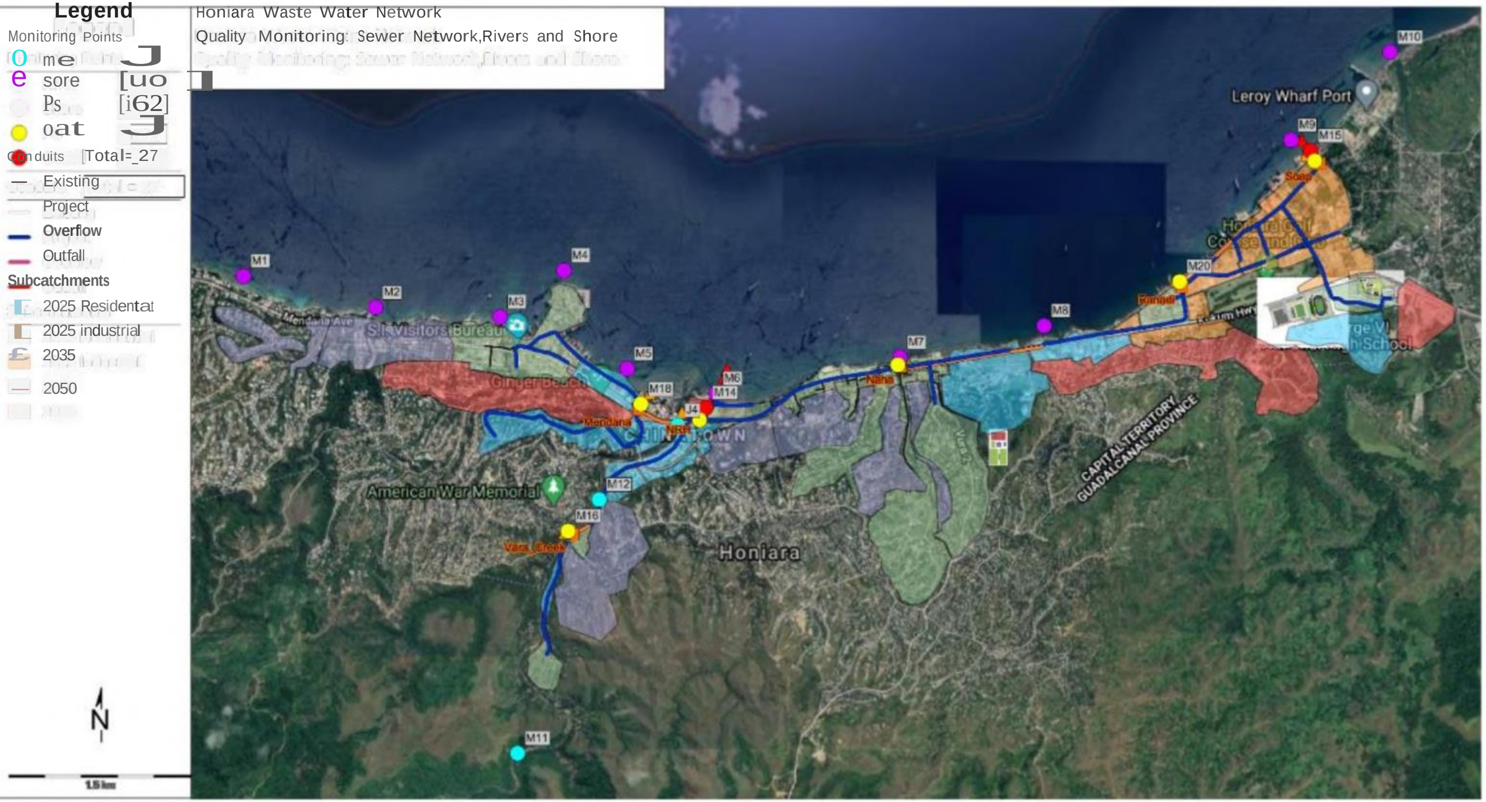
Short Term (say 2025-2040)



Long Term (post 2040)



Monitoring Proposal – Ambient WQ & System Instrumentation



- Monthly ambient water quality (Foreshore, Mataniko and eventually Lungga in the future)
- System measurements
  - Outfalls (continuous flow and quality)+ weekly spot samples
  - PS continuous hydraulic+ overflow events

II – Methodology for exceedance analysis

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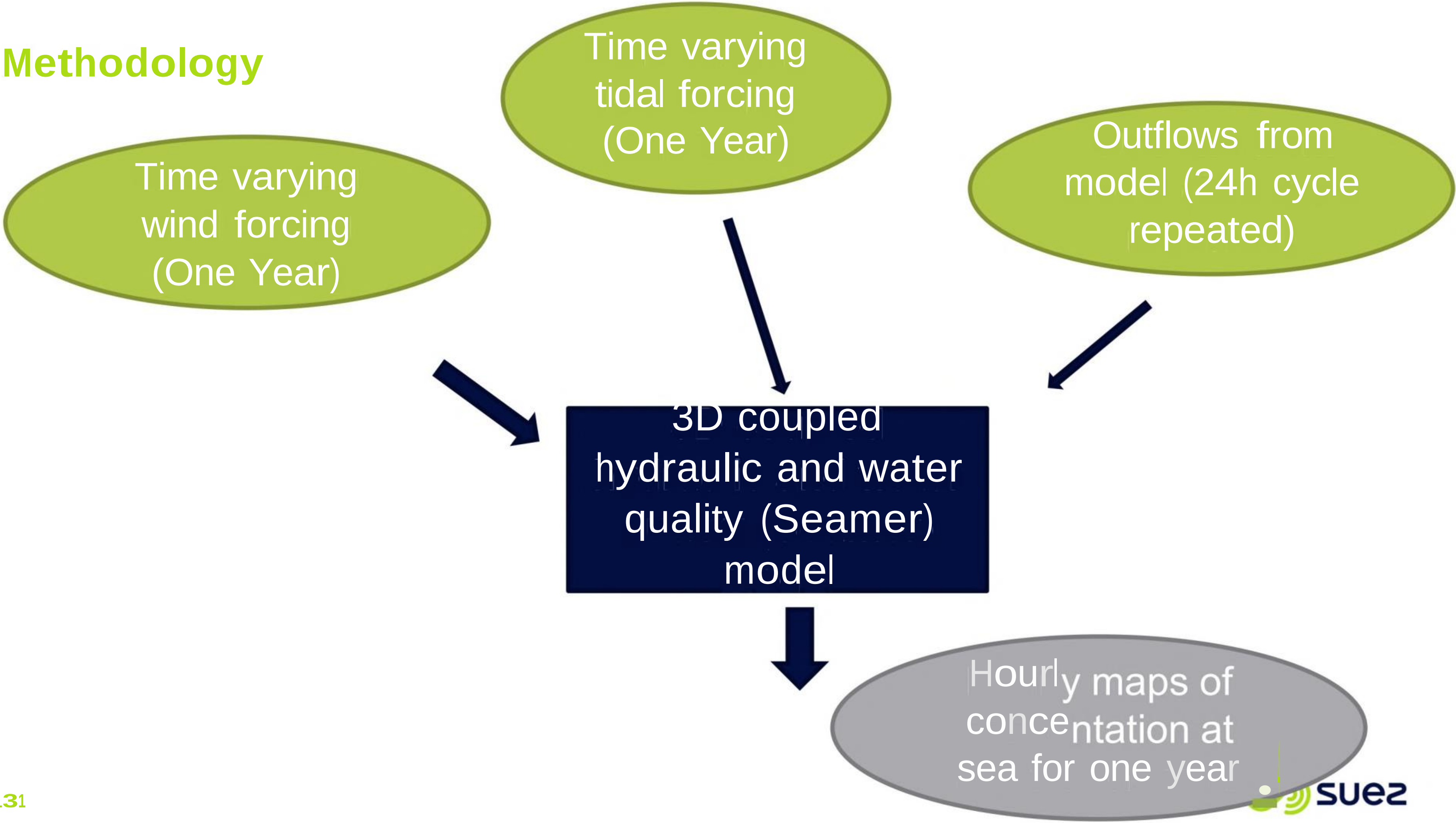
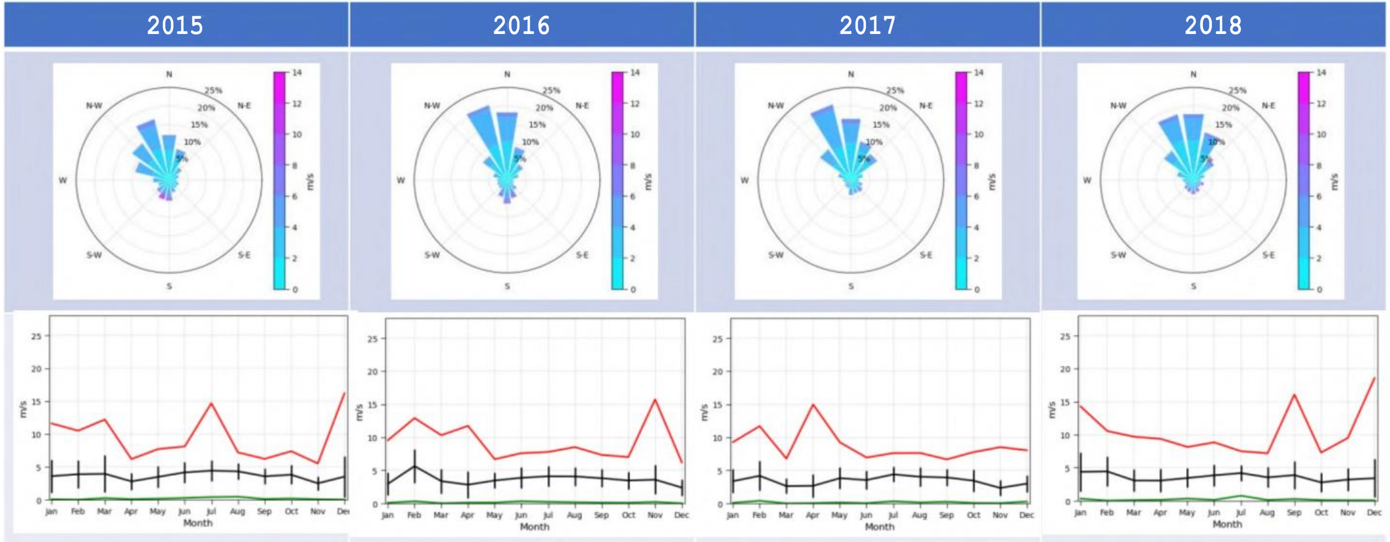
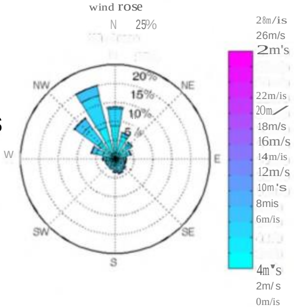
Methodology

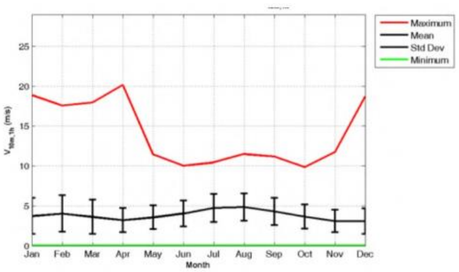


Identification of Representative Year from database



30 years timeseries





- ➔ Mean current speed (black line) very similar to complete timeseries for all the years
- ➔ Peak values (red line) always around 15 m/s
- ➔ 2017 wind rose is the closest to the complete timeseries

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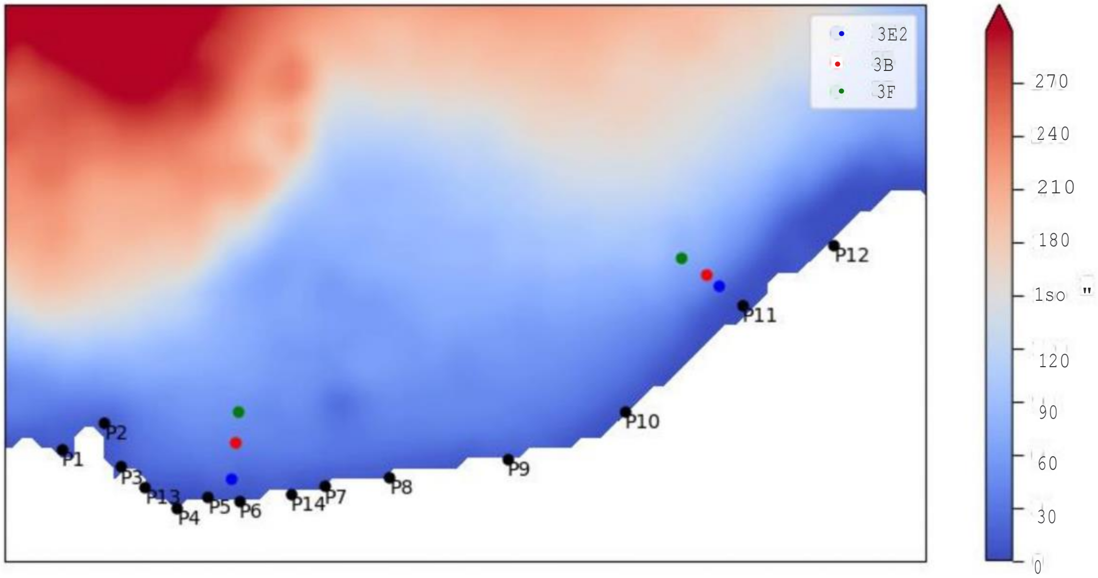
Model Set Up & Output Results

Simulation for year 2017 wind and tidal conditions. Four discharge scenarios:

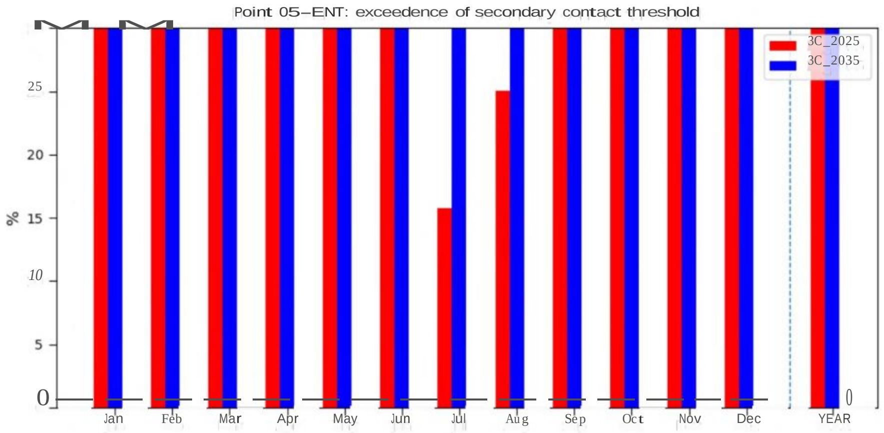
- Short outfalls (3E2, blue)
  - Depth NRH 8 m
  - Depth RAN 15 m
- Medium outfalls (3B, red)
  - Depth NRH 38 m
  - Depth RAN 40 m
- Long outfalls (3F, green)
  - Depth NRH 51 m
  - Depth RAN 72 m
- Medium outfalls (3C, red)
  - Depth NRH 25 m
  - Depth RAN 40 m



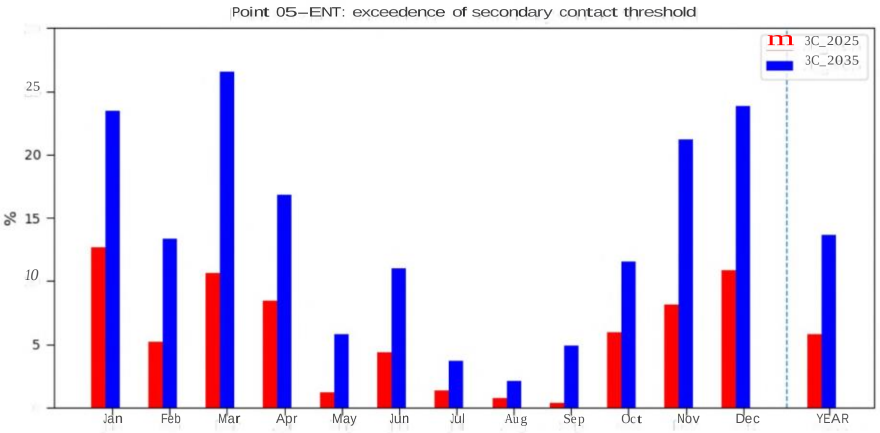
Output point: second « wet » point of the model perpendicular to the coastline at each location, approximately 100m from the shoreline

Seamer Results Comparison Enterococci (Point 5) – additionally conservative

At second wet point {effectively 150m offshore)



At first wet point {effectively 50 m offshore)



