

## Nutrición de la Playa de Matinhos y Complejidad de la Gestión Costera: Cooperación entre la Universidad y la Fiscalía

## Matinhos Beach Nourishment and the Complexity of Coastal Management: Cooperation between the University and the Prosecutor's Office

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### Abstract

The Paraná State Prosecutor's Office launched an investigation against the Paraná State and its Environmental Agency due to serious illegalities in the bidding and licensing procedure of a project that cost around US\$ 77,861,223.28, to contract a company for the execution of the work of Matinhos Seafront Recovery. Since the analysis of the project required deep technical and scientific knowledge, the Prosecutor's Office had the support of the Federal University of Paraná (UFPR), which delivered several technical notes, pointing out the problems of the studies, the administrative procedures, and the projects. After a long attempt of trying to reach an extrajudicial agreement, the Prosecutor's Office had no other option than to file a lawsuit against the Paraná State and the IAT (Water and Land Institute) to annul the Bidding Procedure No. 49/2021 and the environmental licensing pro-

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ocols and permits, since the environmental licensing procedures are null, without the obligatory Environment Impact Assessment (EIA/RIMA) and before the preparation of the basic and executive projects. Furthermore, the projects were expensive and carried out immense cultural, social, and environmental impacts and significant modifications to the natural environment, its coastal dynamics, and the ecosystem services provided, losing natural habitats, and interfering with nutrient circulation. Due to a partnership between the Public Ministry of Paraná and the Federal University of Paraná, a class action still pending final judgment was drawn up to analyze and question fundamental technical points neglected in carrying out public works to nourish the beach, in Matinhos, on the coast of the Paraná State, Brazil. The study reviews technical notes presented by university researchers and highlights gaps in the project's environmental licensing. Remote sensing was used to analyze the variability of the area after beach fattening.

## 1. Introduction

Currently in Brazil, 70% of the population lives within 200 km of the coast. The municipalities in the coastal zone are home to 26% of the Brazilian population (IBGE, 2021). In coastal areas, occupation alters landscapes and is generally driven by urban land subdivisions (Souza et al., 2021). To ensure the correct use of coastal areas and land occupation, municipal, state, and federal laws were instituted in Brazil for the correct zoning of these areas of great interest and conflict. For example, article 255 of the 1988 Brazil Constitution; law no. 7,661, of May 16, 1988, which established the National Coastal Management Plan; law no. 13,164, of May 23, 2001, that Provides for the Coastal Zone of the Paraná State and Adopts Other Provisions and the New Forest Code, law no. 12,651 of 2012.

In Miura and Noernberg (2020) work, they analyzed and quantified human impact indices and overlapping economic and cultural activities on the coast of Paraná. Correlating them with areas of environmental protection demarcated on land and water. After that, they concluded that 19,21% of Protection Areas (Conservation Unities) in the study area are affected by other human activities. With the advancement of coastal cities towards the sea and natural factors, the need to nourish beaches becomes increasingly inevitable.

According to Dean (2002), beach nourishment comprises the placement of large quantities of good quality sand on the beach to advance it seaward. Coastal evolution and hence coastal sediment budgets in cells are strongly related to long term sea level rise (relative to the land). Shoreline response to relative sea level rise can be broadly divided into two main categories: erosional transgression and depositional regression (Van Rijn, 1998). Shoreface nourishments (also known as feeder berms) are used in regions of relatively wide and high dunes (relatively safe coastal regions) to maintain or increase the sand volume in the nearshore zone to nourish the nearshore zone in the long term by natural processes (net onshore transport) (Van Rijn, 2011). In general, three main types of beach nourishment differ in where the sediments are deposited along the shoreline profile, whether on the beach, shore-face, or dunes (Speybroeck et al., 2006). Overall, beach nourishment projects were used to defend seaboard areas from the risk of a growing shore withdrawal (Cantasano and Letto, 2022). However, the technique is controversial as it may have significant environmental impacts, such as altering coastal dynamics, losing natural habitats, and interfering with nutrient circulation. Although sand nourishment may offer significant benefits, it may also be a costly method if life spans are fairly

short at very exposed beaches or if the long term availability of adequate volumes of compatible sand at nearby (economic) locations is problematic (Van Rijn, 2011).

