Nicaragua Canal
Post Feasibility Study
Updates

20 November 2014

HKND GROUP

The Grand Canal Route

In our route announcement in July 2014, this was the route proposed for further study.

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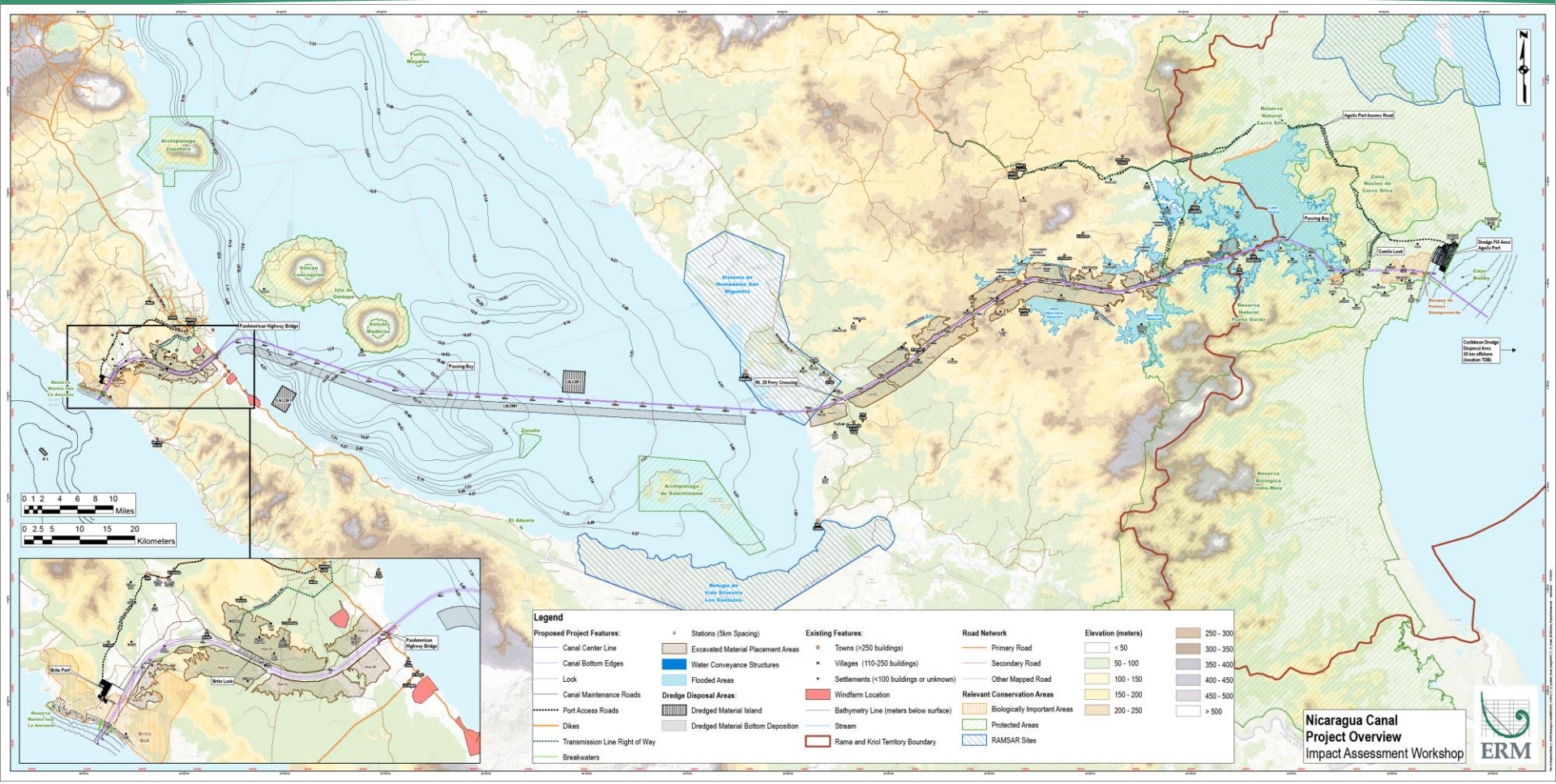
Improved Alignment for the ESIA



This alignment addresses many environmental & social concerns.

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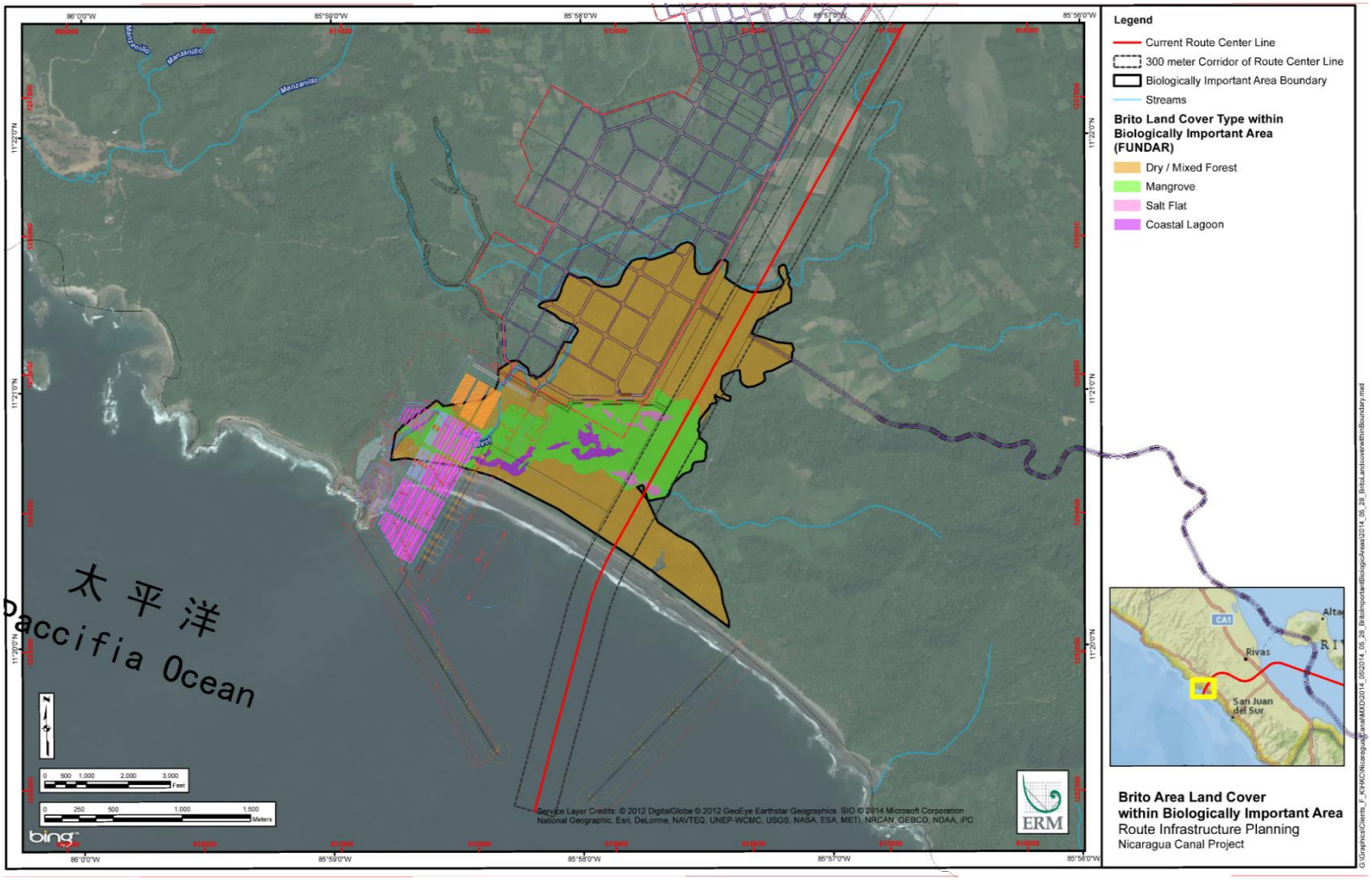
Initial proposal of an Ocean Port