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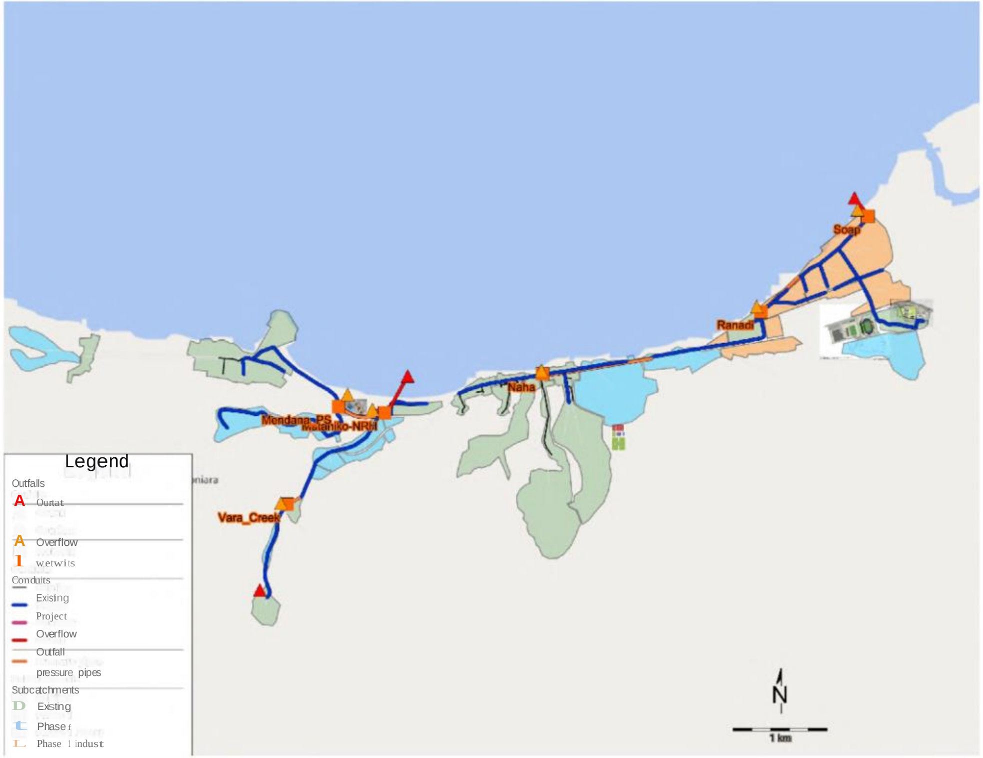
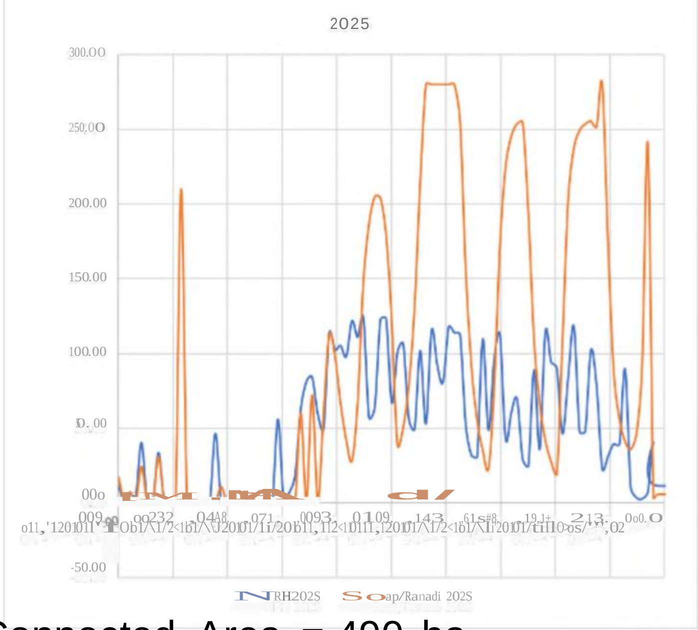
Phase 1 (2025) Discharge Characteristics





- Connected Area = 490 ha
- Maximum flow at NRH = 124.8 l/s
- Mean flow at NRH = 49.7 l/s
- Maximum flow at Soap/Ranadi = 288.4 l/s
- Mean flow at Soap/Ranadi = 101.0 l/s

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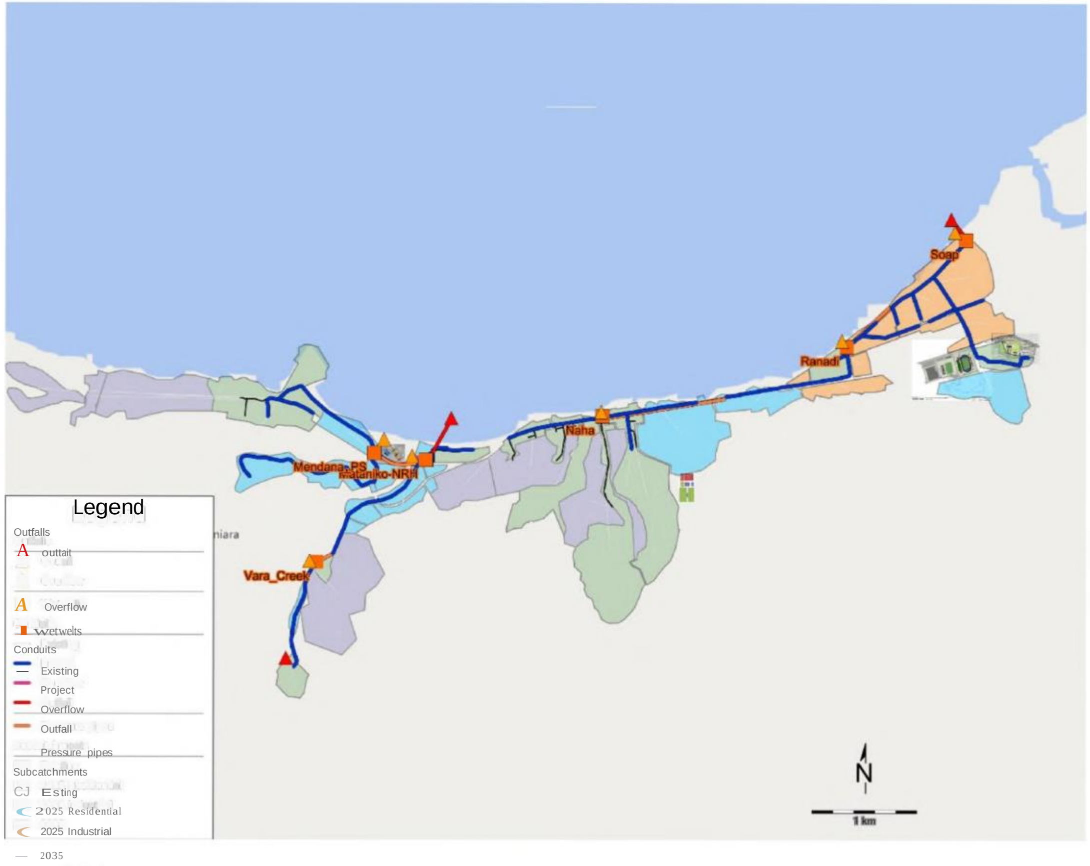
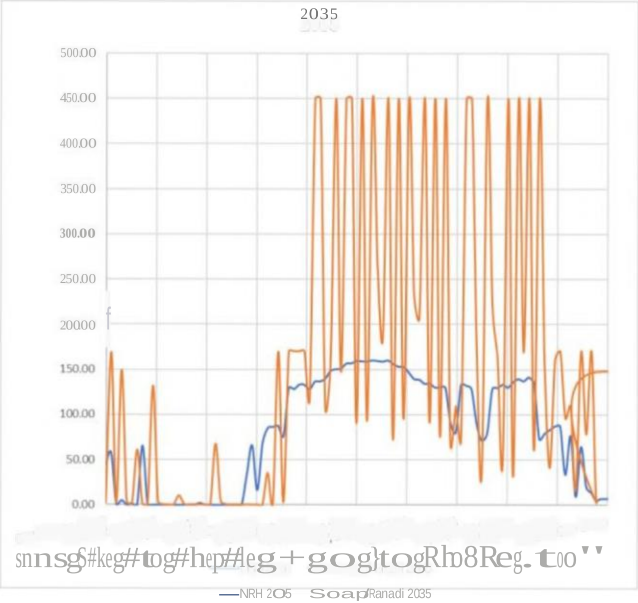
Phase 2 (2035) Discharge Characteristics





- Connected Area = 690 ha
- Maximum flow at NRH = 161 l/s
- Mean flow at NRH = 82 l/s
- Maximum flow at Soap/Ranadi = 460 l/
- Mean flow at Soap/Ranadi = 153 l/s

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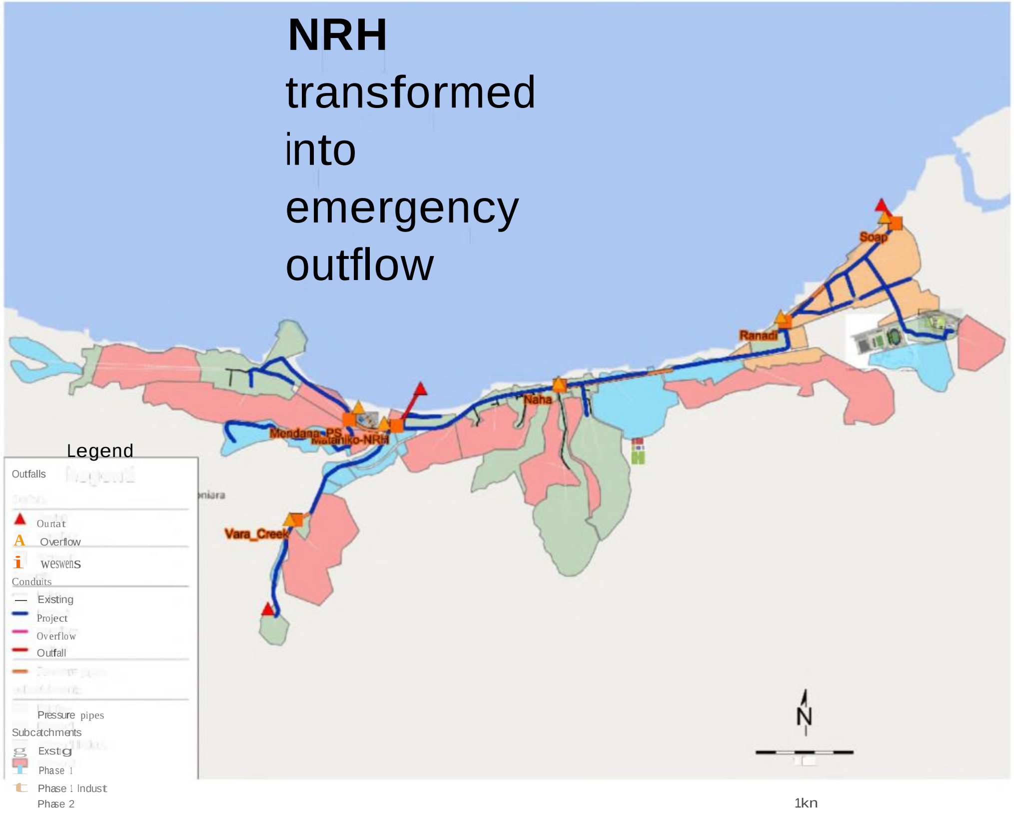
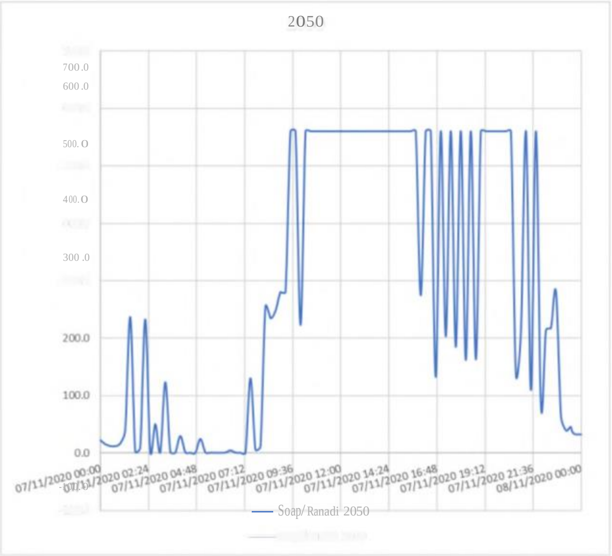
Phase 3 (2050) Discharge Characteristics





- Connected area = 831 ha
- Maximum flow at Soap/Ranadi = 560 l/s
- Mean flow at Soap/Ranadi = 280 l/s

Discharge Scenarios & Configurations

Date/Phase	Outfalls (Length in m)	Concentration (CFU/100 ml)
2025 – Phase 1 (3B 2025)	NRH 700 RANADI 500	E.coli 1e7 ENT 2.56
2025 – Phase 1 (3E2 2025)	NRH 350 RANADI 350	E.coli 1e7 ENT 2.56
2025 – Phase 1 (3F 2025)	NRH 1000 RANADI 750	E.coli 1e7 ENT 2.56
2025 – Phase 1 (3C 2025)	NRH 500 RANADI 500	E.coli 1e7 ENT 2.56
2035 – Phase 2 (3C 2035)	NRH 500 RANADI 500	E.coli 1e7 ENT 2.56
2050 – Phase 3 (4A 2050)	RANADI 500 (no treatment)	E.coli 1e7 ENT 2.56
2050 Phase 3 (4B 2050)	RANADI 750 (no treatment)	E.coli 1°7 ENT 2.56
2050 Phase 3 (4C 2050)	RANADI 500 (with treatment) -- 50% efficiency assumed for physico- chemical	E.coli 0.5e7 ENT 1.256
2050 Phase 3 (4D 2050)	RANADI 500 (with treatment) -- 25% efficiency assumed for primary treatment	E.coli 0.757 ENT 1.96

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III – Graphical plots for Enterococci for Intermediate Simulations & Exceedance Statistics @NRH outfall only Comparison of a 350m length and a 500 length outfall

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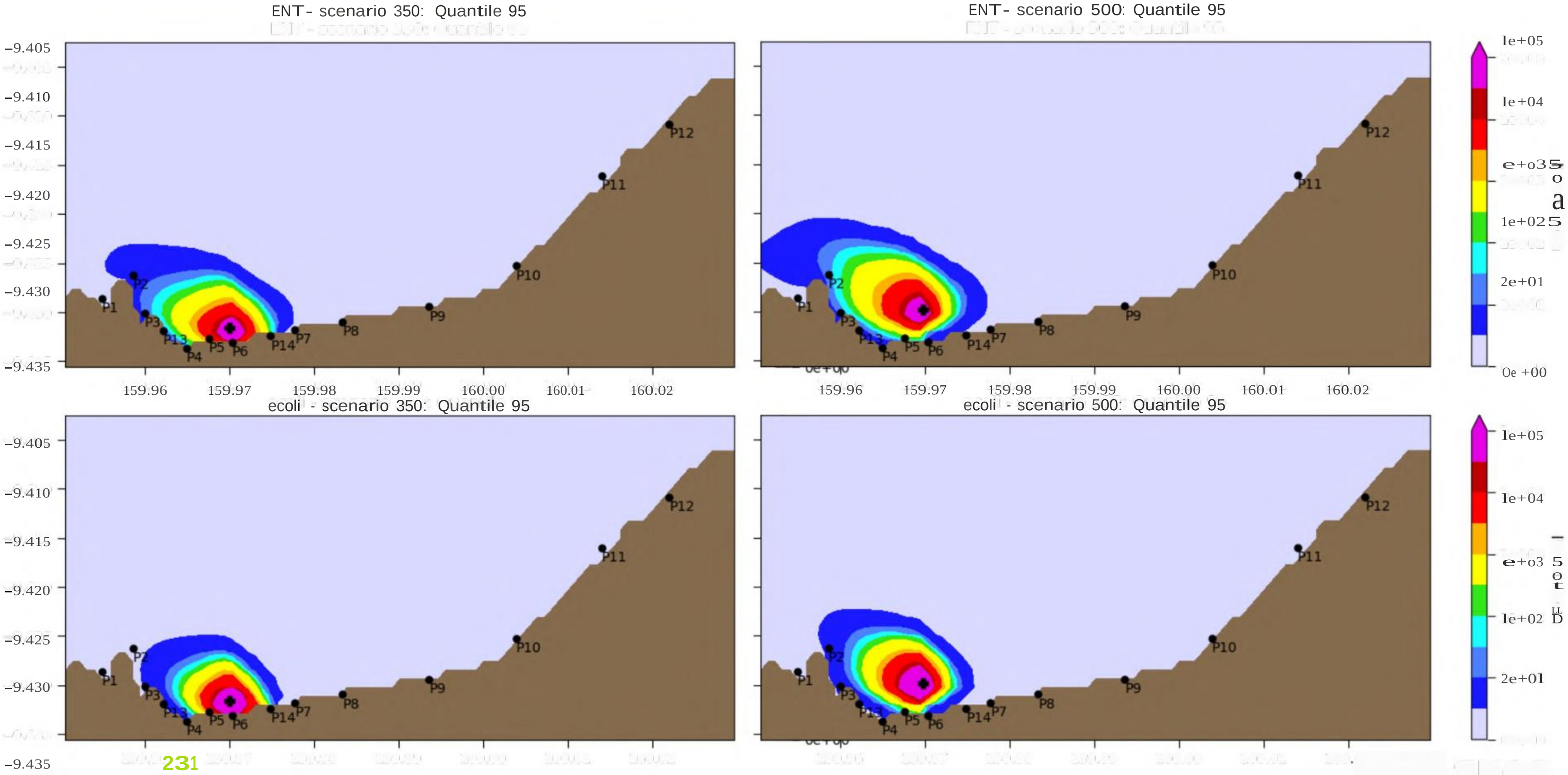
Simulations and results

Simulation for year 2017 wind and tidal conditions. Two scenarios for a single outfall at NRH with intermediate discharge rates at year 2035:

- Scenario 1– Short outfall: 350m (red dot)
- Scenario 2 - Medium outfall: 500m (blue dot)

Output point: second « wet » point of the model perpendicular to the coastline at each location, approximately 100m from the shoreline

95 Percentile Plots for 350m and 500m outfalls



159.96
159.97
159.98
159.99
160.00
160.01
160.02

159.96 159.97 159.98 159.99 160.00 160.01

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Exceedance Statistics for Enteroccoci for Water Quality Classes per Scenario