The case study is focused on the environmental licensing procedure for the project called Matinhos Seafront Recovery, in Matinhos City, Paraná state, Brazil. The paper also aims to emphasize the vital and indispensable cooperation between the Prosecutor's Office and the University, in complex cases, in exchange for high-level technical support from Academia, to support investigations, criminal lawsuits, and class action litigation to protect the environment. Satellite images were used to reinforce and prove some of the questions raised in the legal action.

### **Environmental protection in courts**

Indian Supreme Court Justice Deepak Gupta (The Indian Express, 2021), while criticizing sustainable development, asserted that a bad environment can never be a good economy and that although at the heart of development, there is conflict, the prevailing view protects the environment. Likewise, he criticized climate change deniers (GHOSH, 2020) and their effects on the immigration of victims of environmental disasters, such as the floods in Bangladesh. Finally, in a similar situation to Brazil, he stressed that India's problem is not legislative, but the application of existing norms (law enforcement).

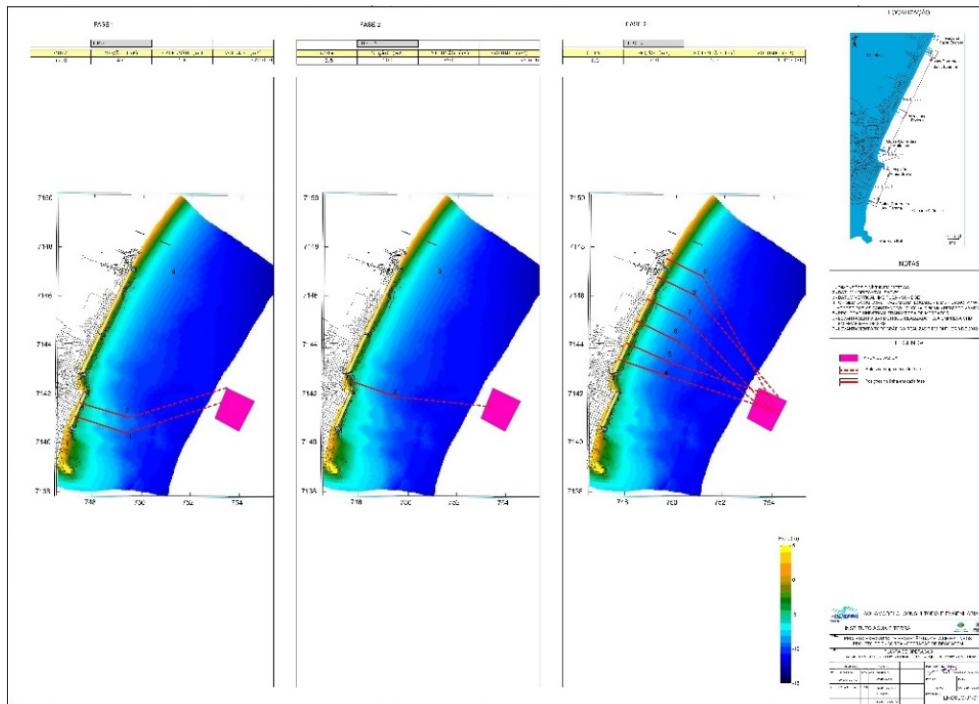
At this point, it shall be clarified that the Prosecutor's Office has public legitimacy, which means, it is politically independent of the government and plays a vital role in representing public interest. One of its main constitutional roles is environmental protection through the surveillance of environmental agencies' compliance with the legal framework, environmental impact studies follow-up, establishment of air and water quality standards, protection of natural areas, and other environmental protection policies. Nonetheless, environmental regulation fails due

to the limited capacity of regulatory and surveillance agencies (lack of staff, human resources inadequately trained or equipped), creating conditions for corruption and impunity; and interference by elected officials and more powerful agencies, particularly agencies responsible for economic development.

The work of the Brazilian Environmental Prosecutor's Office differs from the traditional role of just prosecuting crimes because it also includes civil offenses and administrative improbity. As pointed out by McAllister (2008), in Brazil, prosecutors also became extremely active in civil litigation involving public interests such as consumer defense, children's rights, disability rights, and worker health and safety as well as environmental protection. Prosecutorial enforcement emerged as an alternative, more effective mode of enforcement than the administrative enforcement conducted by Brazilian environmental agencies. The involvement of legal actors in environmental protection significantly enhanced the environmental rule of law and made environmental law more effective.