Impact to the Brito River, Historical sites & Mangrove are of concern

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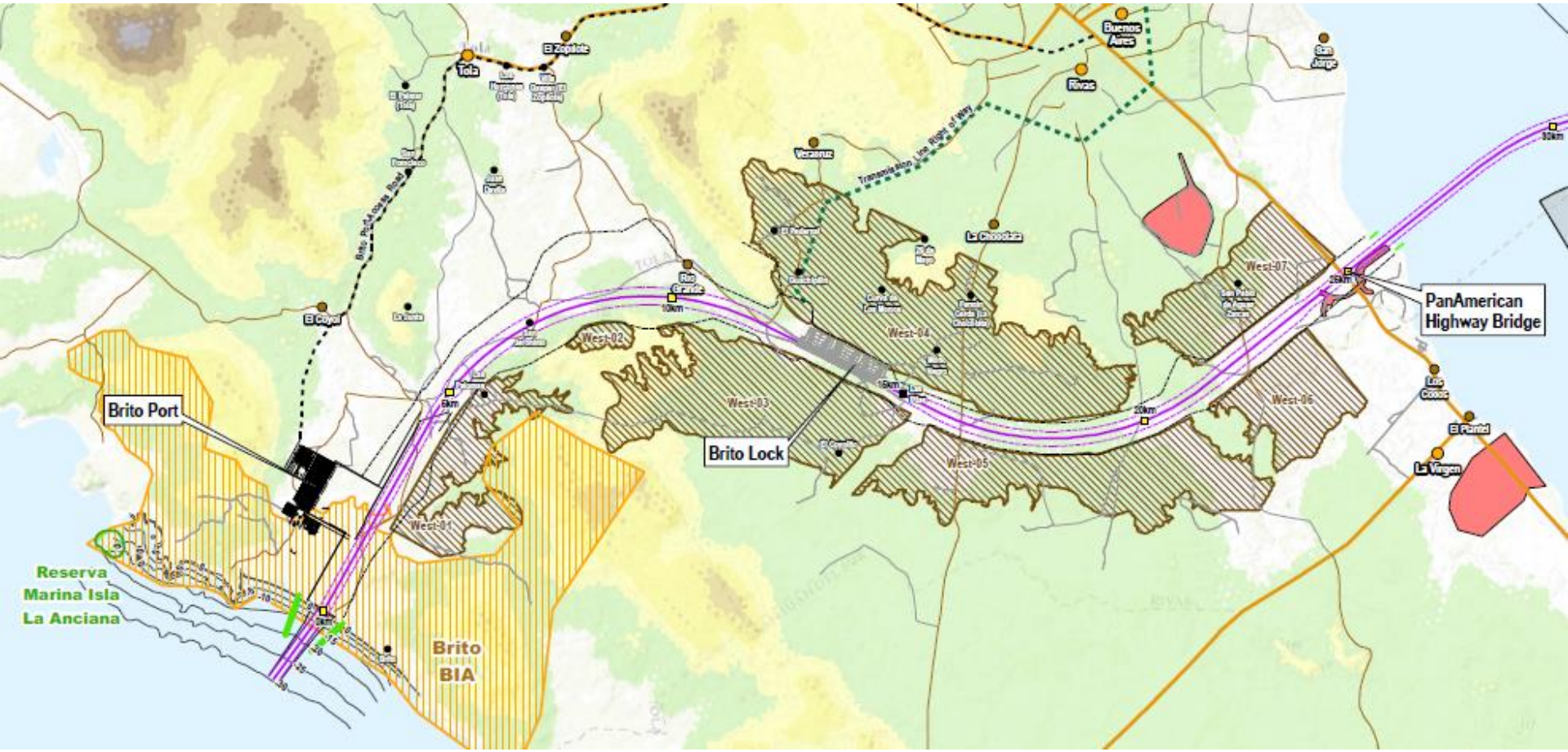
We now have an Inland Port design



Healthy portion of Mangrove & most of Brito River will be preserved and impact to Reserva Marina Isla La Anciana will be minimize

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Brito River and Mangrove

Most of the Brito River and healthy mangrove will NOT be affected

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Ecology along Brito River is quite unique

Brito Mangrove to the south of the Canal will not be touched

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These People can still live as today

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Mangrove to the North already suffer human activities

Mangrove to the north already have human activities and is being damaged

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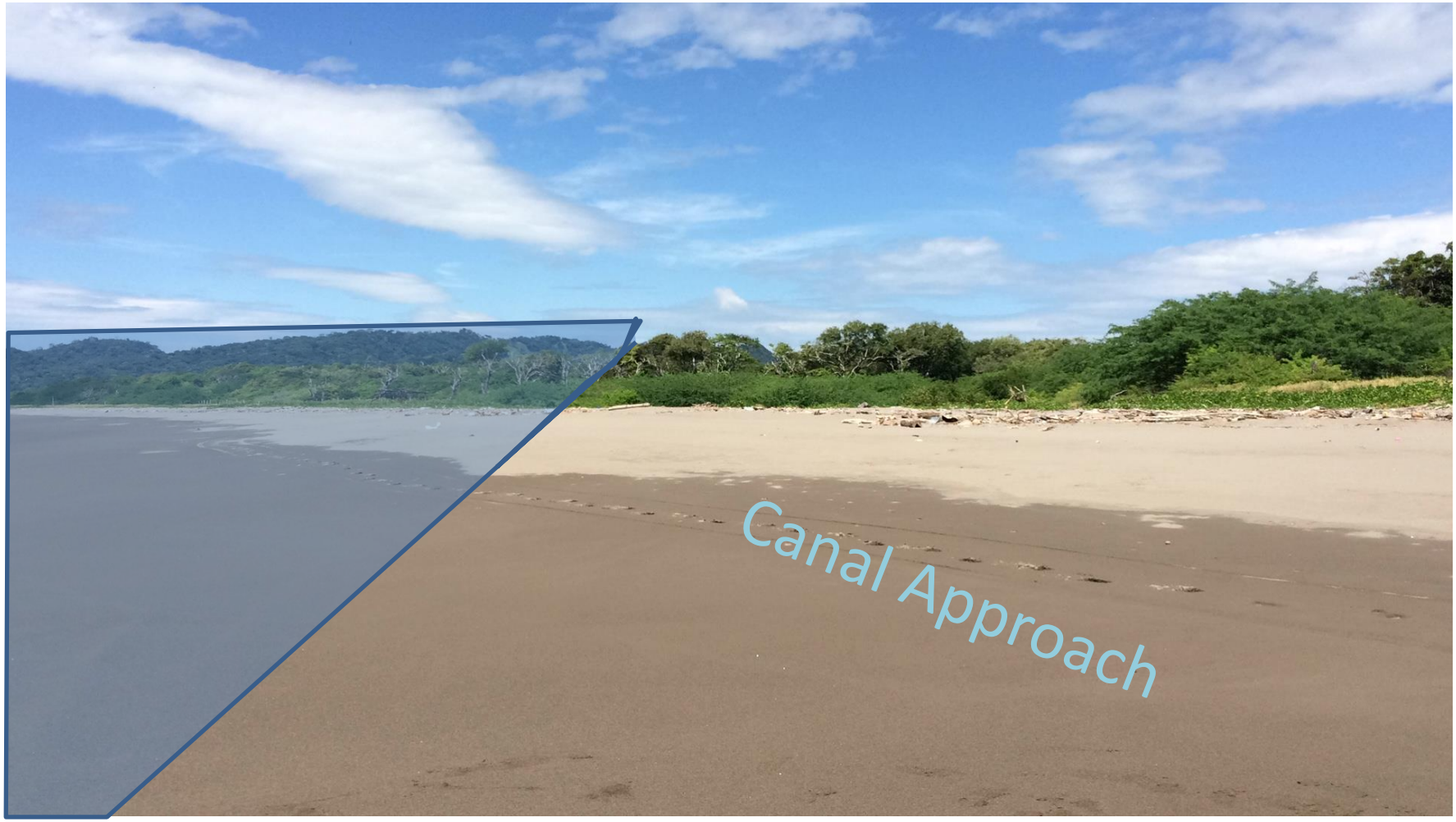
Canal Approach at bad Mangrove to the North



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The Healthy portion of Mangrove will be untouched

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This scene will still be the same after Canal opens

A Rock Bund to be designed to enable good mix of salt and fresh water to mangrove

Canal starts South of this hill

The beach to the North of the hill will not be touched

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This is where the Breakwaters start

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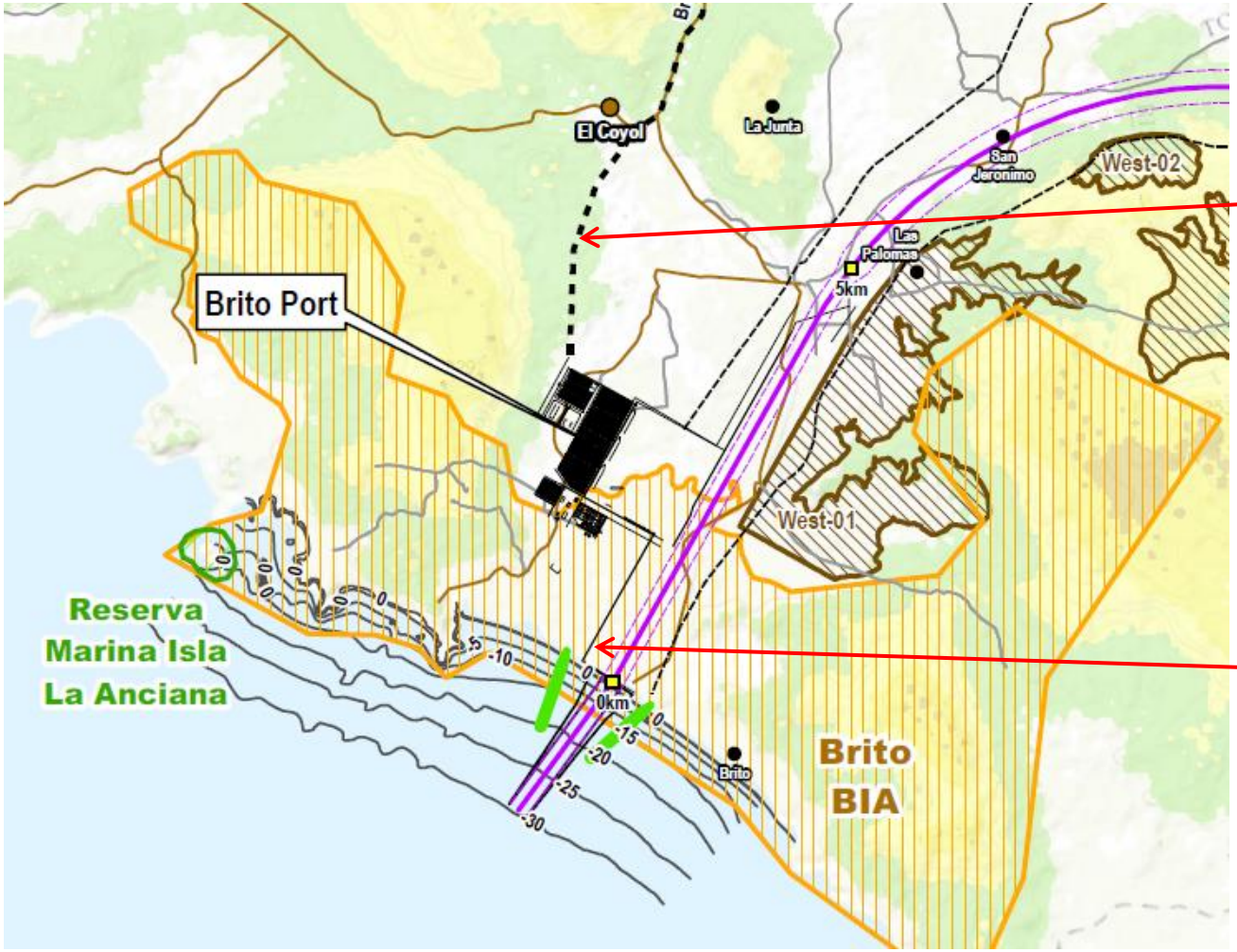
Inland Port has less disturbance by the sea