	Water Quality Class	ENT (FC/IO0mL)	Baseline (2019)	Scenario 1 3E2 2035 350m @NRH & 500m @Ranadi	Scenario 2 3C 2035 500m @NRH & 500m @Ranadi
P1	B	>200	100	0	0
P2	B	>200	100	0	0
P3	C	>500	100	0	0
P13	C	>500	100	0	0
P4	C	>500	100	0	0
PS	C	>500	100	30	4
P6	C	>500	100	83	3
P14	C	>500	100	0	0
P7	C	>500	100	0	0
P8	C	>500	100	0	0
pg	C	>500	100	0	0
P10	D		100	0	0
P11	D		100	0	0
P12	D		100	0	0

Exceedance Statistics for Enteroccoci for Water Quality Class A (Primary Contact}

	Water Quality Class	ENT (FC/100mL)	Baseline (2019)	Scenario 1 3E2 2035 350m @NRH & 500m @Ranadi	Scenario 2 3C 2035 500m @NRH & 500m @Ranadi
P1	A	>40	100	0	0
P2	A	>40	100	0	1
P3	A	>40	100	5	12
P13	A	>40	100	7	10
P4	A	>40	100	12	6
PS	A	>40	100	81	37
P6	A	>40	100	99	25
P14	A	>40	100	0	0
P7	A	>40	100	1	0
P8	A	>40	100	0	0
pg	A	>40	100	0	0
P10	A	>40	100	0	0
P11	A	>40	100	0	0
P12	A	>40	100	0	0

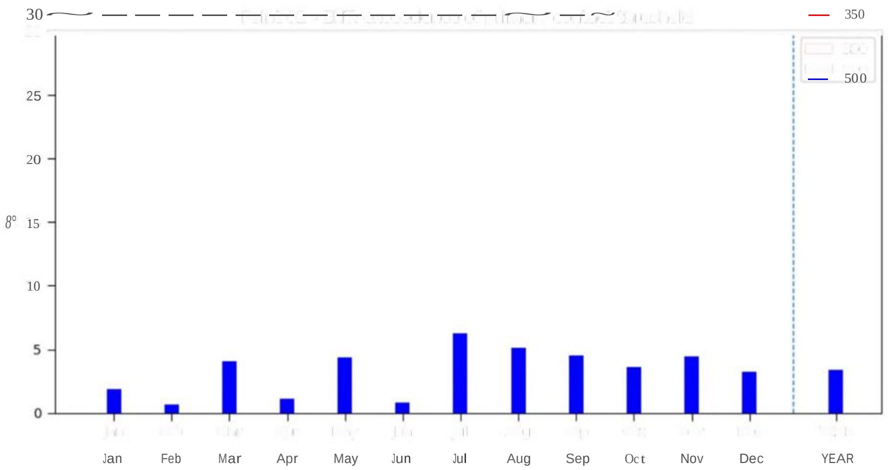
Exceedance Statistics for Enteroccoci for Water Quality Class B (Secondary Contact)

	Water Quality Class	ENT (FC/100mL)	Baseline (2019)	Scenario 1 3E2 2035 350m @NRH & 500m @Ranadi	Scenario 2 3C 2035 500m @NRH & 500m @Ranadi
P1	B	>200	100	0	0
P2	B	>200	100	0	0
P3	B	>200	100	0	2
P13	B	>200	100	1	1
P4	B	>200	100	1	0
PS	B	>200	100	53	14
P6	B	>200	100	93	9
P14	B	>200	100	0	0
P7	B	>200	100	0	0
P8	B	>200	100	0	0
pg	B	>200	100	0	0
P10	B	>200	100	0	0
P11	B	>200	100	0	0
P12	B	>200	100	0	0

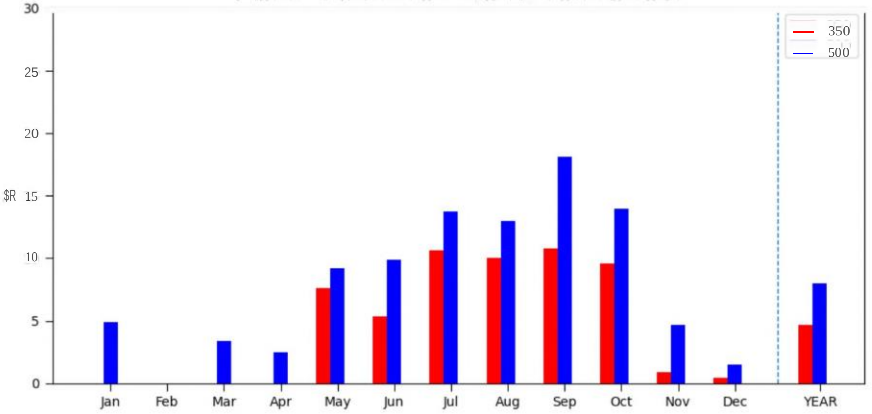
West of Mataniko river (1)

- No impact at P1
- Small impact at P2 for 500m outfall
- Significant impact at P3 for both

Point 02 - ENT: exceedence of primary contact threshold



Point 03 - ENT: exceedence of primary contact threshold



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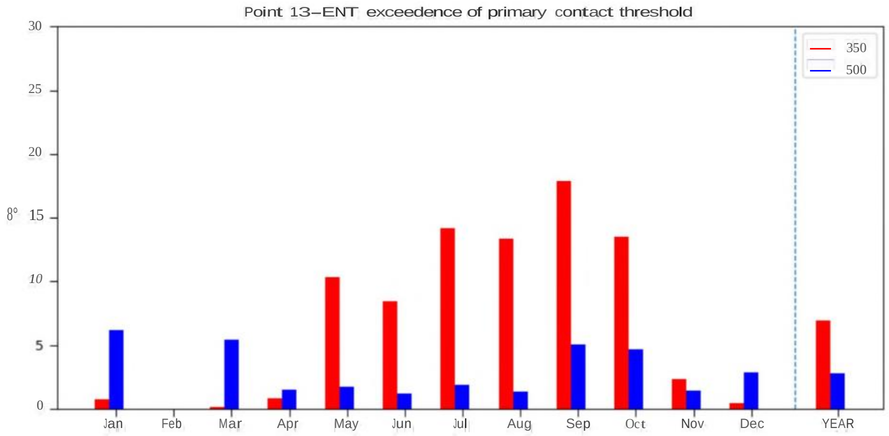
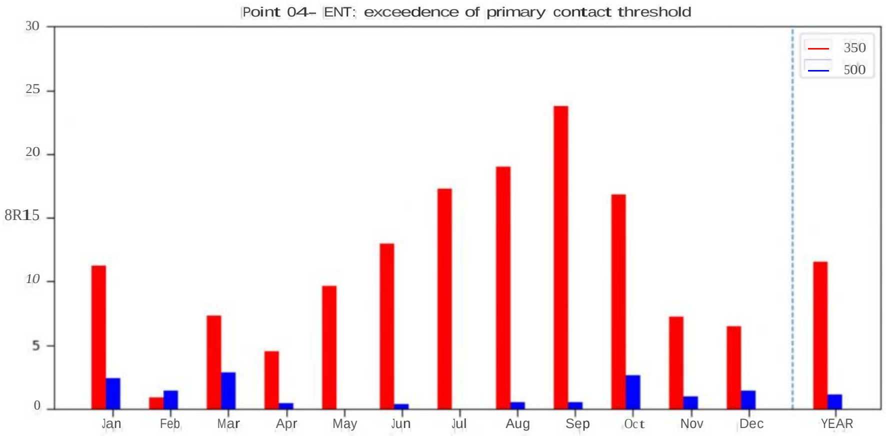
West of Mataniko river (2)

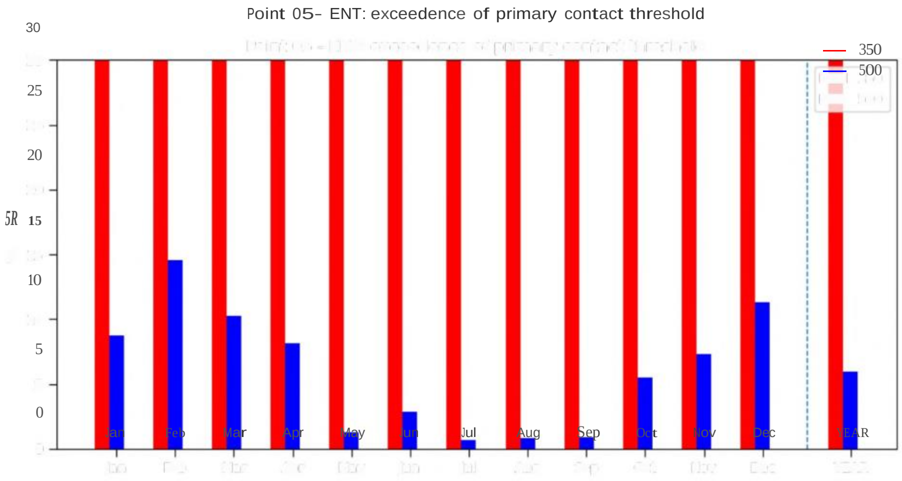
- Higher impact with 350m at P13 and P4
- Low impact with 500m outfall

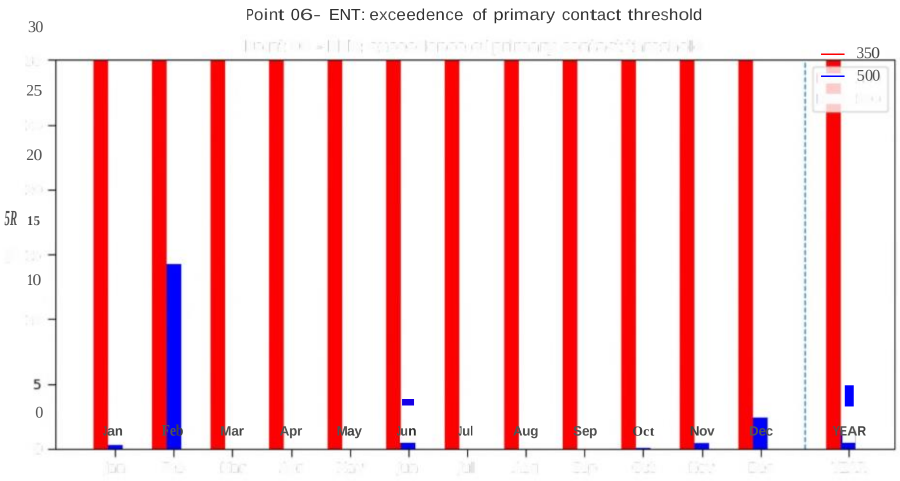




East of Mataniko river (1)

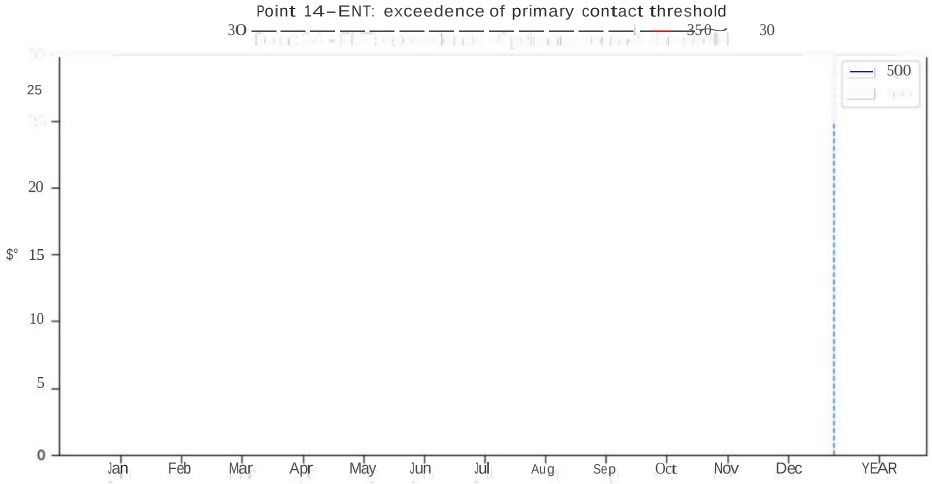
- **High impact at P5 and P6 for 350m outfall**
- **Lower impact with 500m**

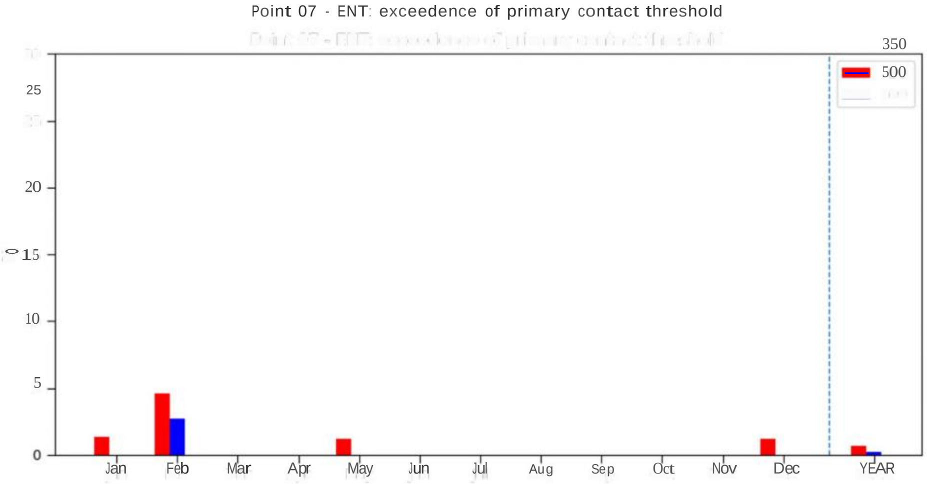




East of Mataniko river (2)

- High impact at P14 for 350m outfall, no impact with 500m
- No significant impact for P7 and points on the East





Conclusion

- With the 350m outfall: the plume is closer to the coast. Larger impact around Mataniko river, but lower impact at Point Cruz
- With the 500m outfall: higher impact to the west coast and lower impact around Mataniko river
- No impact to the East coast for both scenarios

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IV – Graphical plots for Enterococci for Intermediate Simulations & Exceedance Statistics

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Exceedance Statistics for Enteroccoci for Water Quality Classes per Scenario

Measurement Point		ENT (FC/100ml)		Annual Exceedance per Scenario (%)				
	Water Quality Class		Baseline (2019)	3B	3E2	3F	3C (2025)	3C (2035)
P1	B	>200	100	0	0	0	0	0
P2	B	>200	100	0	0	0	0	0
P3	C	>500	100	0	0	0	0	0
P13	C	>500	100	0	0	0	0	0
P4	C	>500	100	0	0	0	0	0
P5	C	>500	100	0	12	0	1	4
P6	C	>500	100	0	10	0	1	3
P14	C	>500	100	0	0	0	0	0
p7	C	>500	100	0	0	0	0	0
P8	C	>500	100	0	0	0	0	0
pg	C	>500	100	0	0	0	0	0
P10	D		100	0	0	0	0	0
P11	D		100	0	2	0	0	0
P12	D		100	0	0	0	0	0

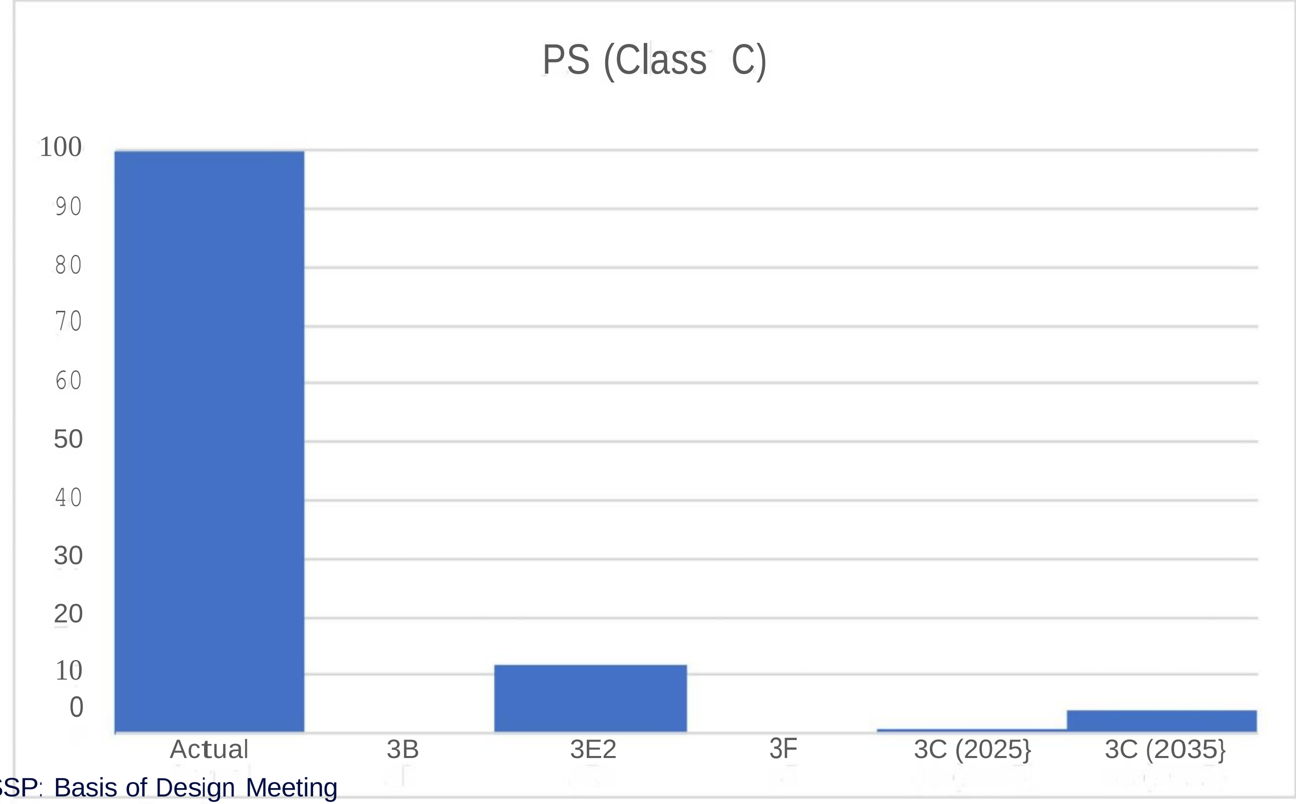
Exceedance Statistics for Enteroccoci for Water Quality Class A (Primary Contact}