### **Matinhos seafront recovery**

The Water and Land Institute (IAT) initiated the bidding procedure whose object is the execution of works for the Matinhos Seafront Recovery project, which includes the fattening of the beach strip through hydraulic embankment, the implantation of maritime structures, micro and macro drainage interventions, and urban revitalization, with the initial value of US\$ 78,264,759.91. In few words, it predicted six coastal interventions. The first is a Maritime Intervention with Flexible Structures: filling of sand strips through a hydraulic embankment (Figure 1 – see supplementary material for better resolution). The landfill operation sequence was separated into 3 stages. Phase 1 will increase by +4.0 m, moving 720,000 m<sup>3</sup> of sediment; Phase 2 will increase by +2.5 m and will require 35,000 m<sup>3</sup> of sediment and



**Figure 1.** Maritime Intervention project with Flexible Structures: sand strip fattenning using hydraulic embankment proposed. Source: IAT, 2021.

the more significant Phase 3 will increase by +3.0 m generating a volume of 1,950,000 m<sup>3</sup> of sediment. The deposit of material for fattenning is highlighted in the figure.

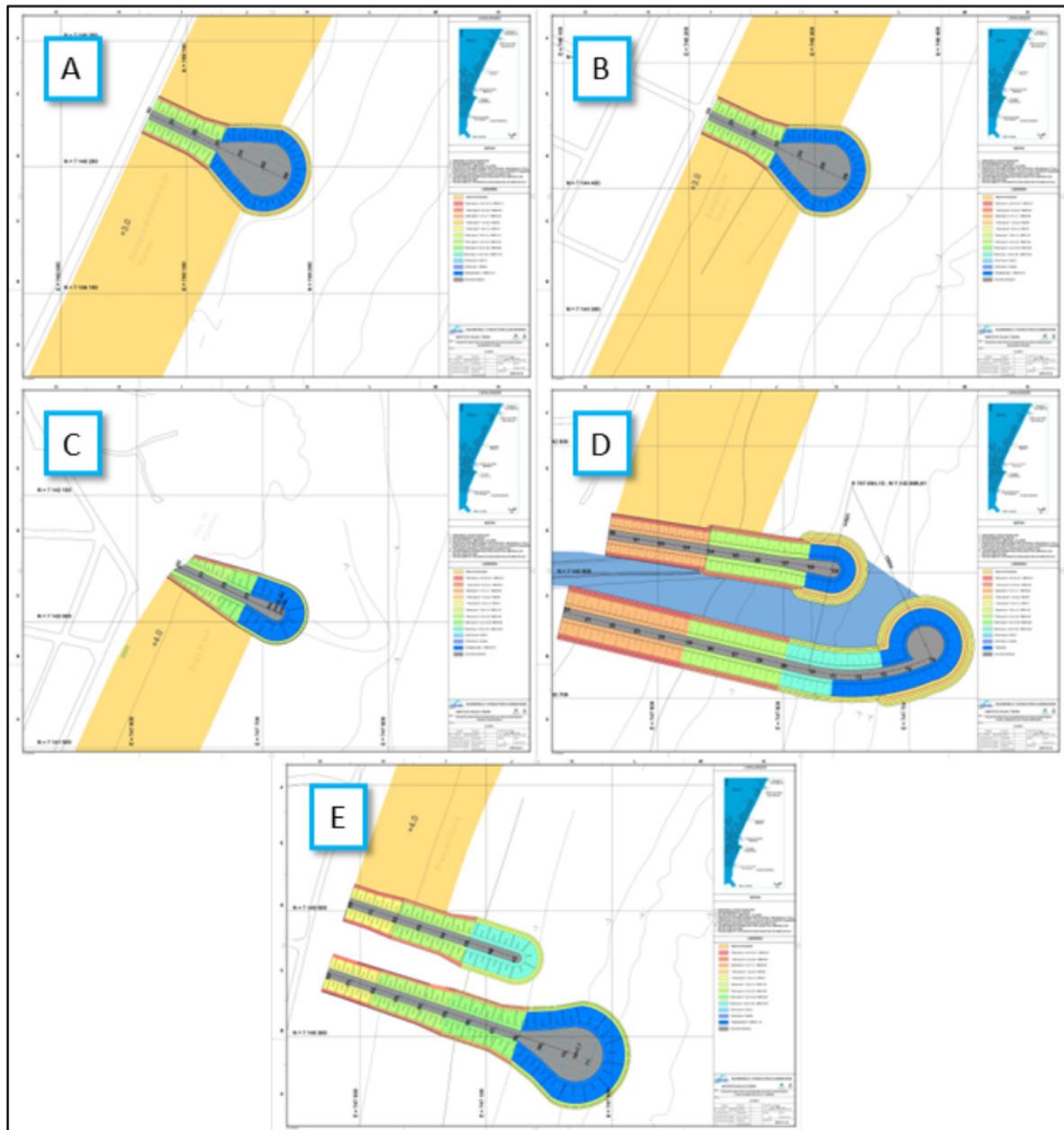
Another Maritime Intervention of Matinhos Seafront Recovery project is a Semi-Rigid Structure made with headlands, current guides, and spikes – headland of Florida beach and coastal; headland of Riviera beach; spike of Praia Brava; current guides of the Matinhos River; protection current guides at Av. Paraná (Figure 2).