A Road linking the Port to Tola

A Rock Bund to be designed to enable better mix of salt and fresh water to mangrove

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The Landscape & Mangrove shelters the Port

The Inland Port will gradually be transformed from the Construction Port

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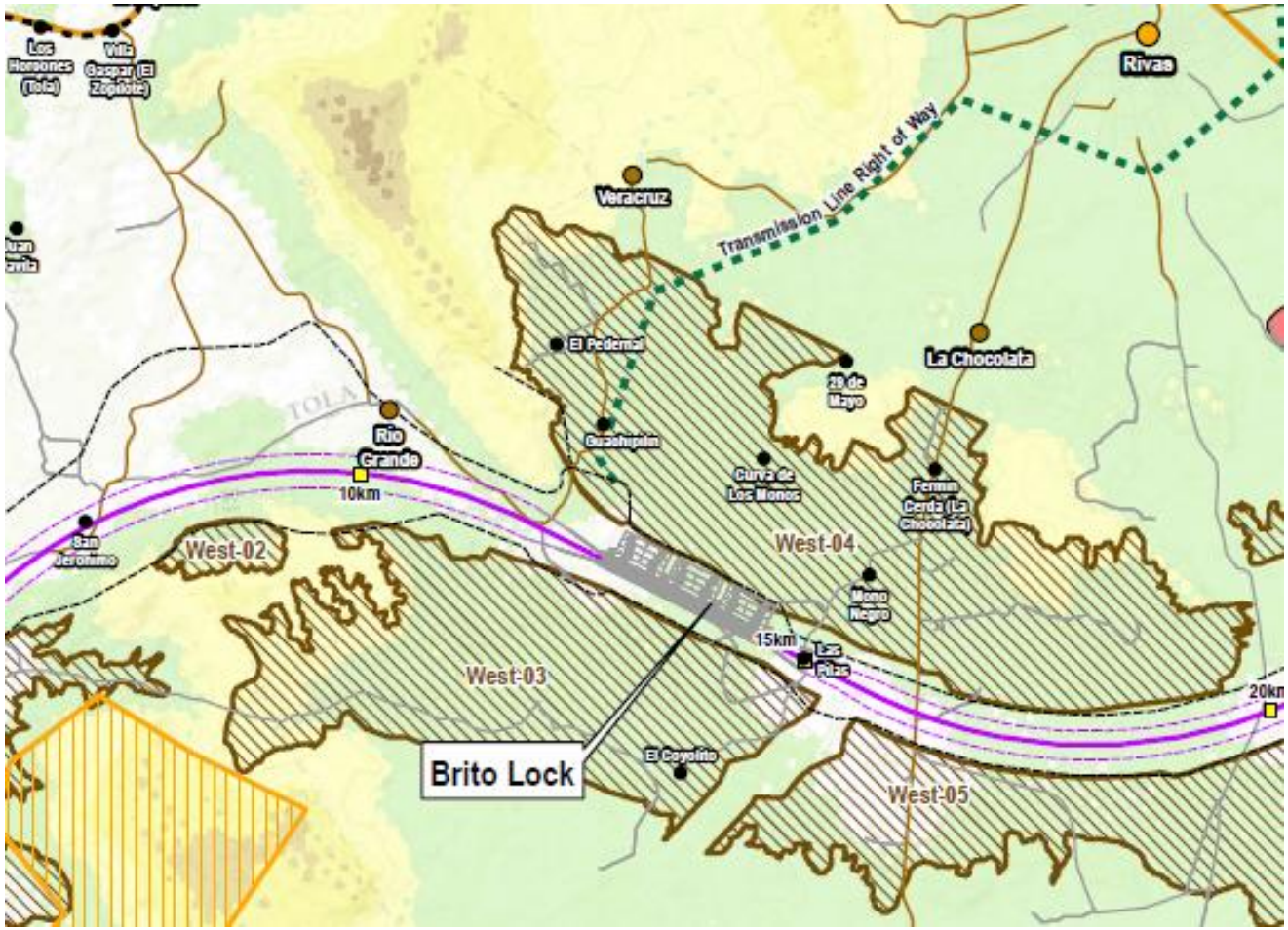
The Brito Lock



The Lock is 7km inland on hard rock to minimize impact by Seismic & Tsunami activities

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Preliminary Calculations Supporting Lock Location

Working condition of calculation	Stability security factor			Maximum stress of the basement（MPa）	Minimum stress of the basement（MPa）
	Anti-floating	Anti-skating	Anti-overturning		
Operation condition	1.92	10.26	3.83	0.45	0.39
Maintenance condition	1.90	10.50	3.88	0.43	0.39
Completion condition	-	42.24	143.21	0.70	0.65
Check flood	1.91	9.82	3.72	0.45	0.38
Operating condition + earthquake	1.84	4.08	2.69	0.64	0.20
Maintenance condition + earthquake	1.84	5.10	2.99	0.56	0.27

Table 4.1—6　Calculation results of stability and foundation stress of lock head (north abutment pier)

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Preliminary Calculations Supporting Lock Location

Working condition of calculation	Stability security factor			Maximum stress of the basement （MPa）	Minimum stress of the basement （MPa）
	Anti-floating	Anti-skating	Anti-overturning		
Operation condition	1.50	10.49	3.24	0.42	0.09
Maintenance condition	2.81	4.78	2.11	0.72	0.04
Completion condition	-	8.62	13.02	0.60	0.49
Check flood	1.50	10.07	3.18	0.43	0.08
Operating condition+earthquake	1.48	6.25	2.67	0.55	-0.05
Maintenance condition+earthquake	3.13	4.16	1.84	0.85	-0.04

Table 4.1—7 Calculation results of stability and foundation stress of sluice chamber

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Overflow Dam stability and base stress calculation

Calculated work conditions	Anti-sliding buckling safety factor	Maximum stress of base MPa）	Minimum stress of base MPa）
Normal pool level conditions	8.56	0.16	0.14
Design flood level conditions	9.86	0.30	0.04
Check flood level conditions	10.51	0.40	0.00
Earthquake conditions	5.98	0.21	0.07

Table 4.4-2
Overflow dam stability and base stress calculation results

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Earth-rock dam stability calculation

Parameter index		Rock ballast filling materials	Silty clay
Unit weight （kN/m³）	Wet density	21.0	18.3
	Saturated unit weight	21.5	19.0
Cohesion c （kPa）	Quick shear	83	17
	Slow shear	85	19
	Consolidated quick shear	80	16
Internal friction angle ϕ （degree）	Quick shear	32	14
	Slow shear	35	17
	Consolidated quick shear	33	16

Table4.3-1 Rock and soil mechanical parameters of earth-rock dam stability calculation

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Possible Layout of Lock in Grand Canal Nicaragua

Courtesy of SBE

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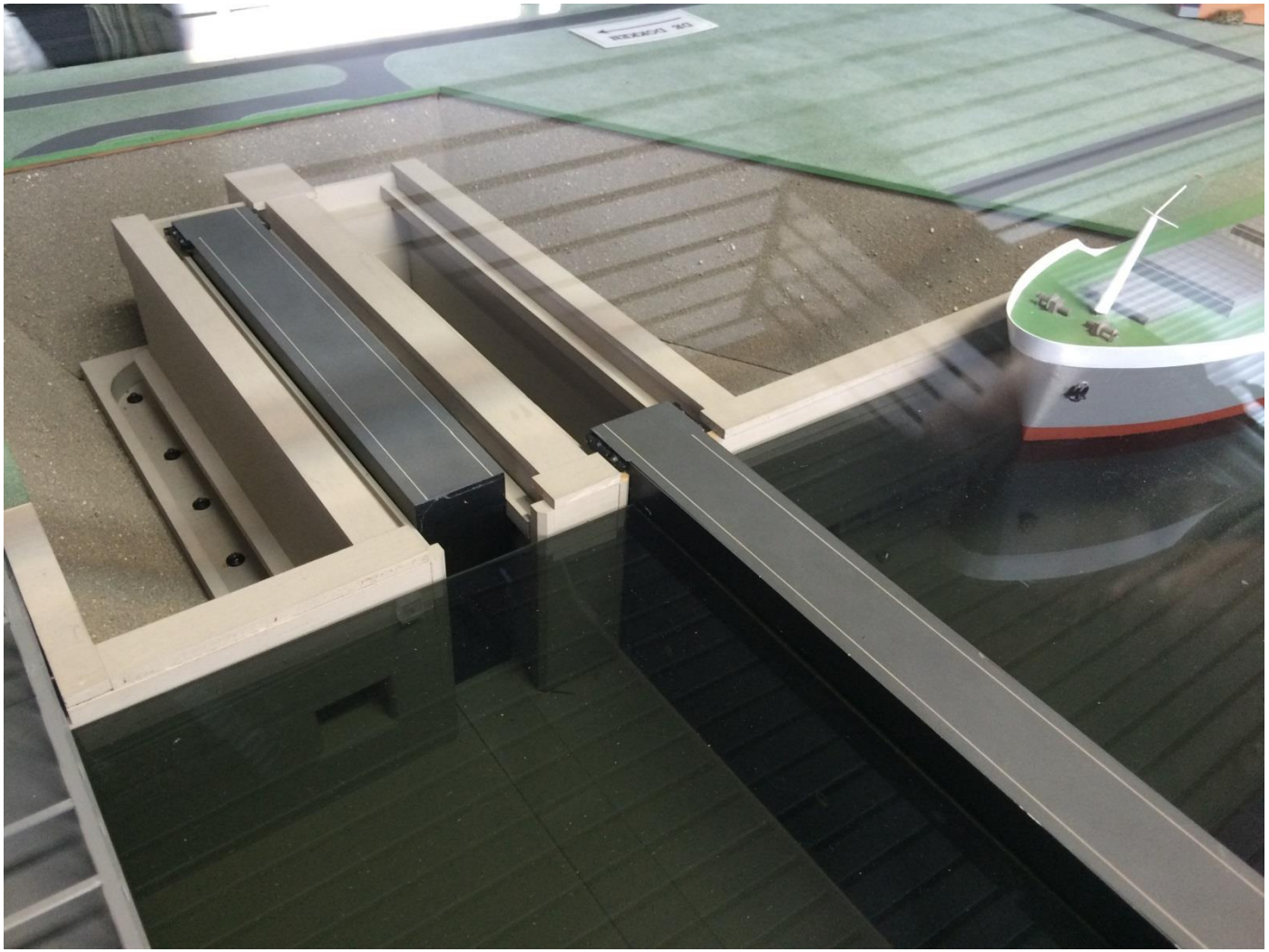
Rolling Gates will be used