Measurement Point		ENT (FC/100ml)		Annual Exceedance per Scenario (%)				
	Water Quality Class		Baseline (2019)	3B	3E2 (2025)	3F	3C (2025)	3C (2035)
P1	A	>40	100	0	0	0	0	0
P2	A	>40	100	0	0	0	0	1
P3	A	>40	100	1	0	6	7	12
P13	A	>40	100	0	8	0	4	10
P4	A	>40	100	0	8	0	2	6
P5	A	>40	100	0	55	0	27	37
P6	A	>40	100	1	37	0	17	25
P14	A	>40	100	0	0	0	0	0
P7	A	>40	100	0	0	0	0	0
P8	A	>40	100	0	0	0	0	0
pg	A	>40	100	0	0	0	0	0
P10	A	>40	100	1	1	0	1	2
P11	A	>40	100	2	15	0	8	10
P12	A	>40	100	0	0	0	1	1

Exceedance Statistics for Enteroccoci for Water Quality Class B (Secondary Contact)

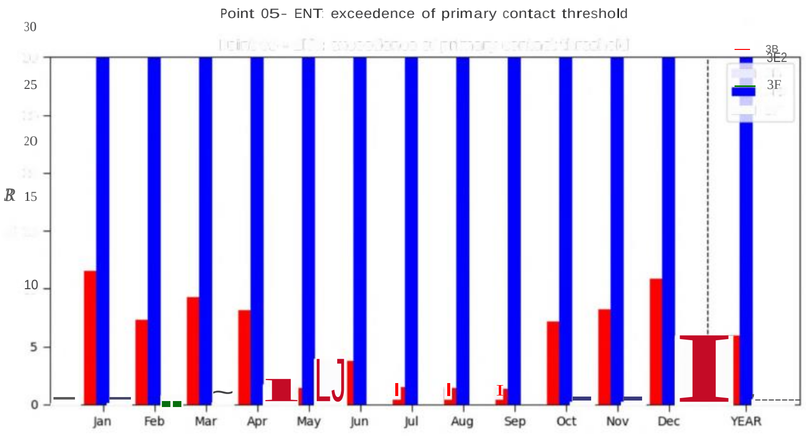
Measurement Point		ENT (FC/100ml)		Annual Exceedance per Scenario (%)				
	Water Quality Class		Baseline (2019)	3B	3E2	3F	3C (2025)	3C (2035)
P1	B	>200	100	0	0	0	0	0
P2	B	>200	100	0	0	0	0	0
P3	B	>200	100	0	0	0	0	2
P13	B	>200	100	0	0	0	0	1
P4	B	>200	100	0	0	0	0	0
P5	B	>200	100	0	27	0	6	14
P6	B	>200	100	0	20	0	4	9
P14	B	>200	100	0	0	0	0	0
p7	B	>200	100	0	0	0	0	
0								
P8	B	>200	100	0	0	0	0	0
pg	B	>200	100	0	0	0	0	0
P10	B	>200	100	0	0	0	0	0
P11	B	>200	100	0	6	0	1	2
P12	B	>200	100	0	0	0	0	

Comparison of Point 5 adjacent to Mataniko for Class C with actual conditions

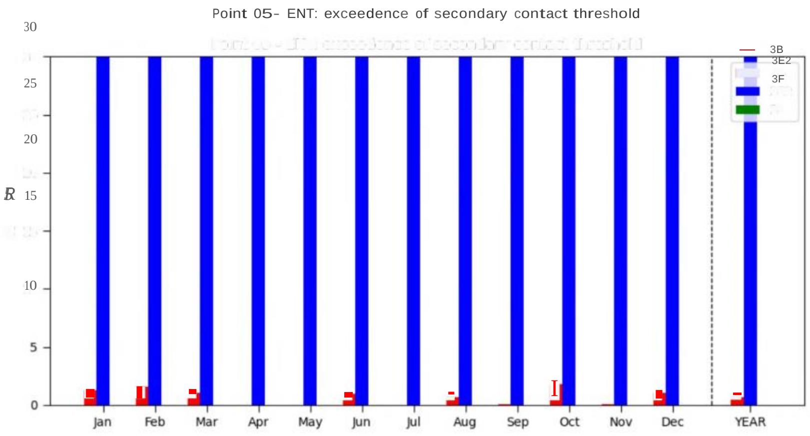


Point 5 Compliance with more stringent classes

Class A Compliance (40 CF/100ml)

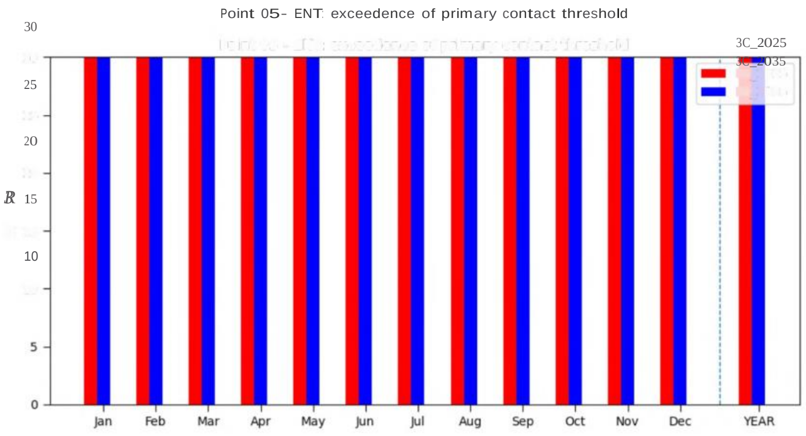


Class B Compliance (200 CF/100ml)

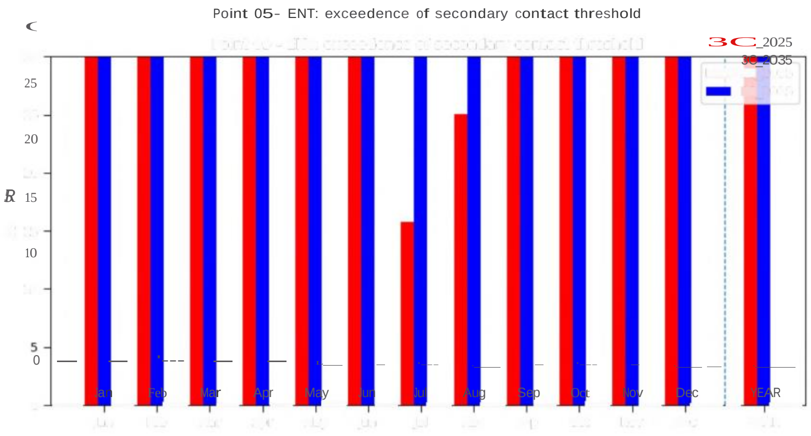


Scenario 3C (2025 & 2035)

Class A Compliance (40 CF/100ml)



Secondary Contact (200 CF/100ml)



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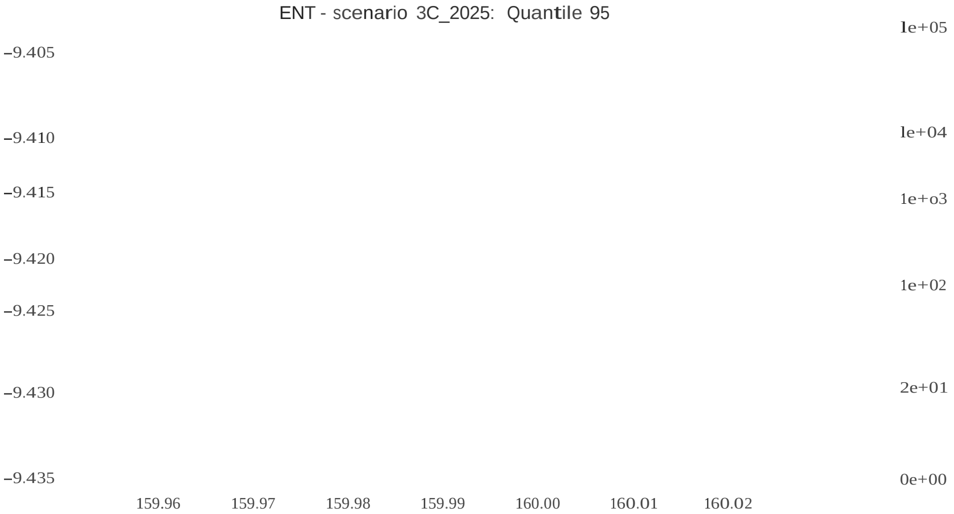
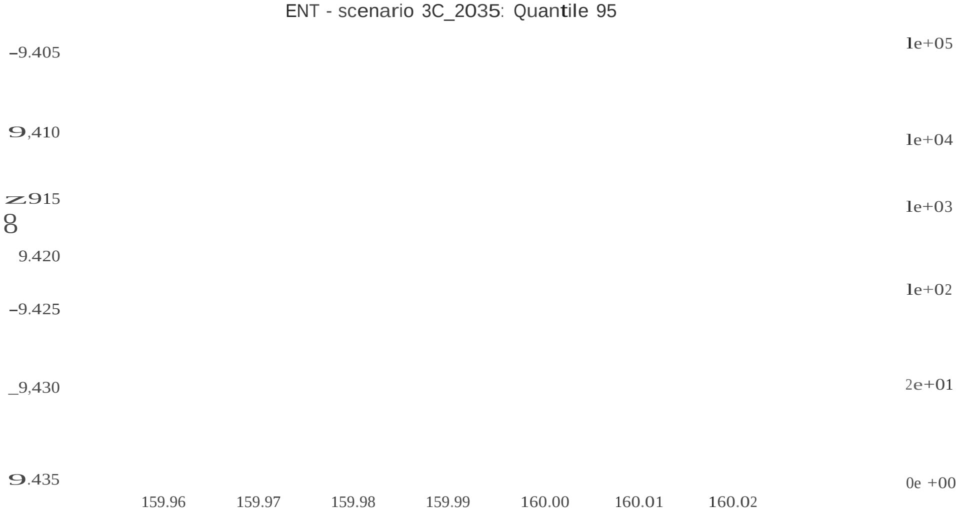
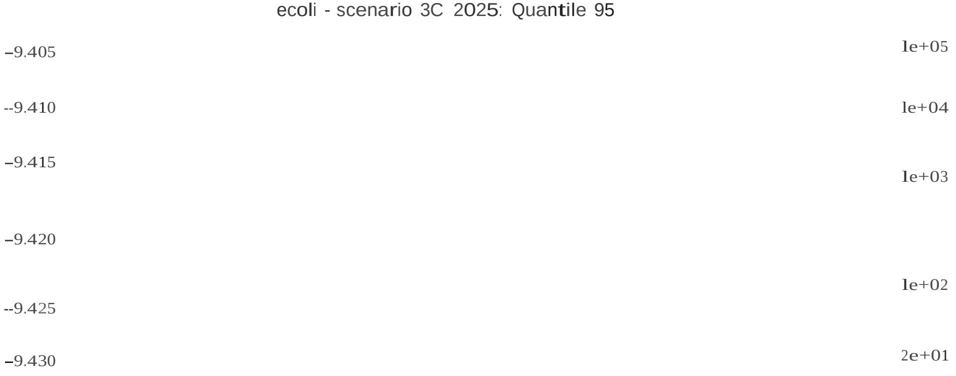
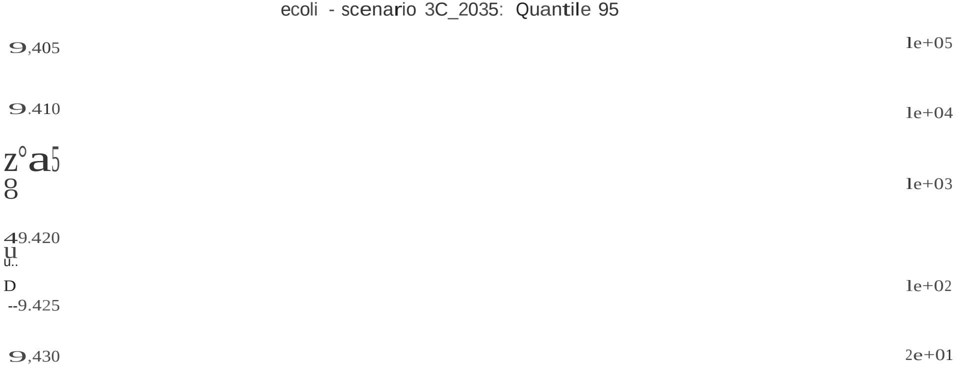
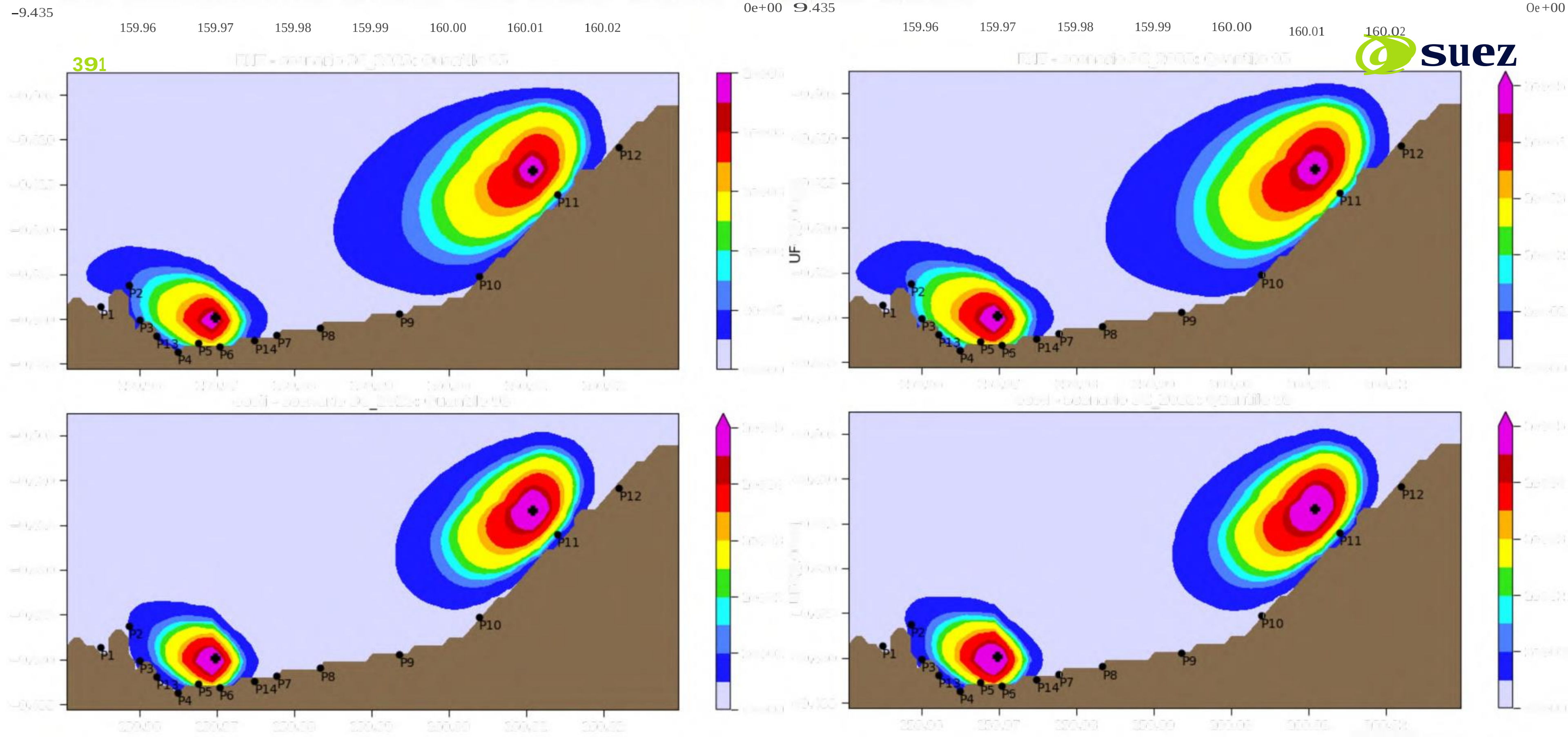
95 Percentile Plots for ENT 2025 & ENT 2035











−9.435
0e+00
9.435
0e+00
159.96
159.97
159.98
159.99
160.00
160.01
160.02
391
UF
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14

V – Exceedance Statistics & Graphical Plots for long term (2050)

2050 – Phase 3 (4A 2050)	**RANADI 500 (no treatment)**	**E.coli 17** **ENT 2.56**
2050 Phase 3 (48 2050)	RANADI 750 (no treatment)	E.coli 1°7 ENT 2.56
2050 Phase 3 (4C 2050)	RANADI 500 (with treatment) -- 50% efficiency assumed for physico- chemical	E.coli 0.5e7 ENT 1.256
2050 Phase 3 (4D 2050)	RANADI 500 (with treatment) -- 25% efficiency assumed for primary treatment	E.coli 0.75°7 ENT 1.96

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Exceedance Statistics for Enteroccoci for Water Quality Classes per Scenario