The third execution of works for the Matinhos Seafront Recovery project is a Macro drainage at Av. Paraná canal. Figure 3 (see supplementary material for better resolution) shows the plant project.

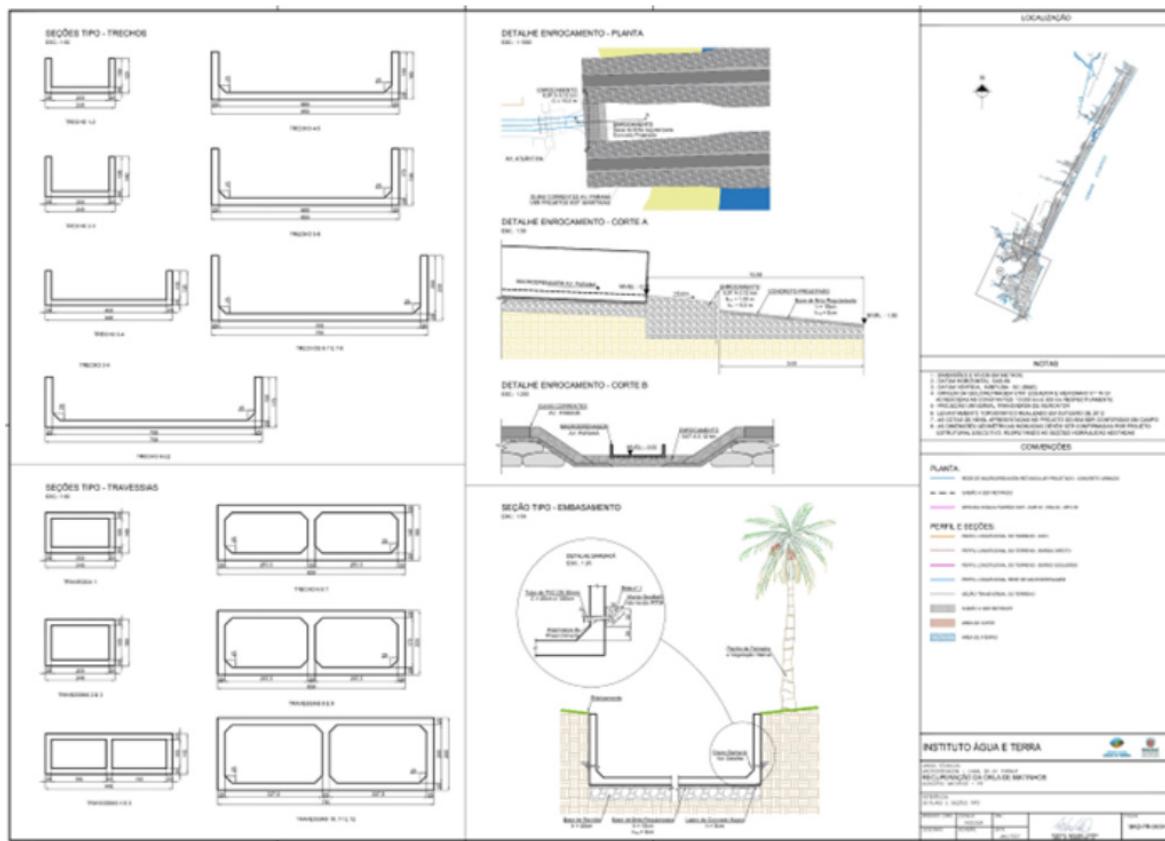
Micro drainage in the networks of storm sewers in Caiobá and the central beaches of Matinhos is proposed by IAT as the fourth intervention in the project (Figure 4 – see supplementary material for better resolution).