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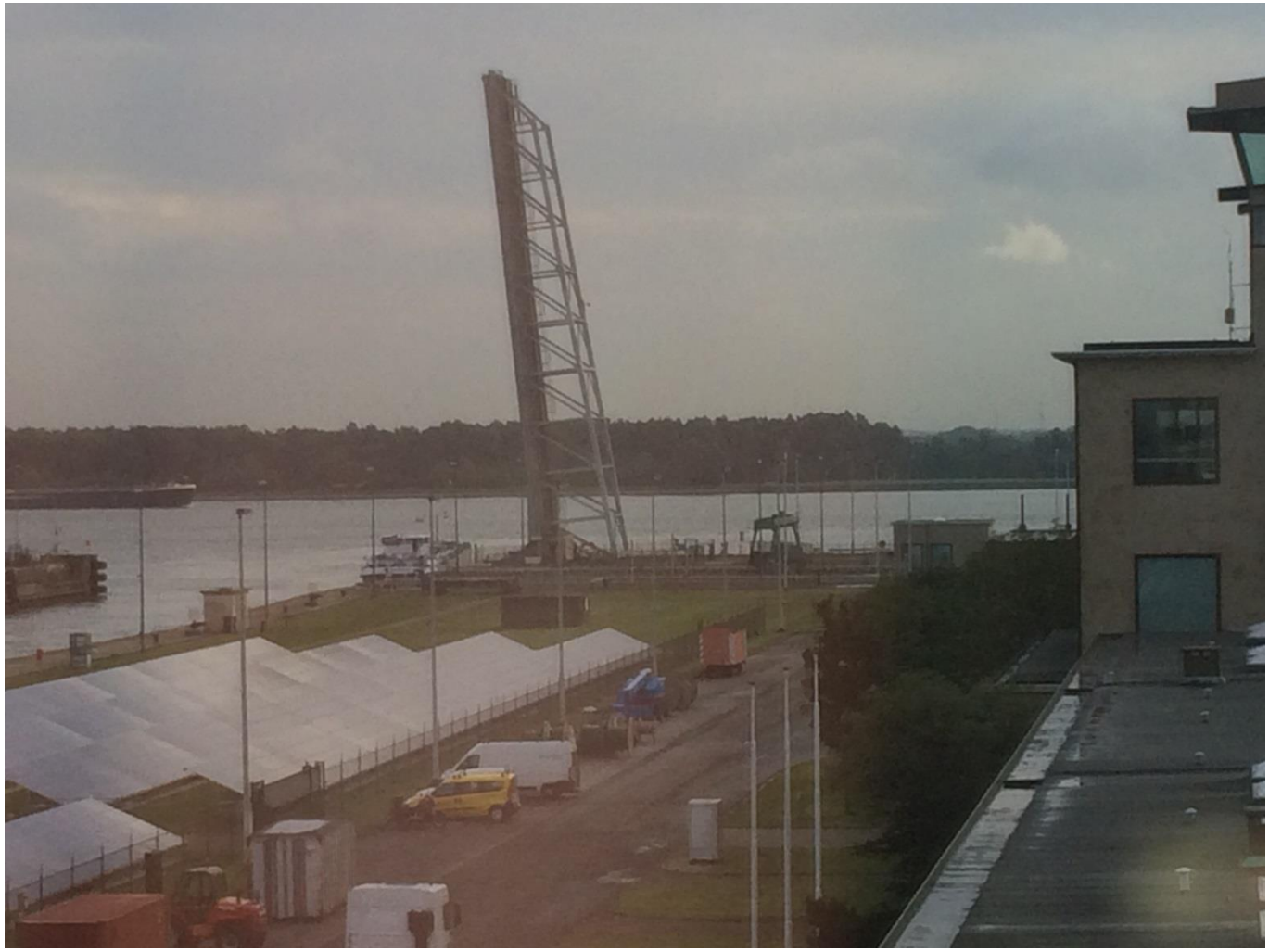
Tug Boats instead of Mules will be used

Bridge across Lock will be considered



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All Spoil sites will be Rehabitated

Just for the East Canal we have 26,030 hectares of good farmland by the end of the project.
Plants like Palm, Copra, Rubber can be grown with secondary industry development