Measurement Point		ENT (FC/100 ml)	Annual Exceedance per Scenario (%)			
	Class		**4A**	4B	4C	4D
P1	**A**	>40	0	0	0	0
P2	**A**	>40	0	0	0	0
P3	B	>200	0	0	0	0
P13	B	>200	0	0	0	0
P4	B	>200	0	0	0	0
P5	B	>200	0	0	0	0
P6	B	>200	0	0	0	0
P14	B	>200	0	0	0	0
P7	B	>200	0	0	0	0
P8	B	>200	0	0	0	0
P9	B	>200	0	0	0	0
P10	C	>500	0	0	0	0
P11	C	>500	1.5	0	0	0
P12	C	>500	0	0	0	0

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Exceedance Statistics for Enteroccoci for Water Quality Class A (Primary Contact}

Measurement Point		ENT (FC/100 ml)	Annual Exceedance per Scenario (%)			
	Class		4A	4B	4C	4D
P1	A	>40	0	0	0	0
P2	A	>40	0	0	0	0
P3	A	>40	0	0	0	0
P13	A	>40	0	0	0	0
P4	A	>40	0	0	0	0
P5	A	>40	0	0	0	0
P6	A	>40	0	0	0	0
P14	A	>40	0	0	0	0
p7	A	>40	0	0	0	0
P8	A	>40	0	0	0	0
pg	A	>40	0	0	0	0
P10	A	>40	5	0	2	3
P11	A	>40	15	0	10	13
P12	A	>40	2	0	1	2

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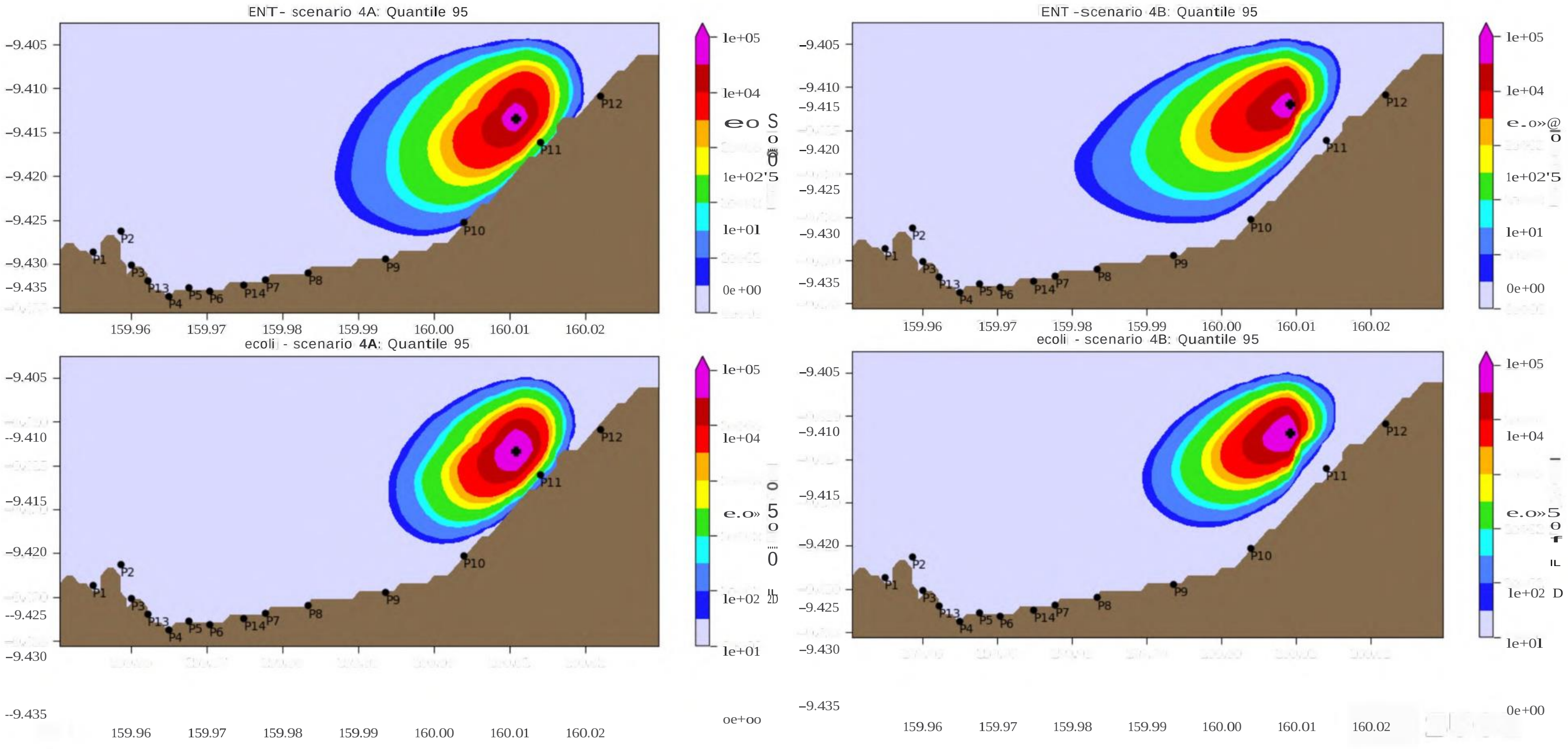
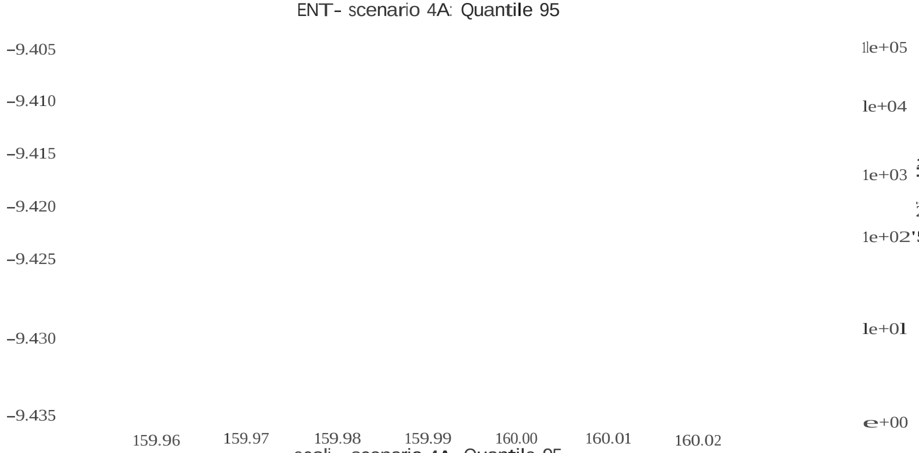
Exceedance Statistics for Enteroccoci for Water Quality Class B (Secondary Contact)

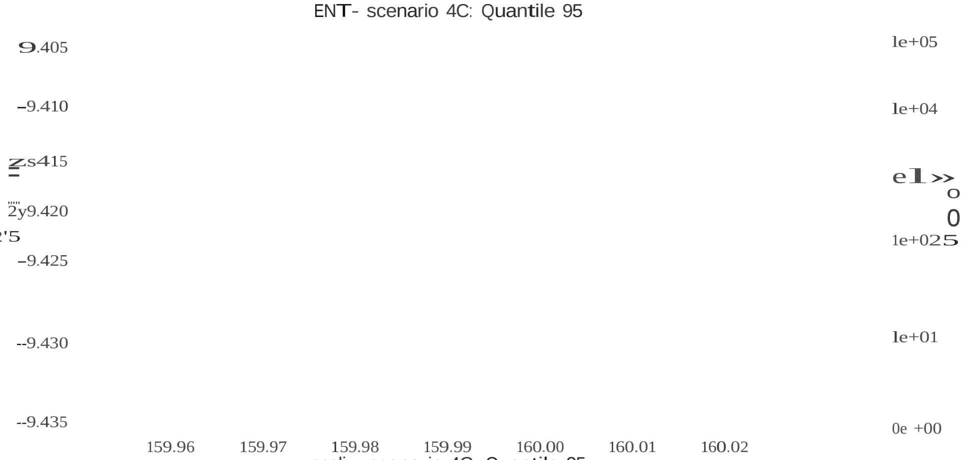
Measurement Point		ENT (FC/100 ml)	Annual Exceedance per Scenario (%)			
	Class		4A	4B	4C	4D
P1	B	>200	0	0	0	0
P2	B	>200	0	0	0	0
P3	B	>200	0	0	0	0
P13	B	>200	0	0	0	0
P4	B	>200	0	0	0	0
P5	B	>200	0	0	0	0
P6	B	>200	0	0	0	0
P14	B	>200	0	0	0	0
P7	B	>200	0	0	0	0
P8	B	>200	0	0	0	0
pg	B	>200	0	0	0	0
P10	B	>200	0	0	0	0
P11	B	>200	5	0	2	3
P12	B	>200	0	0	0	0

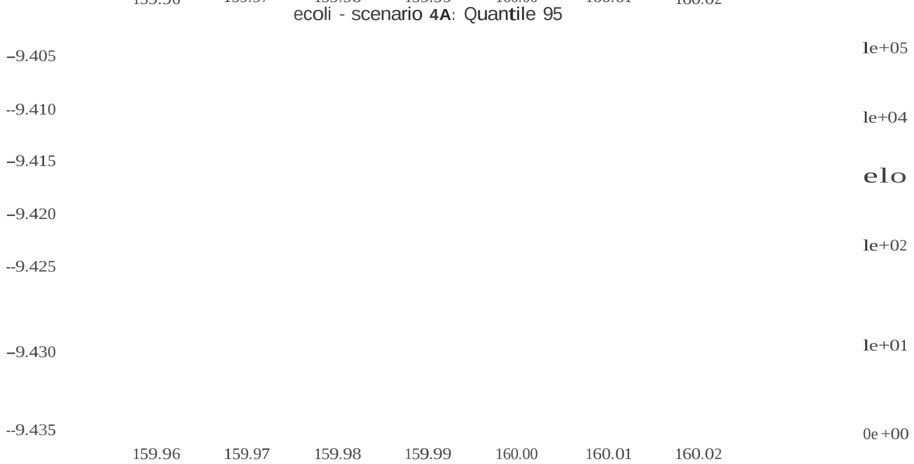
95 Percentile Plots for ENT 2050 500 m & ENT 2050 750 m

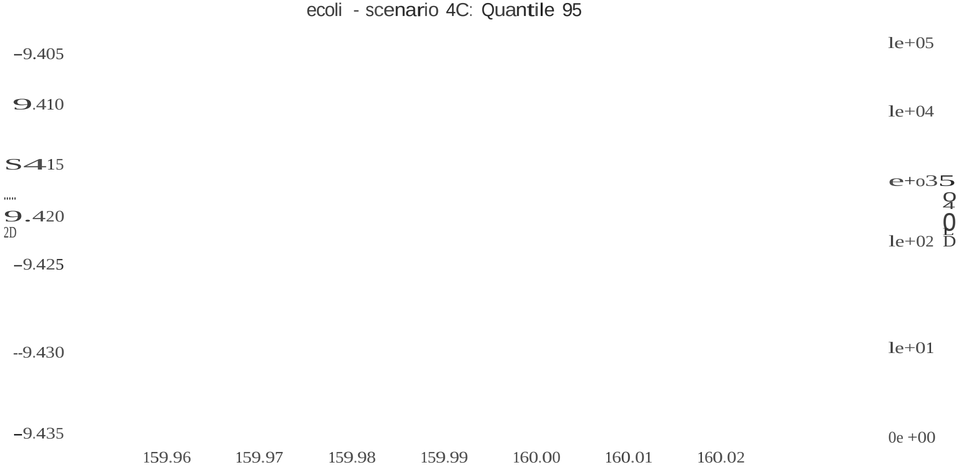


95 Percentile Plots for ENT 2050 500 m & ENT 2050 500 m {physico chemical treatment)









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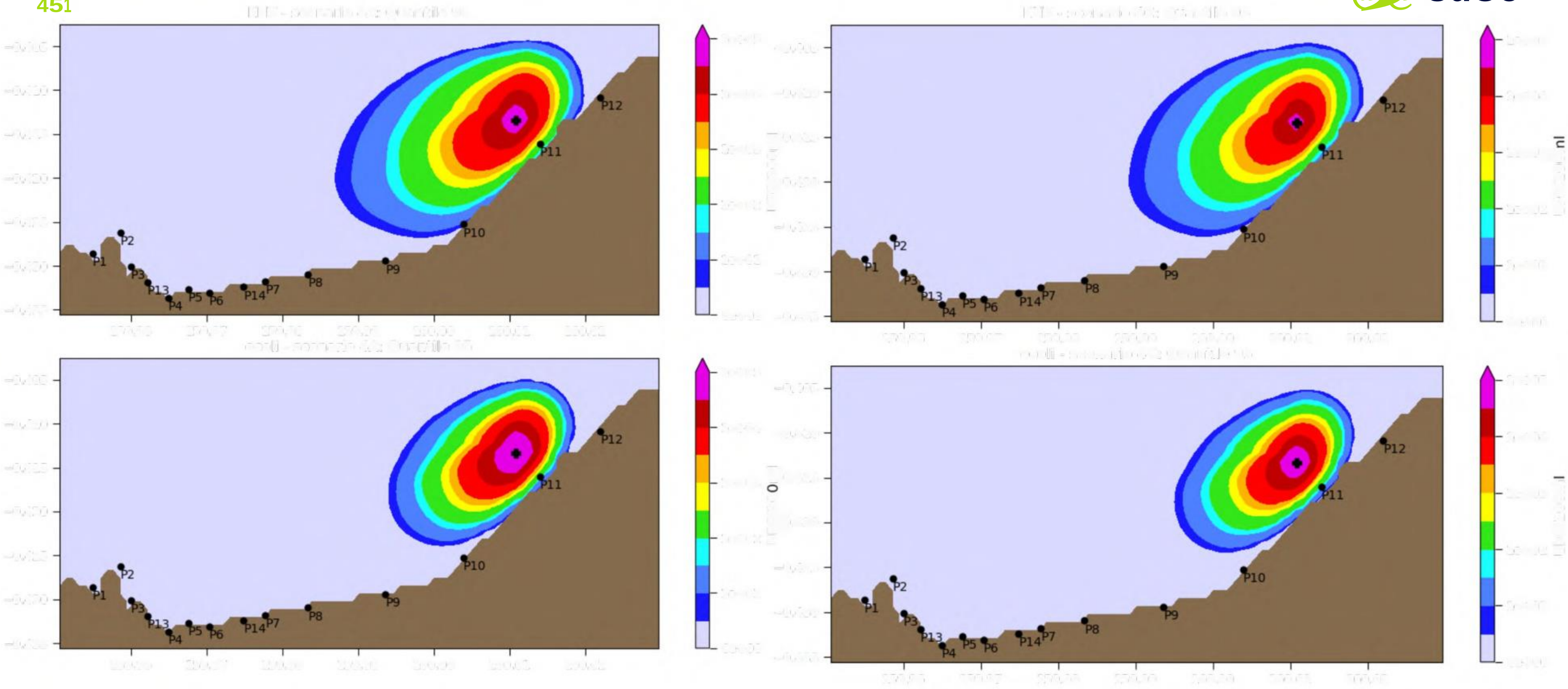
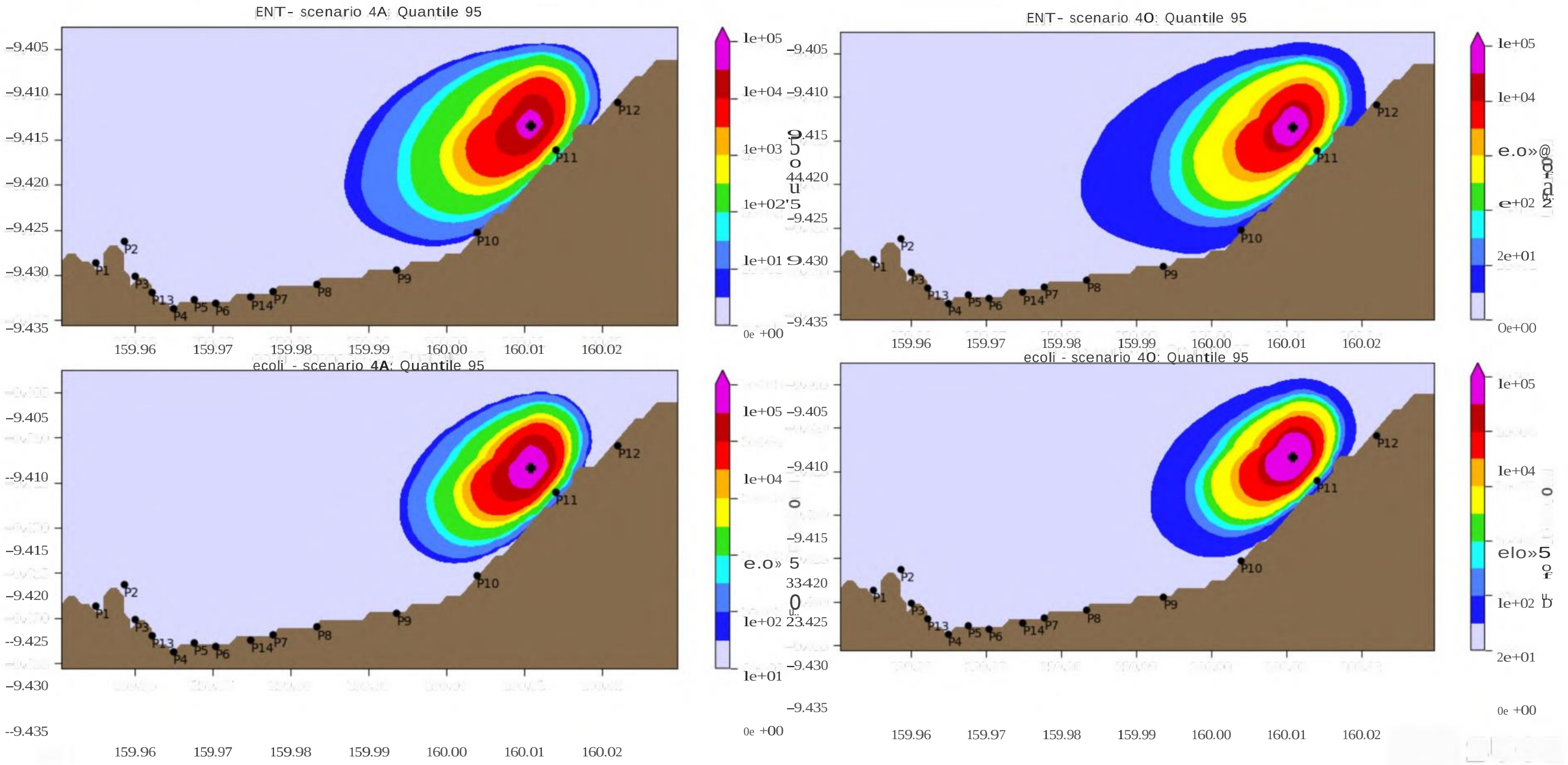