An Urban Revitalization of the Waterfront (Figure 5 – see supplementary material for better resolution) was proposed in the Matinhos Seafront Recovery project. In Stretch 1-B, Av. Paraná-Sereias Street; in Section 2, Sereias street - Av. Curitiba; in Stretch 3, Av. Curitiba-Orquídeas Street.

The final work of the proposal is Paving and Road Recovery. The paving services of Sections 1-B, 2, and 3 (Figure 6 – see supplementary material for better resolution) were defined as main sections.



**Figure 2.** Maritime Intervention project with Semi-Rigid Structures: headlands, current guides, and spikes  
(A) headland of Florida beach and coastal; (B) headland of Riviera beach; (C) spike of Praia Brava; (D) current guides  
of the Matinhos River; (E) protection current guides at Av. Paraná. Source: IAT, 2021.



**FFigure 3.** Macro drainage project at Av. Paraná canal. Source: IAT, 2021.



**Figure 4.** Micro drainage project of networks of storm sewers in Caiobá (A) and in the central beaches of Matinhos (B). Source: IAT, 2021..



**Figure 5.** Urban Revitalization of the Waterfront: in Stretch 1-B, Av. Paraná-Sereias Street; in Section 2, Sereias street - Av. Curitiba; in Stretch 3, Av. Curitiba-Orquídeas Street. Source: IAT, 2021.



**Figure 6.** Road Paving and Recovery project on Sections 1-B (A), 2 (B), and 3 (C) in Matinhos waterfront. Source: IAT, 2021.

## 2. Methods

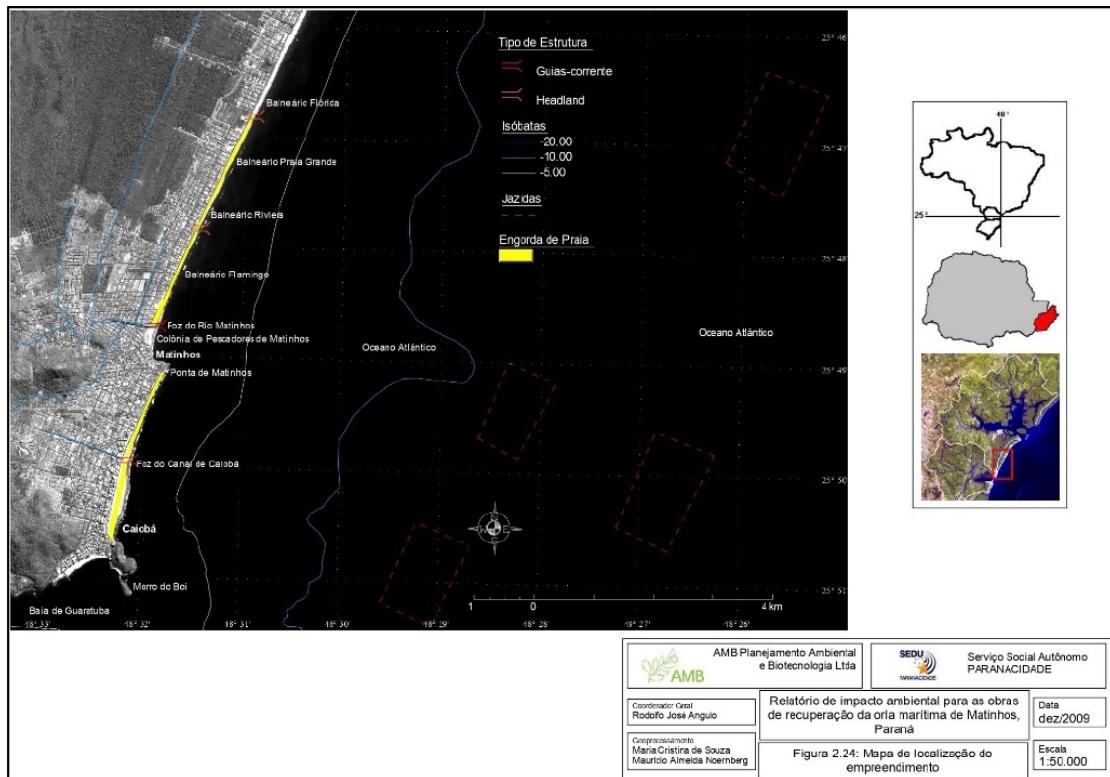
Based upon the application of two main methods, the article will be qualitative and exploratory: Literature Review, through traditional doctrinal legal research and satellite images comparisons from different times satellite images from the Matinhos City Waterfront. This paper approaches a specific case study about the Matinhos beach replenishment based on a thematic (licensing due process and environmental impact assessment) and geographic selection.