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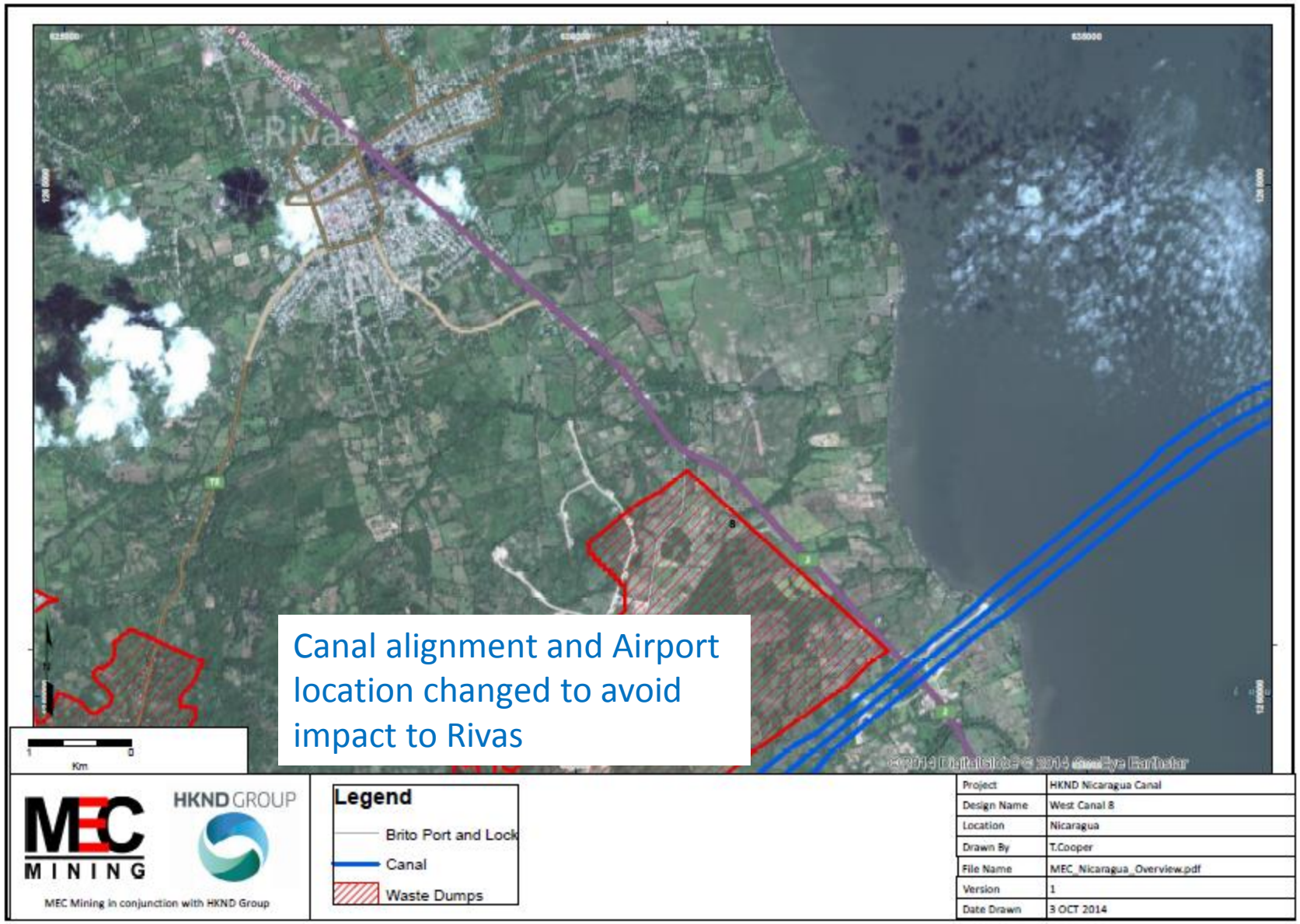
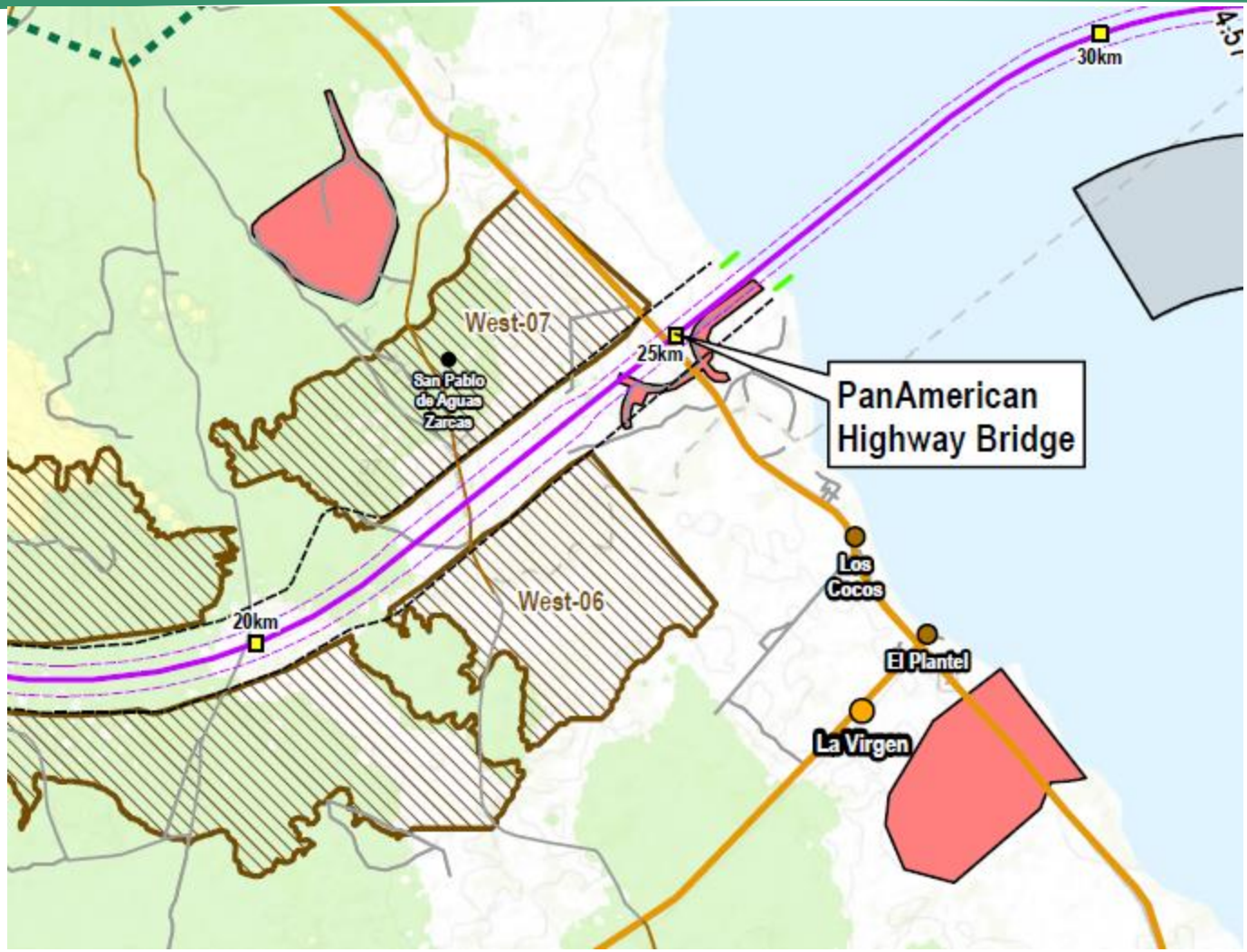
West Entrance into the Lake (avoid populated areas)



A 80M high 600M long Bridge will be built



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The Lake Section (environmental concerns)

There are opportunities of small scale in lake dredging for with large dredgers coming in after Lock opens. There will be no blasting inside the Lake.

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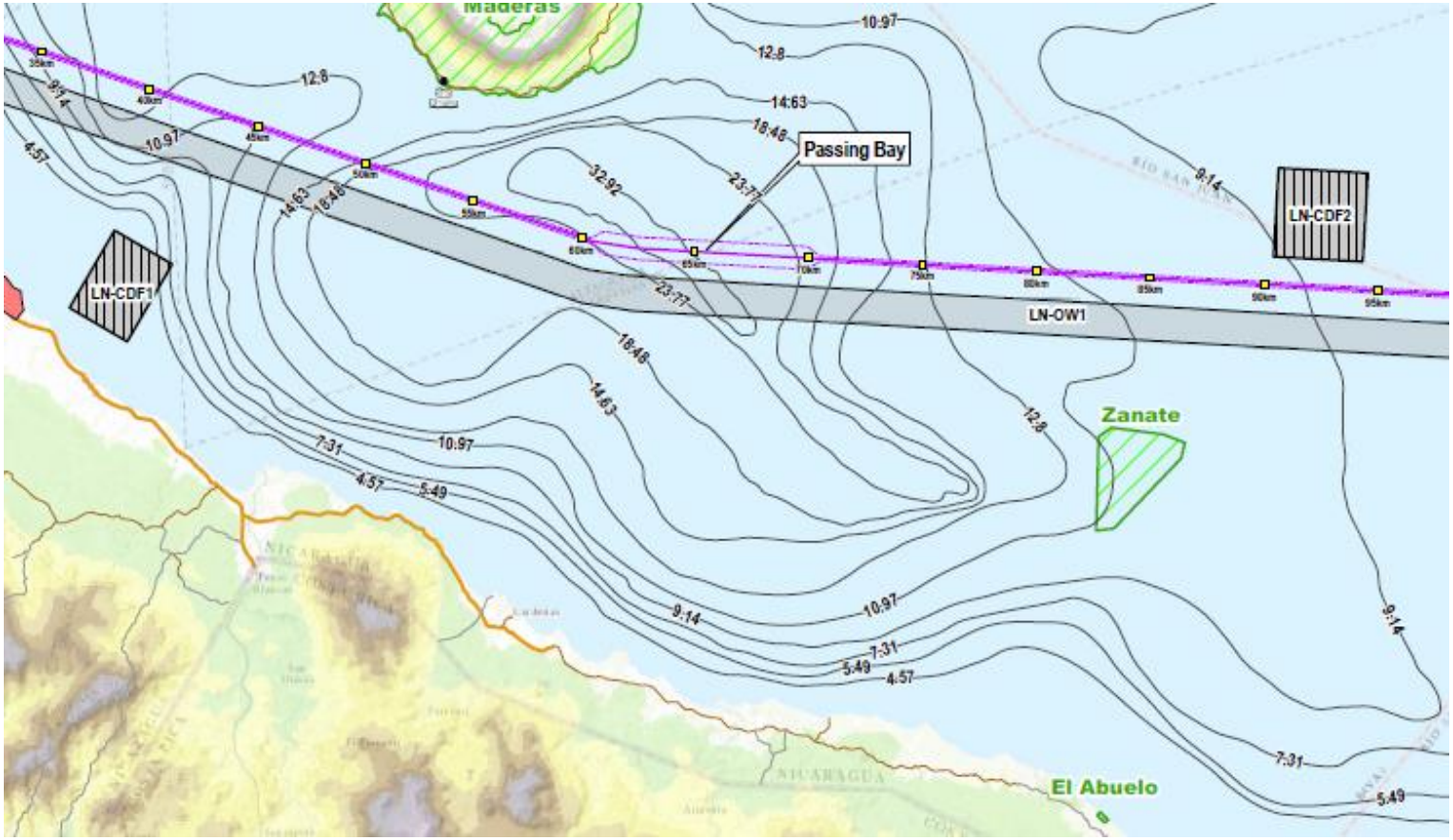
Spoil Treatment in the Lake



Silt and fine materials will be by confined dumping. Sand and hard materials will be along the south side of the Canal route.