95 Percentile Plots for ENT 2050 500 m & ENT 2050 500 m (primary treatment)



VI – Cost Analysis (LCA & Initial investment cost)

Unit Costs for Outfalls
Cost Analysis (LCA & Initial investment cost)
Further Optimisations being undertaken

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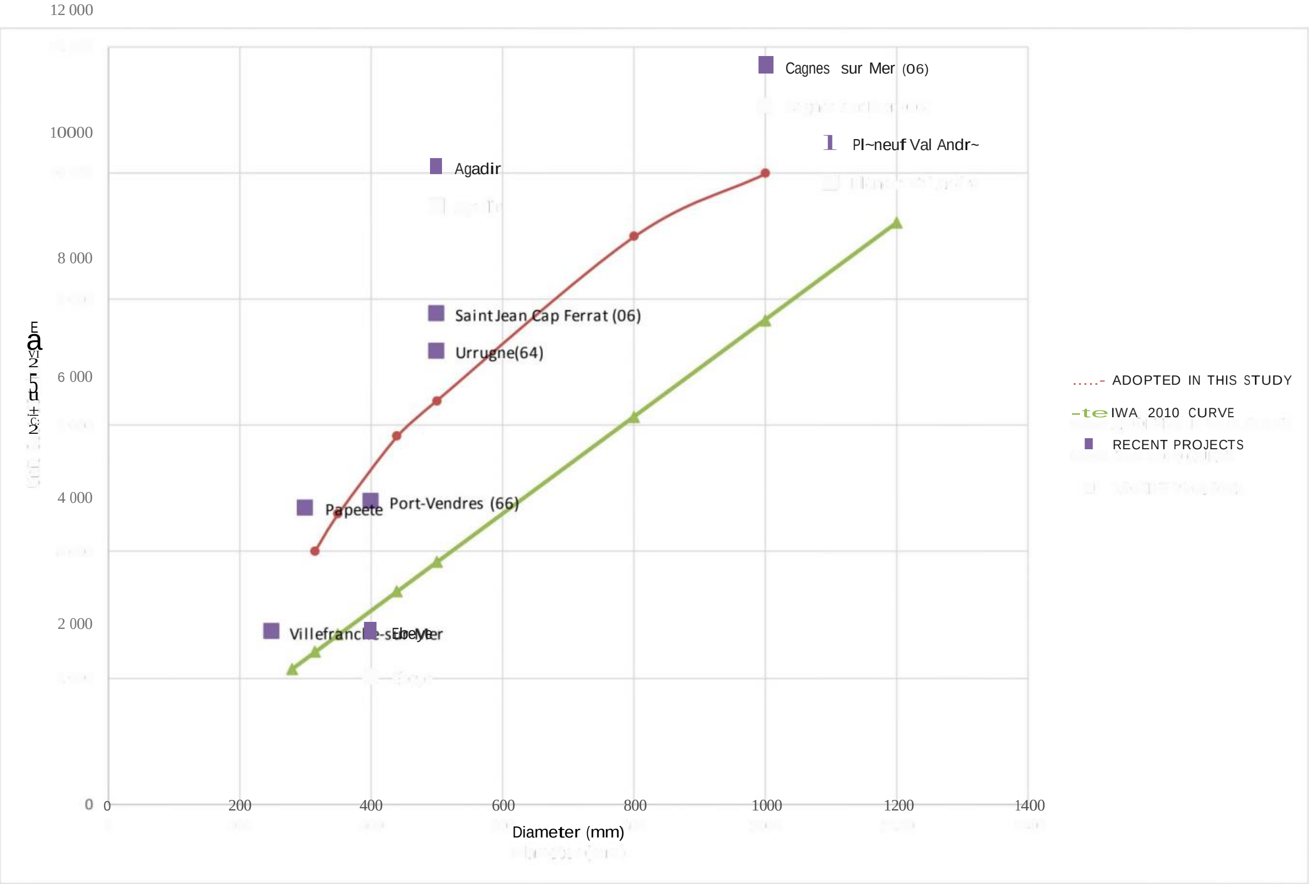
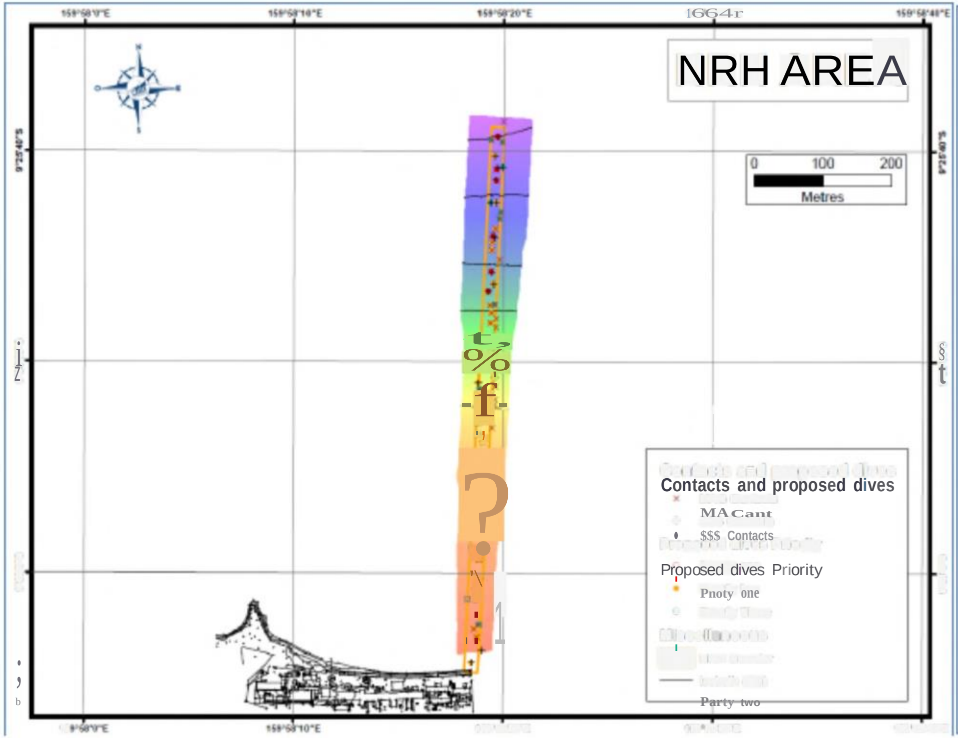
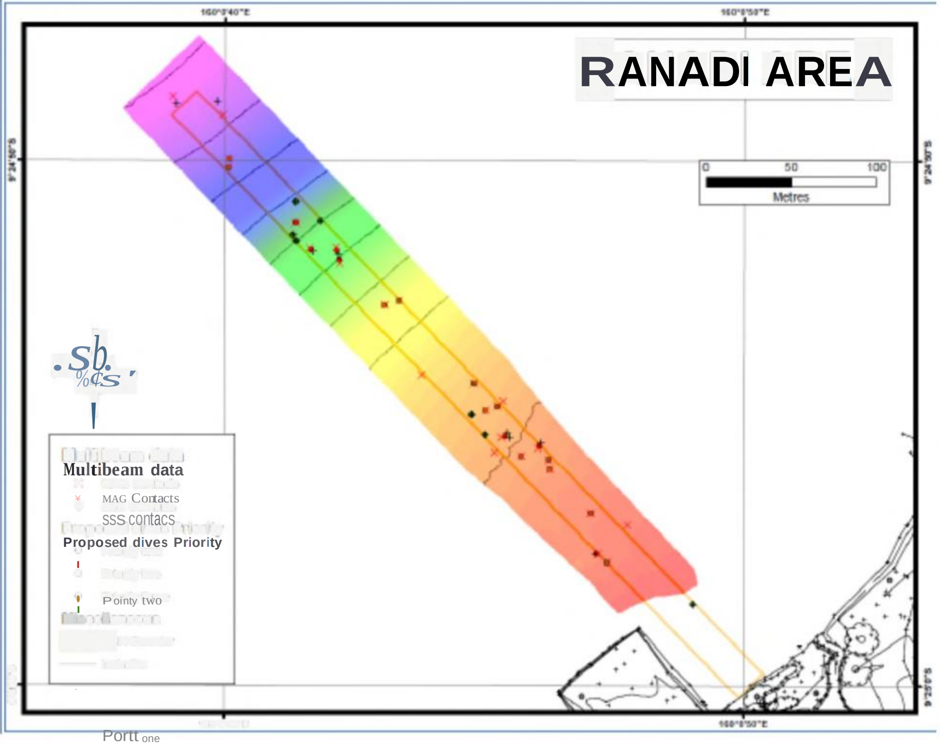
Verification of Unit Costs of Outfalls



Sea Bed/UXO Surveys – Contacts to be checked





Porty Tree
Miscellaneous
Portt one
Miscellaneous

Outfall Optimisation & Dimensioning per Scenario {see *configurations at end for further details*}

Option	Description	Outfalls NRH m	NRH DN(mm)	Ranadi m	Ranadi DN (mm)	Total Outfall Cost (MUSD)
Scenario 3F:	Two Outfalls (NRH & Ranadi; Naha to Renadi;longer outfalls)	1000	560	750	630	12.6
Scenario 3B:	Two Outfalls (NRH & Ranadi; Naha to Renadi;longer outfalls)	700	500	500	560	7.7
Scenario 3E2:	Two Outfalls (NRH & Ranadi; Naha to Renadi;Treatment Phase 2 ; short outfalls)	350	450	350	560	4.3
Scenario 3C:	Two Outfalls (NRH & Ranadi; Naha to Renadi;Treatment Phase 2 ; medium outfalls)	500	450	500	560	6.1
Scenario 4A:	One Outfall (Ranadi), no treatment	0	0	500	800	5.0
Scenario 3E2->4A:	Two Outfalls (NRH & Ranadi; Naha to Renadi;All to Ranadi P2+ No Treatment; medium outfalls)	350	400	500	800	6.6

- **Outfalls designed to maintain a reasonable level at equilibrium chambers. This optimizes energy costs**
- **Longer outfalls for same flow will require larger size to maintain same headloss (also slight increase in headloss with depth)**
- **Scenarios 3F, 38, 3C, 3E2 have two outfalls for whole durations**
- **Scenario 4A has one outfall only**
- **Scenario 3E2->4A is a hybrid, switching to one outfall post 2040 (or thereabouts) with**

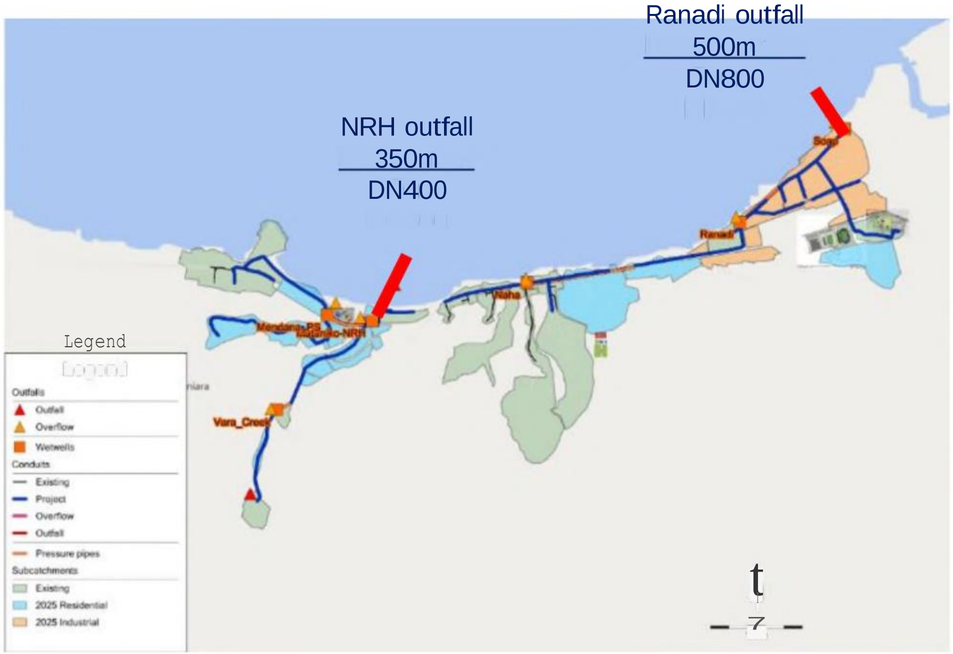
Ranadi outfall installed for the lea lon term in Phase 1

Least Cost Analysis (Alternative Scenarios)

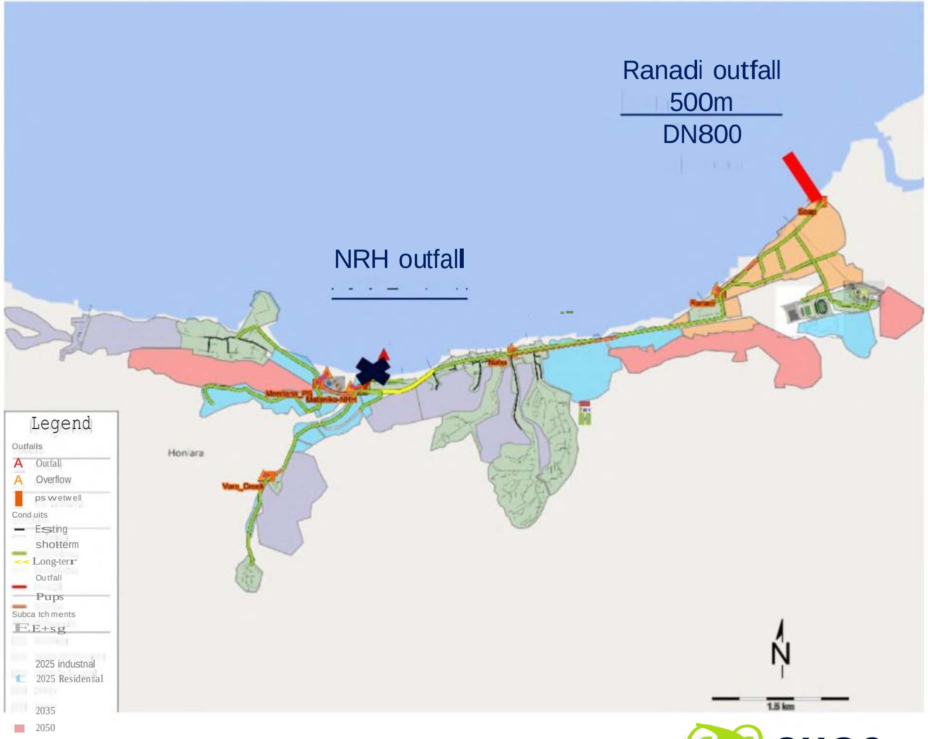
Option	Description	Capital Cost		Annual Operating Cost at		Net Present Value (million USO)			Rank by NPV for all		
		Short Term	Long Term	Short Term (2025)	Long Term (2040)	5%	7%	9%	5%	7%	9%
Scenario 3F:	Two Outfalls **(NRH** &	26.84	26.84	1.06	1.32	39.36	34.04	30.07	5	6	6
Scenario 3B:	Ranadi; Naha to Renadi; longer outfalls) Two Outfalls **(NRH** &	22.19	22.19	1.01	1.27	34.73	29.77	26.12	4	4	4
Scenario 3E2:	Ranadi; Naha to Renadi; longer outfalls) Two Outfalls **(NRH** &								3	2	1
Scenario 3C:	Ranadi; Naha to Renadi;Treatment Phase 2 ; short outfalls) Two Outfalls **(NRH** &	18.48	23.90	0.92	1.35	33.31	27.90	23.98	2	3	3
Scenario 4A:	Ranadi; Naha to Renadi;Treatment Phase 2; medium outfalls) One Outfall (Ranadi), no	20.61	20.61	0.97	1.24	32.88	28.11	24.60	6	5	5
Scenario 3E2->4A:	treatment Two Outfalls **(NRH** &	22.71	22.71	1.32	1.69	39.55	33.58	29.18	1	1	2
	Ranadi; Naha to Renadi;All to Ranadi P2+ No Treatment; medium outfalls)	21.48	21.72	0.87	1.48	32.48	27.90	24.52			