### Study area

The Guaratuba Bay is also located in an extremely relevant area for nature conservation with a Ramsar Site (from the List of Wetlands of International Importance), a significant portion of the Guaratuba En-

vironmental Protection Area (APA), and several UC and their respective buffer zones. In addition, it is a strategic area for the development of the National Action Plan for the Conservation of Endangered Species and of Socioeconomic Importance in the Mangrove Ecosystem - PAN Mangrove, by ICMBio (Chico Mendes Institute for Biodiversity Conservation).

Surrounded by multiple uses, the city of Matinhos city, Paraná State, Brazil (see Figure 7 – see supplementary material for better resolution), the location of this case study, becomes a strategic point for transport routes, tourism, especially summer vacationers, and hospitality. To the North, the Port of Paranaguá controls the largest export of grains in the



**Figure 7.** Study area location with all Matinhos Seafront Recovery projects. Source: AMB, 2009.

country; to the south, the Guaratuba estuary connects the Paraná State with the neighboring state of Santa Catarina, and to the west, Matinhos directly connects the coast with the metropolis Curitiba, the state capital. Adding the existing activities for human use, Matinhos is inserted in a mosaic of more than 30 Conservation Units (UC) present on the Coast of Paraná (Miura and Noernberg, 2020). Therefore, it is inevitable that there are conflicts over the use of resources and spaces due to activities that do not always coexist harmoniously. Anthropic activities carried out on the continent are not limited to the emerging geographic space, so uses for industrial and port purposes impact, either positively or negatively, the aquatic environment. In this context, the coast of Paraná is a place of overlapping territorialities, with populations, their cultural reproductions, and other spaces intended for nature conservation (Pigosso *et al.*, 2018).