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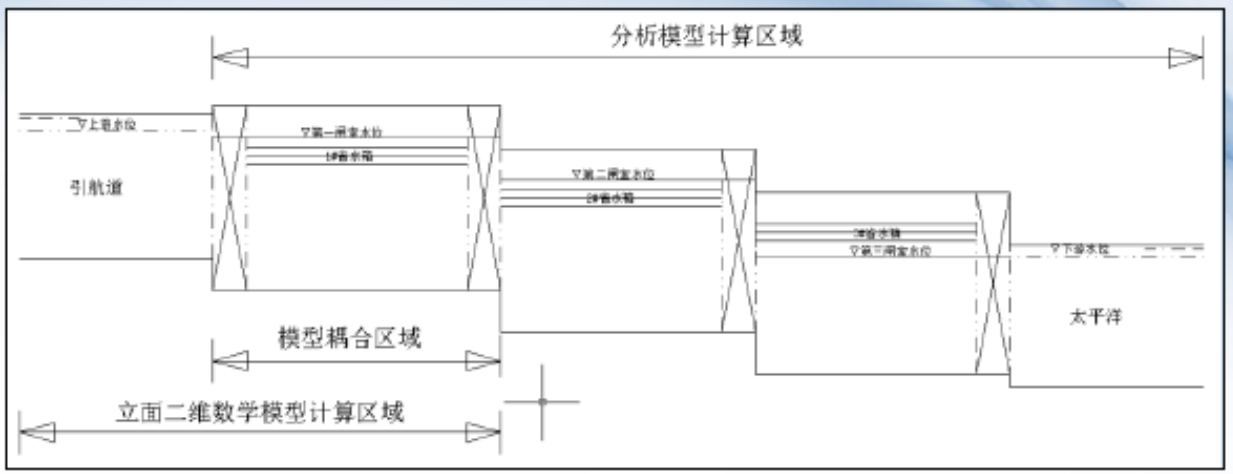
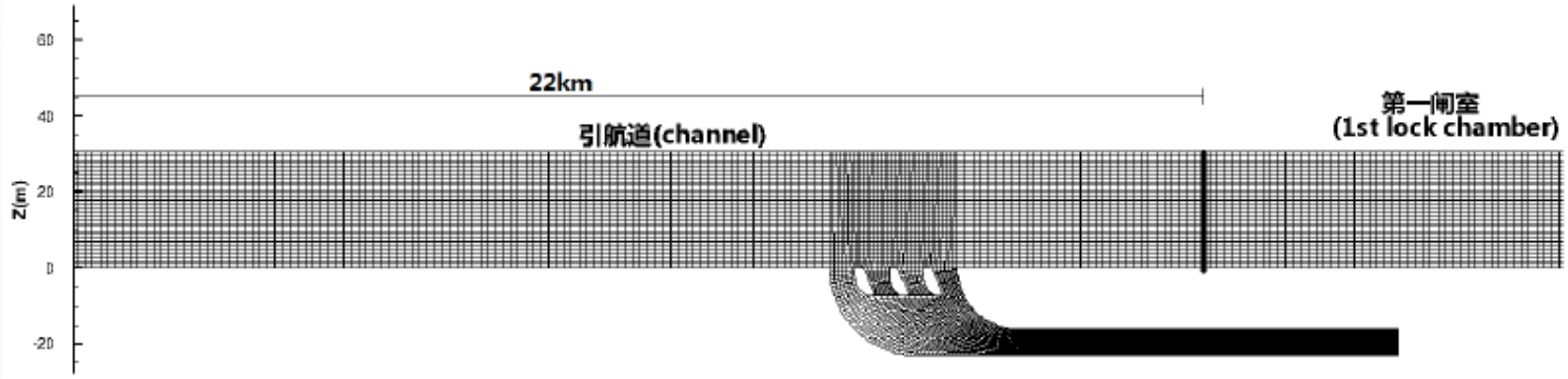
五、海水入侵研究/ Salt Intrusion Studies

（1）计算模型/Calculation Model

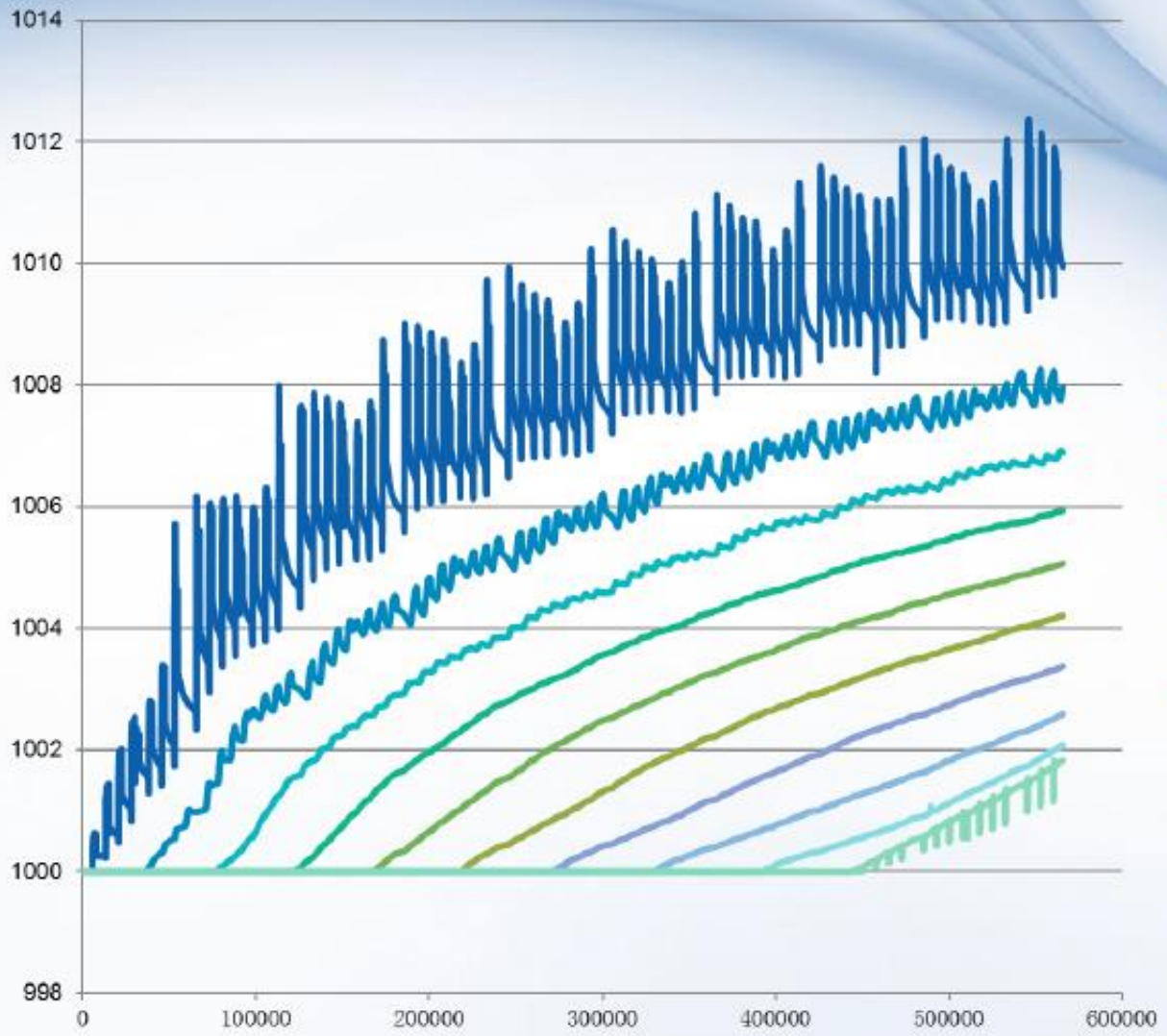


垂面二维模型/ vertical 2D mathematical model



五、海水入侵研究/ Salt Intrusion Studies

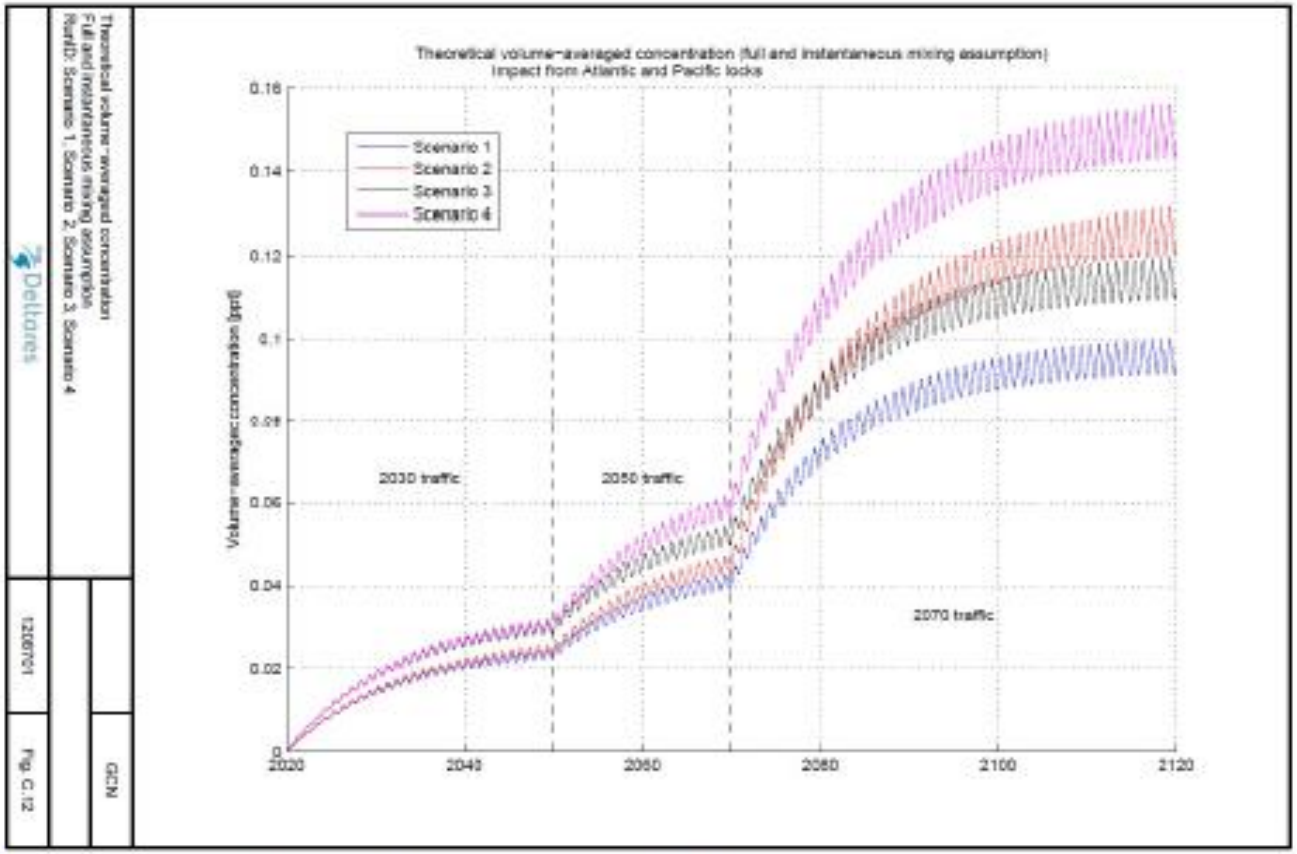
（2）模拟过程/Simulation Process



Similar Results simulated by SBE

Overall result

(including enhancement factor to cover influx via Pacific locks: 1.3-1.4)