Scenario 3E2->4A

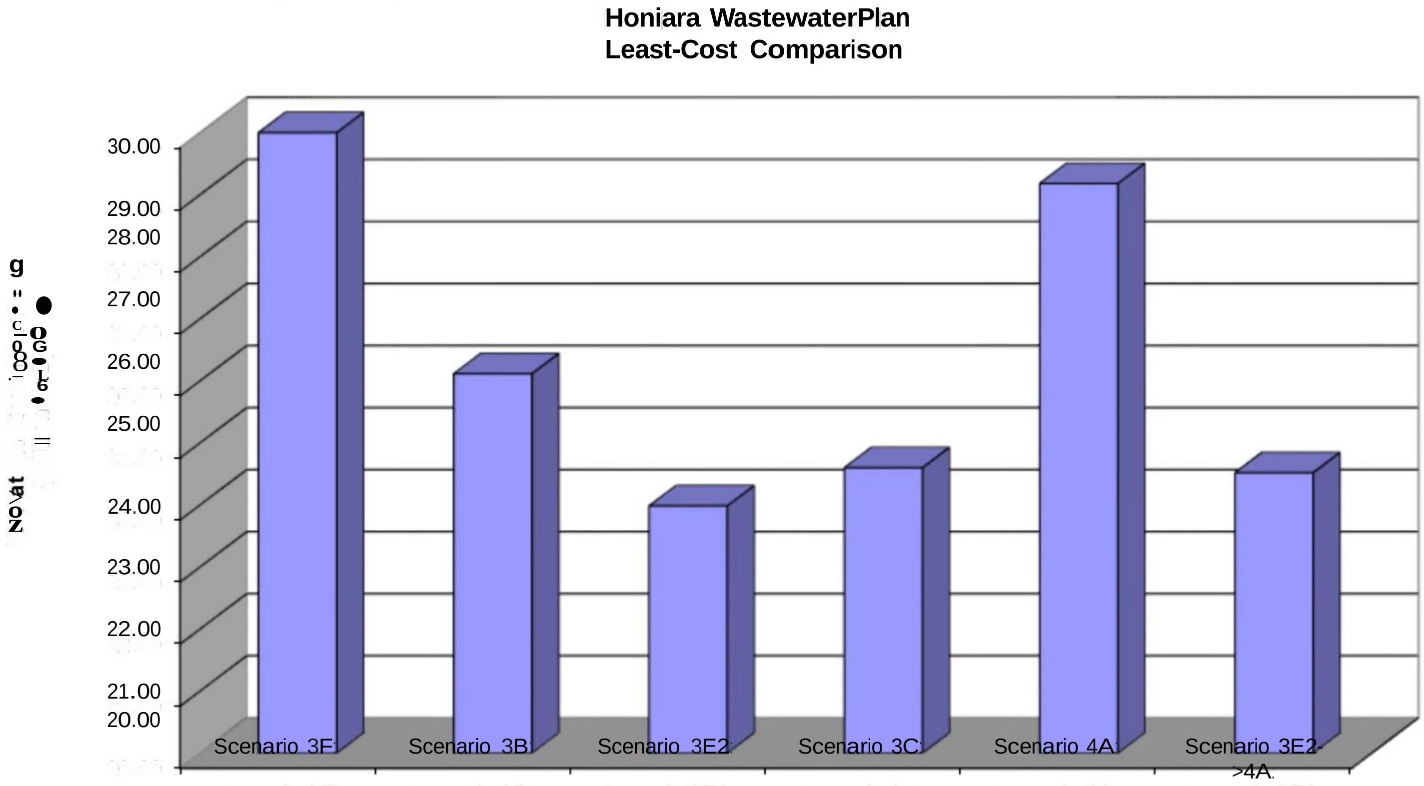
Short-term (2025)



Long-term (2040)



Least Cost Analysis (Alternative Scenarios)



VII – Conclusions & Recommendations

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Conclusions

- The project brings a significant improvements in foreshore water quality. All investigated scenarios enable a very significant improvment to be made when compared with the existing situation.

- Clearly going immediately for a one outfall approach is not the least cost option (due to large initial OPEX costs) nor having longer outfalls (3F).

- Two outfall scenarios of short to medium length represent the least cost option; Scenarios 38 and 3C maintain water quality criteria (exceedance <5%); 3E2 exceeds water quality criteria in the short term (but only in 2 positions for about 10% of the time). This level of exceedance was considered acceptable.

- Proposing a variant of 3E2 (or 3C) in which in Phase 2 there is one outfall site at Ranadi; NRH pumps to head of Naha system and then the system to Ranadi is sized for Phase 2 during Phase 1; Outfall at Ranadi sized for single outfall site in Phase 1 (ie 800mm).

- Ranadi could thereafter be the long term treatment site; although treatment may not be absolutely necessary in the long term and certainly higher forms of treatment (such as activated sludge not necessary)

Recommendations

- ***Proposed scenario is two outfalls in short term with the NRH considered as a temporary outfall (350 or 500 m length) and one outfall in the long term at Ranadi (500 m length)***
- ***The transfer system has been designed in the short term to be able to operate in the longer term with a one outfall scenario (outfall at Ranadi designed for the long term)***
- *NB: the initial proposal to construct an enhanced primary treatment plant for wastewater and septage with digestion/energy production nevertheless remains an option and as a means to mitigate high pumping costs and also to treat septage. The advantages of this are not factored into the economic analysis but could be investigated at a later stage.*

VIII – Additional Scenario comparison by phases

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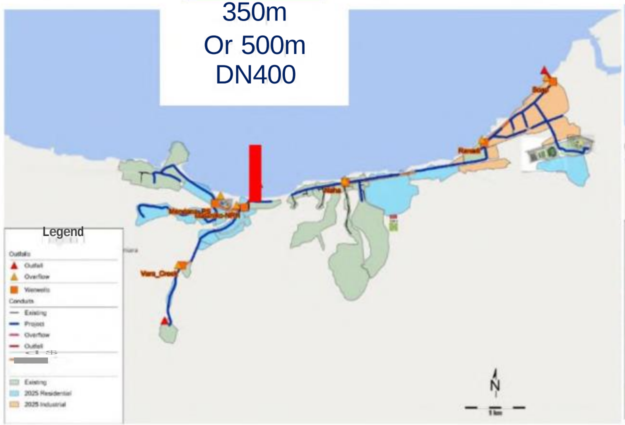
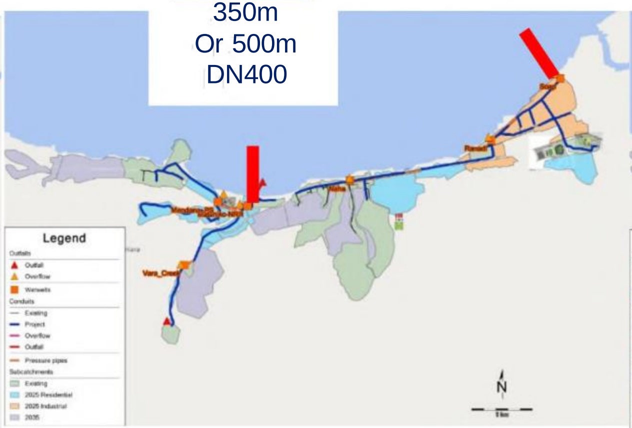
Scenario 3E2or3C → 4A

Year	Scenario 1 Outfalls Capex = 5.97 M$ 24% of Phase 1 Grand Total		Scenario 2 Outfalls Capex = 6.75 M$ 27% of Phase 1 Grand Total	
2025	3E2a			
2035	3E2b			
2050	4A			

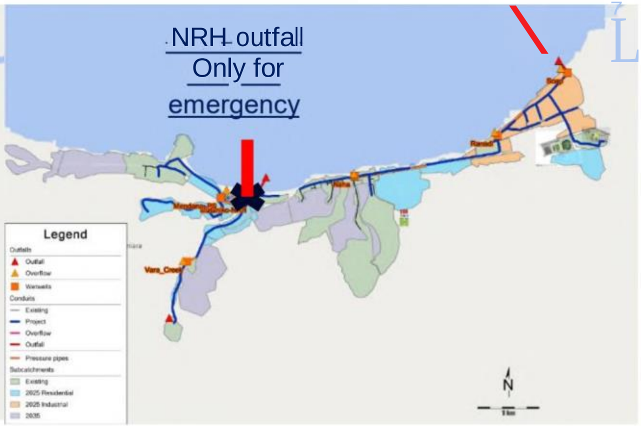
Short-term (2025)



Intermediate-term (2035)



Long-term (2050)



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Scenario 3E2or3C → 4A

The classes objectives takes in consideration the industries discharges that are not included in the simulations.
The objectives in the long-term is to classifify point Cruz coast as Class A for swimming authorizations, the coast from Mataniko Riverbank to Ranadi Landfill as Class B for nautical activities and the area around ranadi landfill as Class C because of the presence of industries

"5 5; objectives ass

Existing Scenario 1:

Outfalls Capex = 5.97 M$
24% of Phase 1 Grand Total

Ranadi 500m

NRH 350m

Long-term: 2050	A	A	A	A	A	A	A	A	A	B	A
Intermediate term: 2035	A	A	A	B	A	A	A	A	A	B	A
Short-term: 2025	A	A	A	B	A	A	A	A	A	A	A
	P1	P2	P3	P13	P14	P7	P8	P9	P10	P11	P12

Ports Authority | Pt Cruz Wharf West Mataniko | NRH | Naha to Ranadi | Ranadi to Lungga

Short-term: 202~	A	A	B	A	A	C	C	A	A	A	A	A	A
Intermediate term: 2035	A	A	B	B	B	C	C	A	A	A	A	A	B
Long-term: 2050	A	A	A	A	A	A	A	A	A	A	A	A	B

NRH 500m

Class category as per the marine simulations with an atowanee6rs _ cadence or oar

Point	Region	Conclusion of the Marine simulations
P1, P2	Ports Authority	Class A for both scenarios
P3	Pt Cruz Wharf	Scenario 1 has a less impact further to the West of Mataniko Riverbank
P13	West Mataniko	Scenario 2 has less impact near Mataniko Riverbank
P4, PS, P6, P14	NRH	The coast nearby NRH where the outfall discharge is in Class D with a 350m length and in Class C with a 500m length
P7, P8, p9, P10	Naha to Ranadi	For both scenarios, the marine simulations results are under 5% exceedence for Class A standard (40 ENT Counts/100mL)
P11		For both scenarios, the marine simulations results are under 5% exceedence for Class A standard (40 ENT Counts/100mL) in the short-

Scena rio 2:

Outfalls Capex
= 6.75 M$
27% of Phase 1 Grand Total

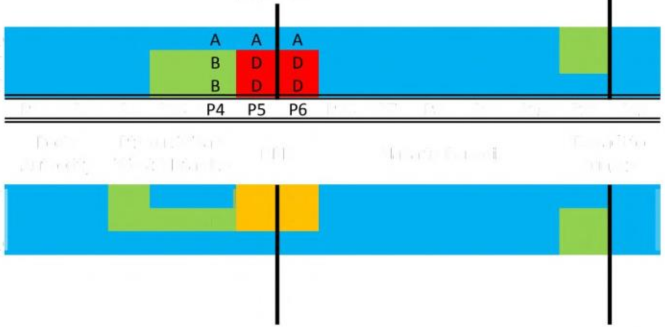
Ranadi 500m

Ranadi to

term.

With a raise of the total discharge at Ranadi outfall, the coast classification falls to Class B

P12
Lungga



Scenario 3E2or3C → 4A
Intermediate-term objectives exceedence details

				Scenario 1		Scenario 2	
				3E2a	3E2b	3Ca	3Cb
				2025	2035	2025	2035
	Water Quality Class	ENT (FC/100mL)	Baseline (2019)	350m @NRH & 500m @Ranadi	350m @NRH & 500m @Ranadi	500m @NRH & 500m @Ranadi	500m @NRH & 500m @Ranadi
P1	B	>200	100	0	0	0	0
P2	B	>200	100	0	0	0	0
P3	C	>500	100	0	0	0	0
P13	C	>500	100	0	0	0	0
P4	C	>500	100	0	0	0	0
PS	C	>500	100	12	30	1	4
P6	C	>500	100	10	83	1	3
P14	C	>500	100	0	0	0	0
P7	C	>500	100	0	0	0	0
P8	C	>500	100	0	0	0	0
pg	C	>500	100	0	0	0	0
P10	D		100	0	0	0	0
P11	D		100	0	0	0	0
P12	D		100	0	0	0	0

Scenario 3E2or3C → 4A
Long-term objectives exceedence details

	Water Quality Class	ENT (FC/100mL)	Baseline (2019)	4A 2050 500m @Ranadi
P1	A	>40	100	0
P2	A	>40	100	0
P3	B	>200	100	0
P13	B	>200	100	0
P4	B	>200	100	0
PS	B	>200	100	0
P6	B	>200	100	0
P14	B	>200	100	0
P7	B	>200	100	0
P8	B	>200	100	0
P9	B	>200	100	0
P10	C	>500	100	0
P11	C	>500	100	1.5
P12	C	>500	100	0

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Scenario 3E2or3C → 4A
Class A Exceedence details

				Scenario 1			Scenario 2		
				3E2a	3E2b	4A	3Ca	3Cb	4A
				2025	2035	2050	2025	2035	2050
	Water Quality Class	ENT (FC/100mL)	Baseline (2019)	350m @NRH	350m @NRH & 500m @Ranadi	500m @Ranadi	500m @NRH	500m @NRH & 500m @Ranadi	500m @Ranadi
P1	A	>40	100	0	0	0	0	0	0
P2	A	>40	100	0	0	0	0	1	0
P3	A	>40	100	0	5	0	7	12	0
P13	A	>40	100	8	7	0	4	10	0
P4	A	>40	100	8	12	0	2	6	0
PS	A	>40	100	55	81	0	27	37	0
P6	A	>40	100	37	99	0	17	25	0
P14	A	>40	100	0	0	0	0	0	0
P7	A	>40	100	0	1	0	0	0	0
P8	A	>40	100	0	0	0	0	0	0
pg	A	>40	100	0	0	0	0	0	0
P10	A	>40	100	1	2	5	1	2	5
P11	A	>40	100	2	10	15	2	10	15
P12	A	>40	100	0	1	2	0	1	2

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Scenario 3E2or3C → 4A
Class B Exceedence details

				Scenario 1			Scenario 2		
				3E2 2025	3E2 2035	4A 2050	3C 2025	3C 2035	4A 2050
	Water Quality Class	ENT (FC/100mL)	Baseline (2019)	350m @NRH & 500m @Ranadi	350m@NRH & 500m @Ranadi	500m @Ranadi	500m @NRH & 500m @Ranadi	500m @NRH & 500m @Ranadi	500m @Ranadi
Pl	B	>200	100	0	0	0	0	0	0
P2	B	>200	100	0	0	0	0	0	0
P3	B	>200	100	0	0	0	0	2	0
P13	B	>200	100	0	1	0	0	1	0
P4	B	>200	100	0	1	0	0	0	0
PS	B	>200	100	27	53	0	6	14	0
P6	B	>200	100	20	93	0	4	9	0
P14	B	>200	100	0	0	0	0	0	0
P7	B	>200	100	0	0	0	0	0	0
P8	B	>200	100	0	0	0	0	0	0
p9	B	>200	100	0	0	0	0	0	0
PlO	B	>200	100	0	0	0	0	0	0
P11	B	>200	100	0	2	5	0	2	5
P12	B	>200	100	0	0	0	0	0	0

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Scenario 3E2or3C → 4A
Class C Exceedence details

				Scenario 1			Scenario 2		
				3E2	**3E2**	**4A**	3C	**3C**	**4A**
				2025	2035	2050	**2025**	**2035**	2050
	Water Quality Class	ENT (FC/100mL)	Baseline **(2019)**	350m @NRH & 500m @Ranadi	350m @NRH & 500m @Ranadi	500m @Ranadi	500m @NRH & **500m @Ranadi**	500m @NRH & 500m @Ranadi	500m @Ranadi
P1	C	>500	100	0	0	0	0	0	0
P2	C	>500	100	0	0	0	0	0	0
P3	C	>500	100	0	0	0	0	0	0
P13	C	>500	100	0	0	0	0	0	0
P4	C	>500	100	0	0	0	0	0	0
P5	C	>500	100	12	**30**	0	1	4	0
P6	C	>500	100	10	**83**	0	1	3	0
P14	C	>500	100	0	0	0	0	0	0
P7	C	>500	100	0	0	0	0	0	0
P8	C	>500	100	0	0	0	0	0	0
p9	C	>500	100	0	0	0	0	0	0
P10	C	>500	100	0	0	0	0	0	0
P11	C	>500	100	0	0	1.5	0	0	1.5
P12	C	>500	100	0	0	0	0	0	0

Questions & Answers

suez

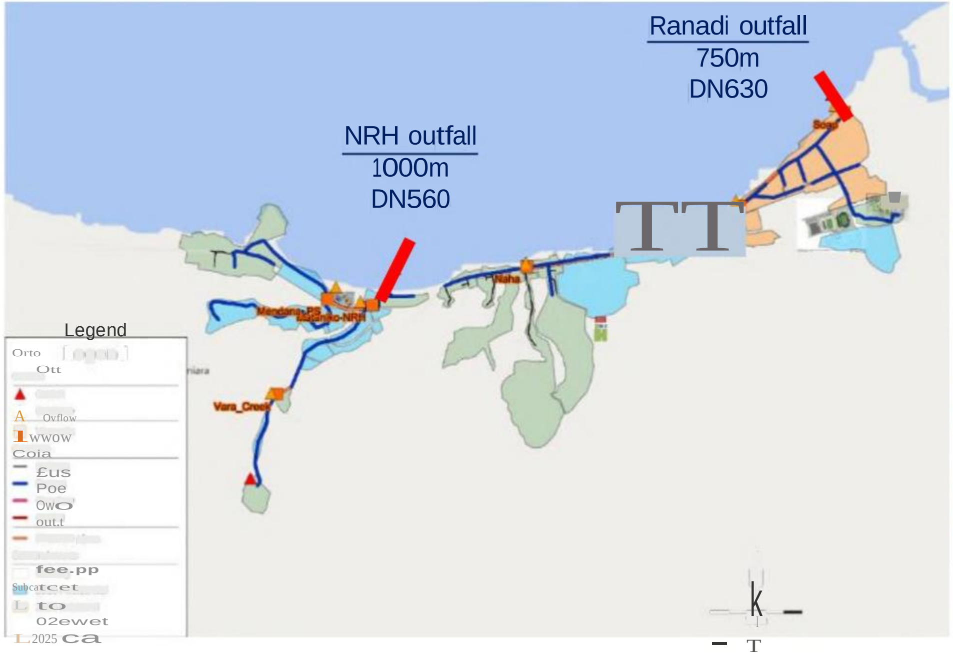
Taem Bio Yumi
Yumi Mas Wok Tugeda
Tangio Tumas