Note: theoretical lake-volume-averaged salt concentration, for comparison uses only

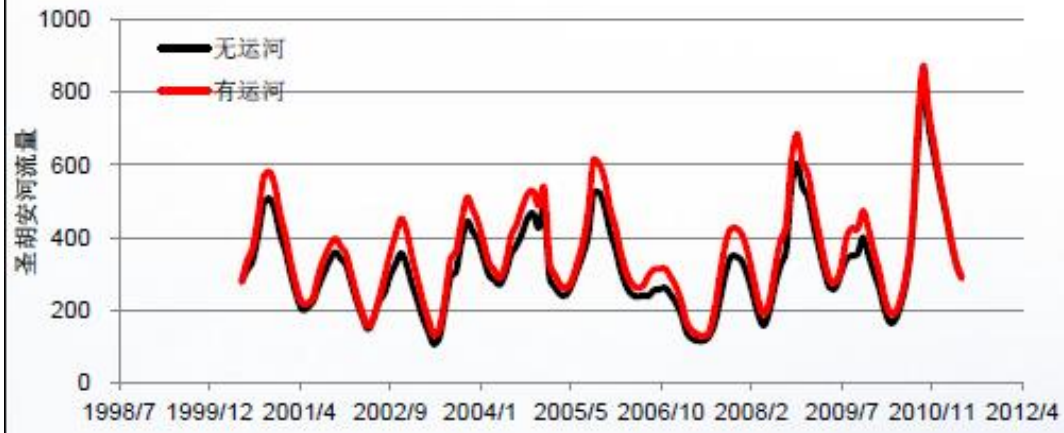
SBE Deltares

四、两船闸方案供水规划/Water Supply Planning for 2-Lock Scheme

（3）尼加拉瓜湖影响分析/Influence Analysis of Lake Nicaragua

尼加拉瓜湖水位（m）
Water level of Lake Nicaragua (m)

	无运河 original	有运河 With canal	有无对比 comparison
最大 max	32.69	32.8	+0.11
最小 min	30.21	30.38	+0.17
平均 avg	31.26	31.42	+0.16



圣胡安河流量（m^3/s）
Runoff of San Juan River(m^3/s)

	无运河 original	有运河 With canal	有无对比 comparison
最大 max	822	874	+52
最小 min	105	128	+23
平均 avg	319	363	+44

CRCC Studies shown lake level not affected by Canal even after taking into account population increase in Lake Basin

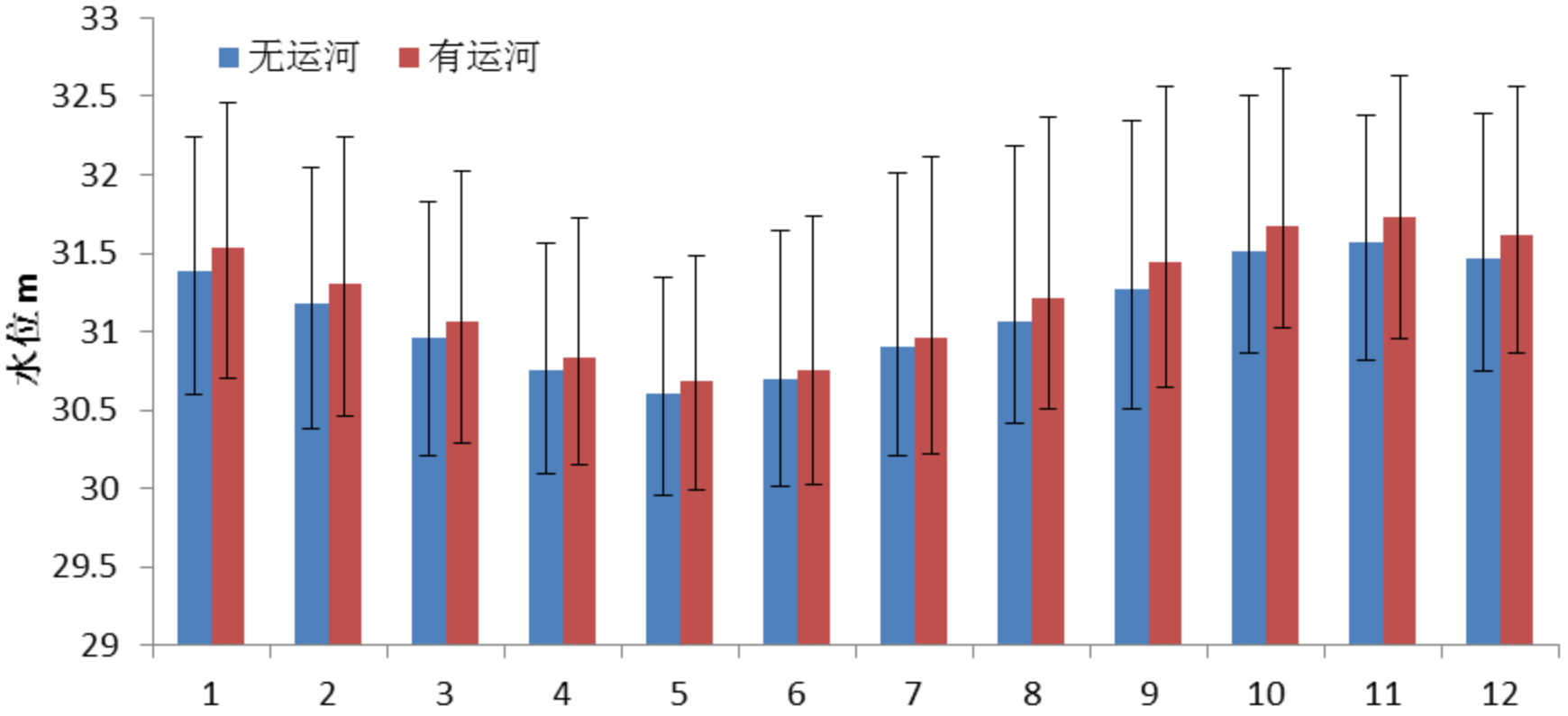


Figure 5.3.2-12 Considered influences of canal operation on Lake Nicaragua water level（2050）

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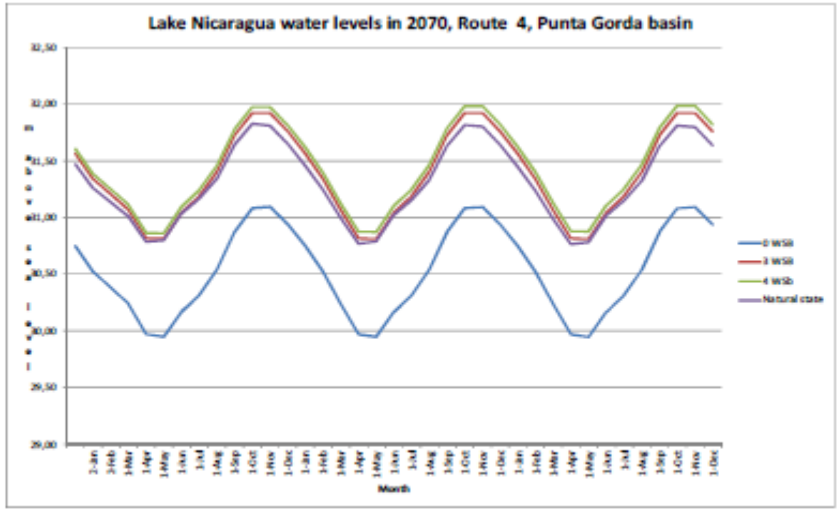
SBE study shows OK even with single El Nino