Solomon Water

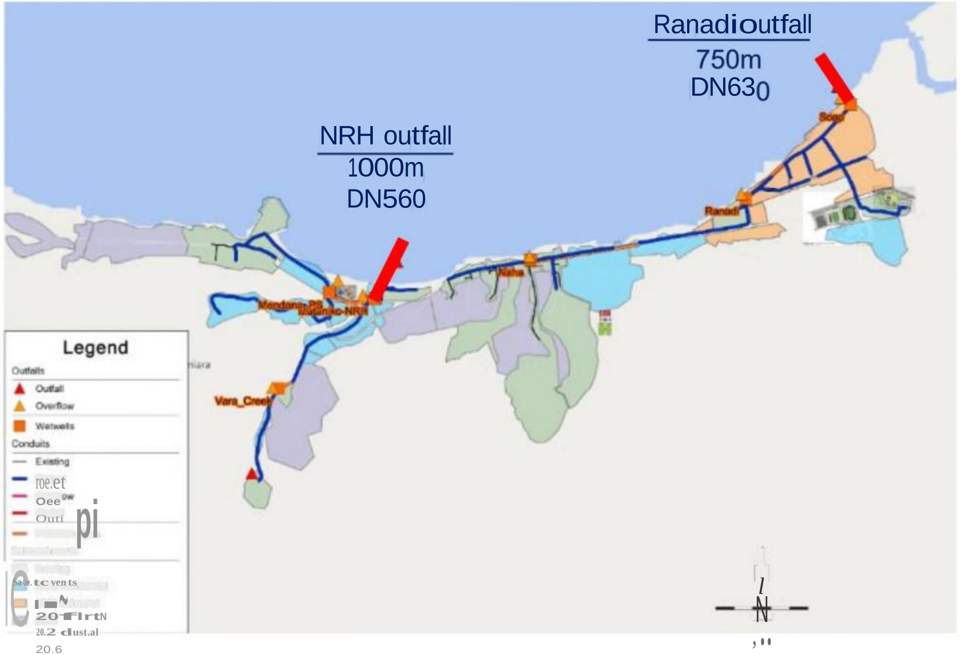
suez

Scenario 3F

Short-term (2025)



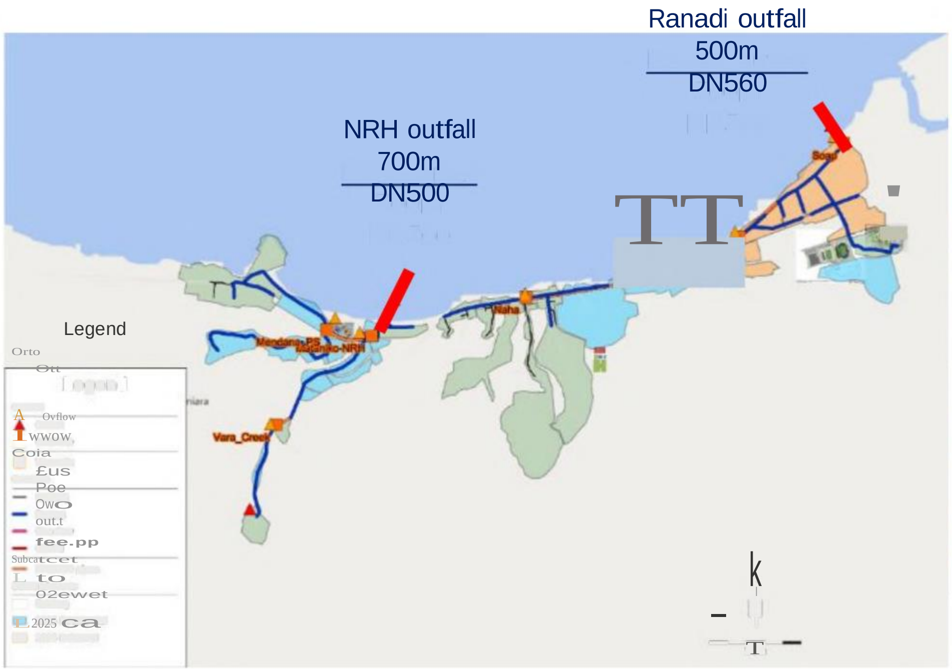
Long-term (2040)



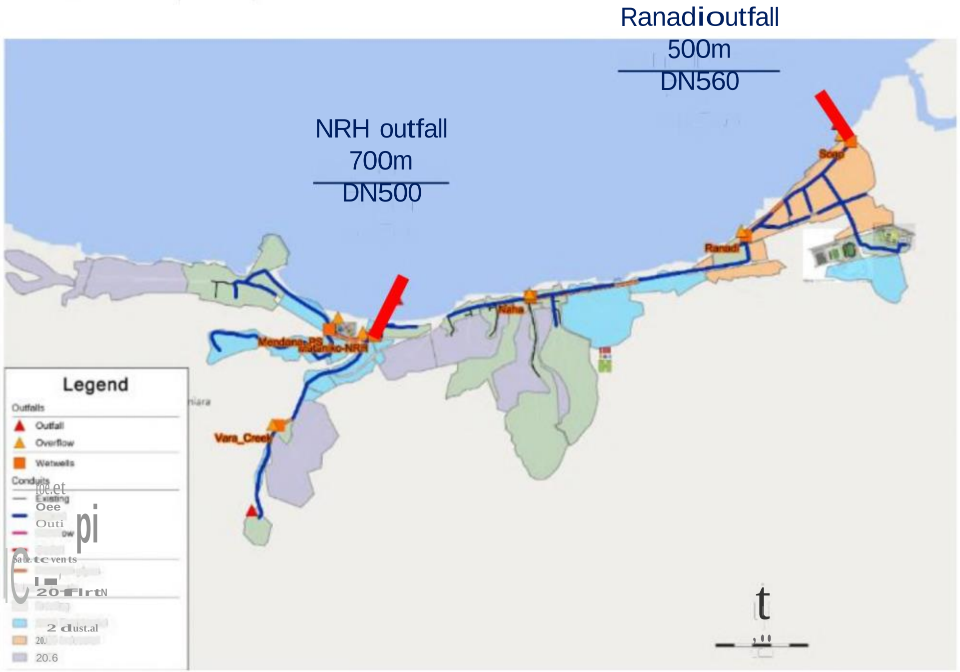
suee

Scenario 3B

Short-term (2025)

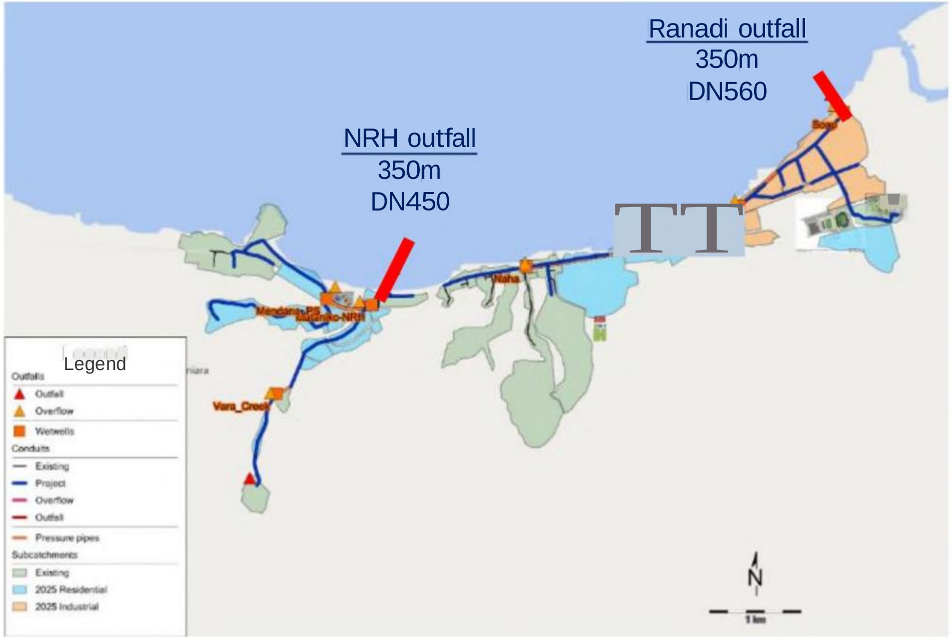


Long-term (2040)

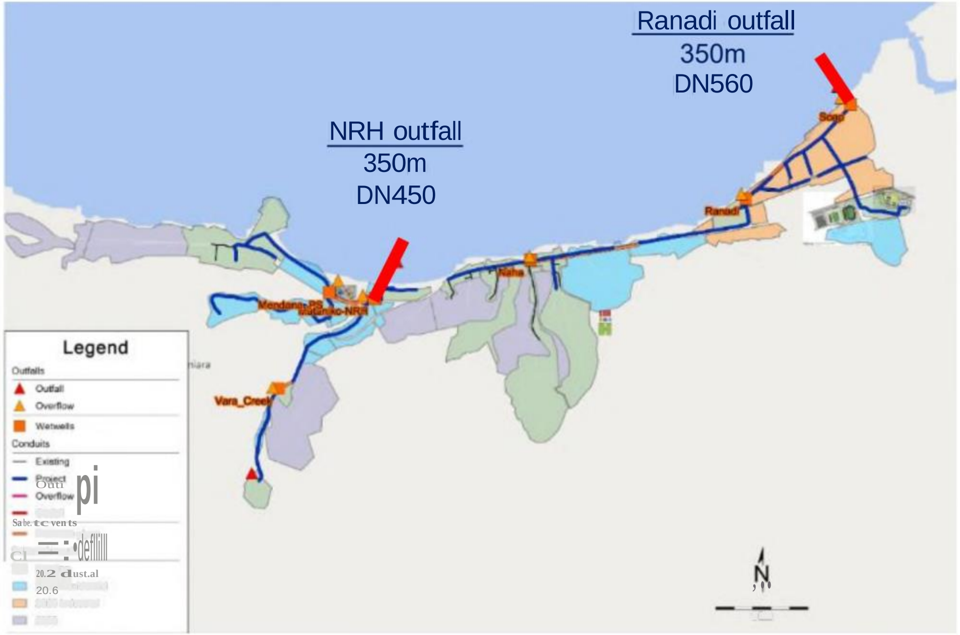


Scenario 3E2

Short-term (2025)

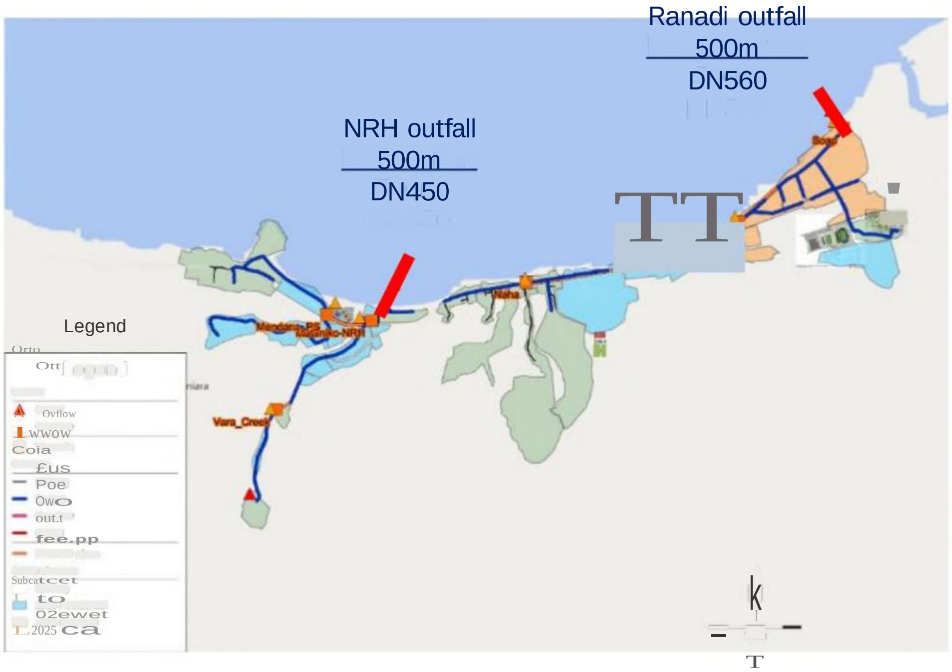


Long-term (2040)

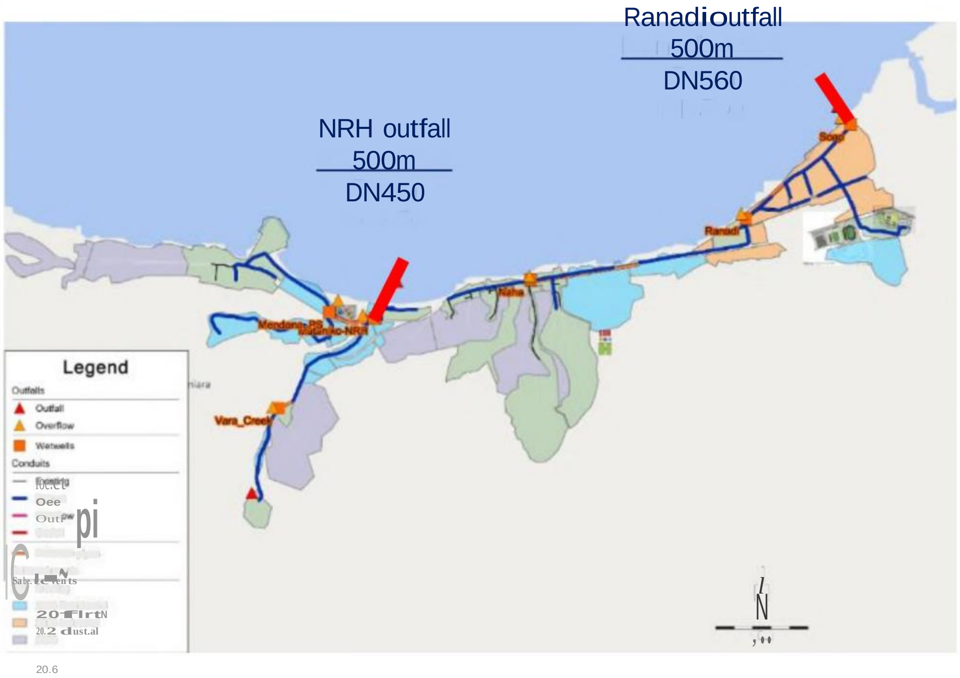


Scenario 3C

Short-term (2025)



Long-term (2040)



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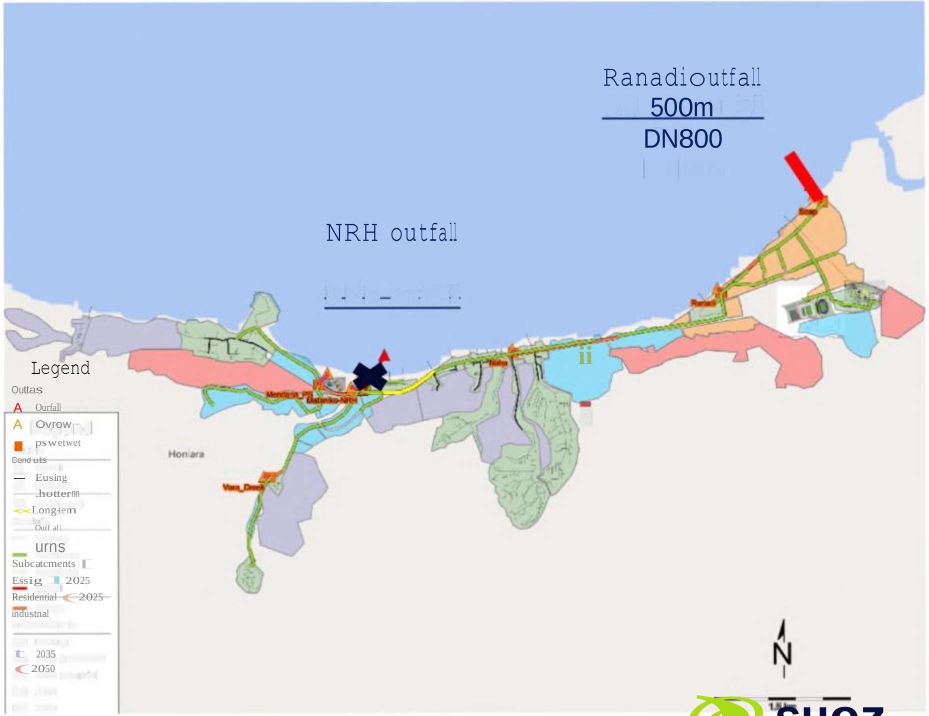
Scenario 4A

Short-term (2025)

Long-term (2040)



suez