Extreme event (El Niño) with canal

with full gravity-driven natural inflow from Atlantic basins

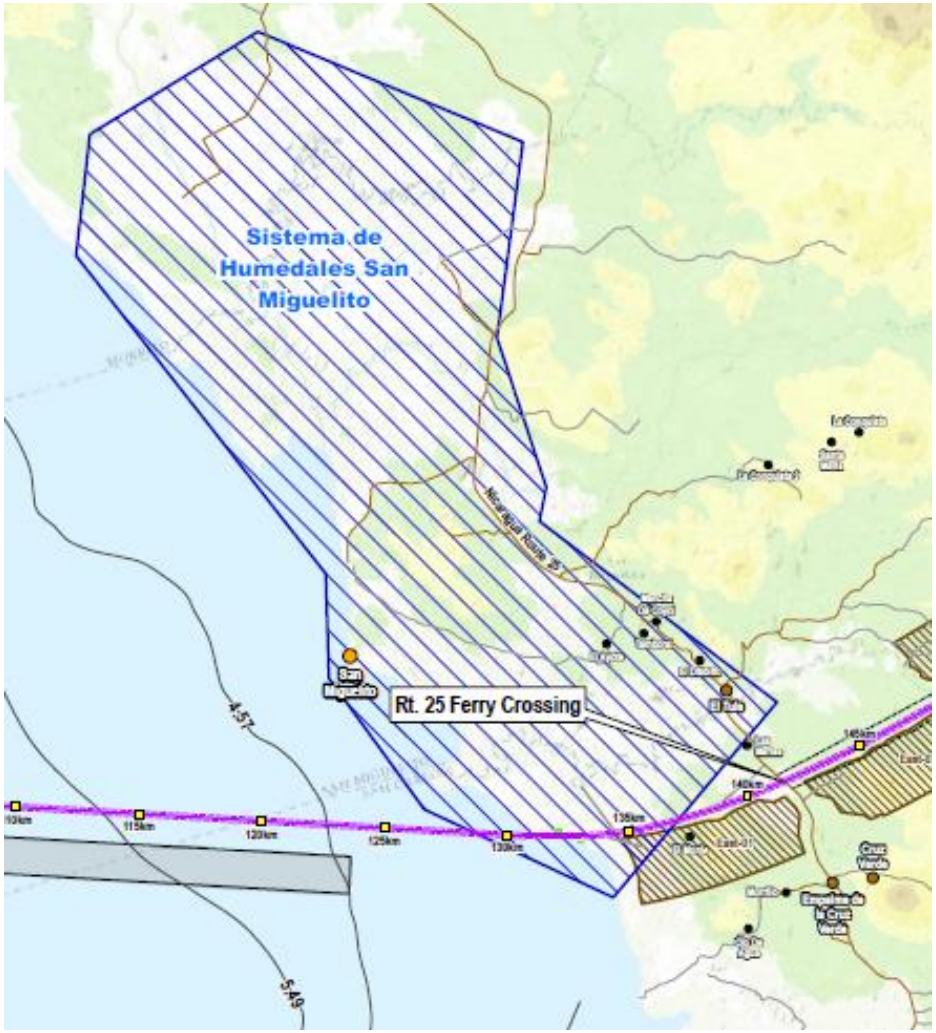
- Balance model, Route 4

	Equilibrium levels 2070			
Lock configuration	0 WSB	3 WSB	4 WSB	Natural State
Water use [m^3/s]	190.3	76.1	63.4	0
Eq. level [masl]	30.54	31.38	31.44	31.31
Min. level [masl]	29.95	30.81	30.88	30.76
Ave. delta level [m]	-0.77	0.07	0.13	0.00
Max. delta level [m]	-1.36	-0.50	-0.43	- 0.54
Ave. surface area [km^2]	6717	8447	8581	8274
Q average San Juan [m^3/s]	160	339	357	319



SBE Deltares

Exit from the Lake (avoid sensitive areas)



Alignment changed for exit from Lake to East Canal to avoid the sensitive environmental areas.

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The Punta Gorda

We treasure Punta Gorda, Canal stay away from it until 15KM upstream and river is south of the breakwaters.

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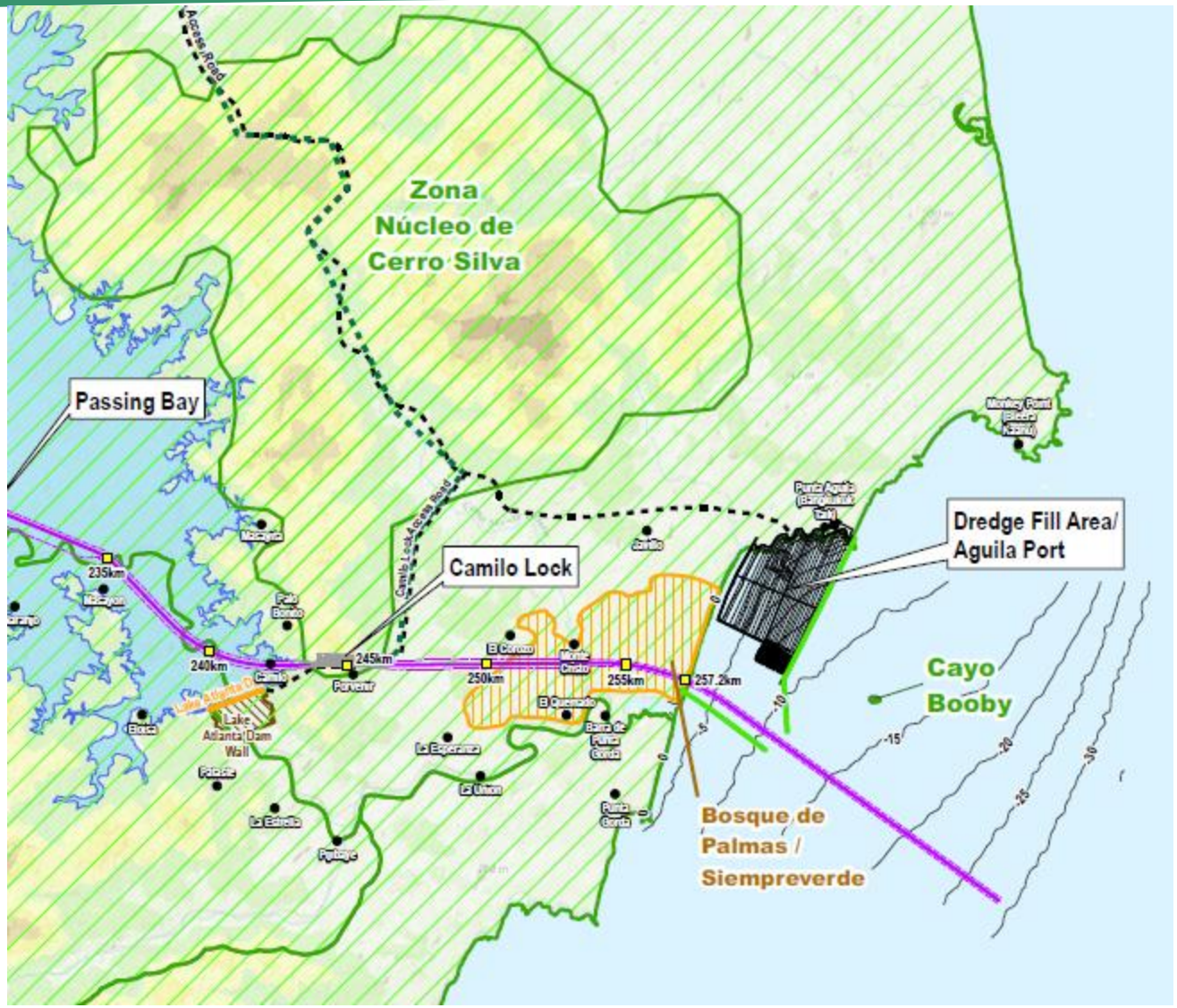
Environmental Consideration for East Canal



We are committed to maintain 10 KM clearance zone in the Miso American Biological Corridor

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The Indo Maize

We are committed to protect the Indo Maize with GoN.
The Canal provides barrier to people getting into the area.

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The Palm Forest

We address the biological importance of the Palm Forest and we would use hydraulic dredging when excavating.

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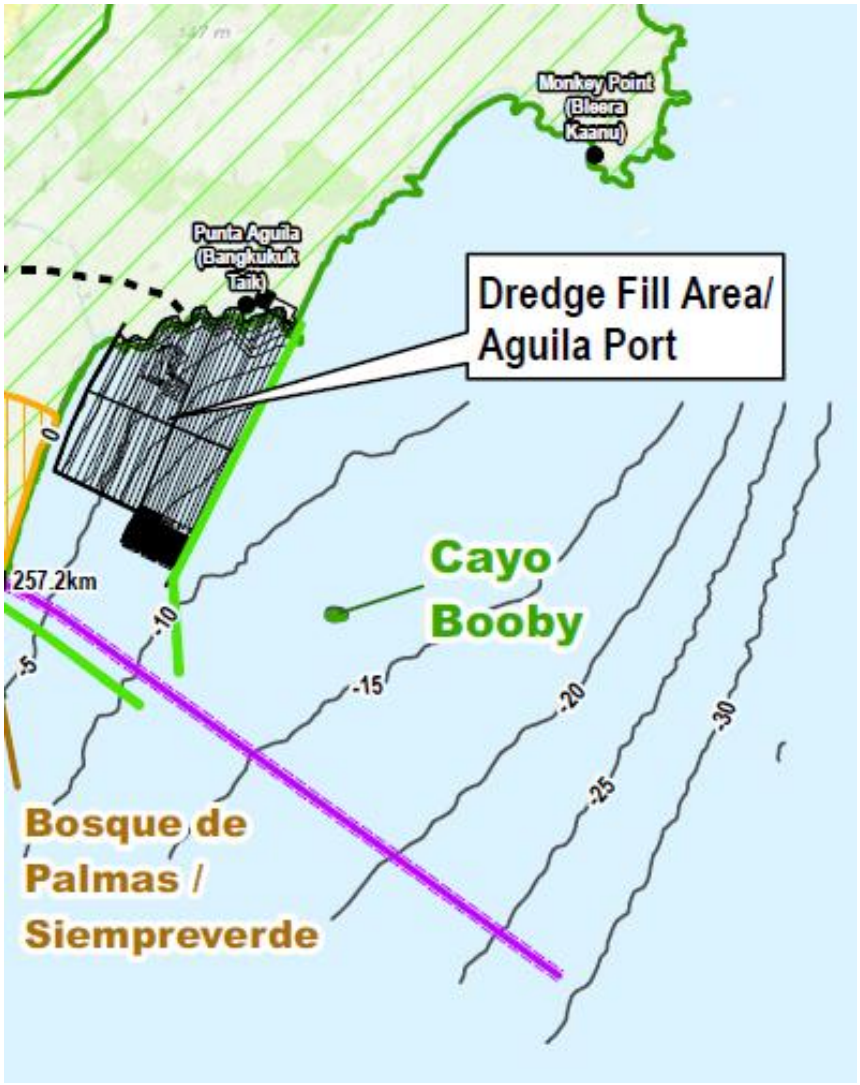
Port Aguila is actually dredge filled



Port Aguila is actually dredge filled with minimal impact to the Indigenous People.

All developments like Free Trade Zone would be confined to this piece of reclaimed land.

Canal route avoid impact to Booby Cay.

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Thank You !

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