### Literature review

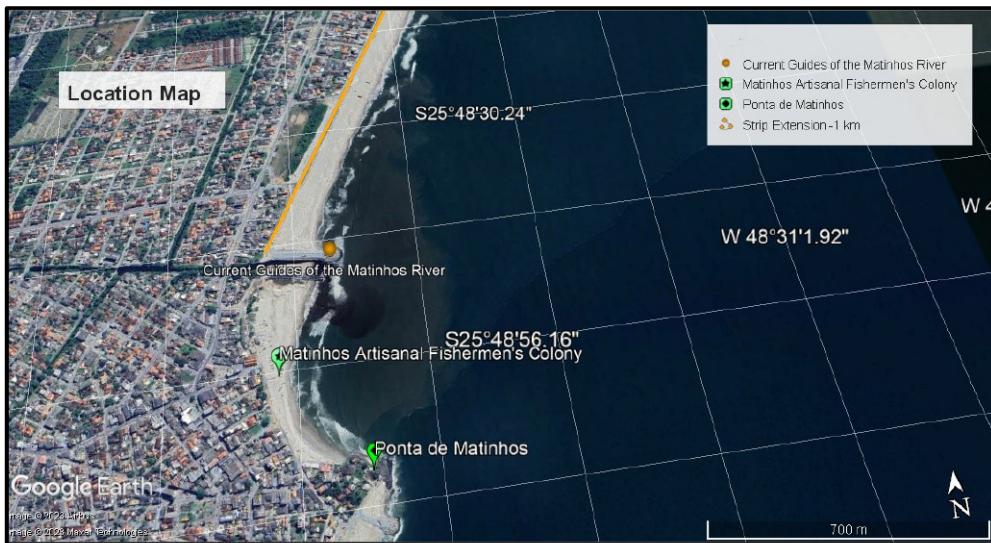
The paper will be divided into six distinct but inter-related stages: bibliographic research (books and periodicals); documentary research; legislative research, codified laws, and regulations; case selection and systematization and qualitative analysis of the collected data. The literature used for the study includes public documents made available by the Public Ministry of Paraná (MPPR - Public Ministry of Paraná) and the Federal Public Ministry (MPF - Federal Public Ministry), such as letters, protocols, determinations and technical notes from researchers and processes federal public courts, of the Federal Court. The Technical Notes (NT), presented in this work, are public acts resulting from the partnership built between MPPR and UFPR that express the technical-scientific positioning of researchers and professors from the Federal University of Paraná (UFPR), on the environmental licensing process and landscaping of the projects.

All the NT provided by UFPR researchers contributed to decision-making and served as a basis for writing Public Class Actions against the actors involved in the environmental licensing of the Matinhos Seafront Recovery project.

### Remote sensing

The analysis of satellite images is a powerful and versatile methodology that allows for the temporal evaluation of specific geographical areas. Through this approach, it is possible to monitor changes over time, ranging from alterations in vegetation cover to urban growth. The use of Google Earth provides access to a vast amount of historical satellite images, offering the opportunity to compare different periods and identify trends and patterns. By closely examining these images, valuable information can be extracted for environmental studies, urban planning, disaster monitoring, and more. The combination of interactive visualization and the ability to overlay additional data allows for a comprehensive and in-depth analysis of the changes occurring on our planet over time. Images from the past 10 years (2014-2023) available on the platform were chosen due to their quality and cloud coverage. A total of 14 images were selected out of 35 available from Google Earth Pro in our study area. This tool was used for the analysis and is available online and free of charge.

The location chosen to analyze the images is located between Ponta de Matinhos ( $25^{\circ}49'6.08''S$ ,  $48^{\circ}31'47.23''W$ ) and Flamingo Balneary (Figure 8). An area was demarcated to compare the area of the sand strip, its length is 1km from the location chosen by the developers to build the Current Guides of the Matinhos River to the north. It is important to highlight that between the Current Guides and Ponta de Matinhos, the entrepreneurs did not choose to carry out beach fattening. Between Ponta de Matinhos and the Rio de Matinhos channel, there is a Matinhos Artisanal Fishermen's Colony.



**Figure 8.** Location map of the study area section for geospatial analysis.

### 3. Results and discussion

#### Coastal and marine management

Likewise, according to the Macrozoning of the Coast, the undertaking location is situated in an Urban Area, surrounded by plains of sand dunes, mangroves, hills, and mountains. In the PDSL (Plano de Desenvolvimento Sustentável do Litoral do Paraná), the development area is in the Occupied Urban Macrozone, Urban Expansion Macrozone, and Environmental Conservation Macrozone. In the zoning of the Matinhos Master Plan, the project area is located close to the Biodiversity Corridor, Environmental Conservation Zones in addition to the Maximum Restriction Zone and Restricted Use Zone. In the Coastal Hydrographic Basin Plan (PBHL, 2019), is situated close to contribution zones (28, 31, 32, and 38) and close to areas of permanent preservation of rivers and springs. In the Ecological-Economic Zoning (ZEE) Diagnosis (ZEE, 2016) they are in the Urban Zone, close to the Differentiated Development Zone and Protected Zone by Specific Environmental

Legislation. The region where the projects are implemented is an area of the Union (Federal), under the management of the Secretary of Union Heritage (SPU). Finally, the entire region of the undertaking, Matinhos Waterfront, is listed by the Paraná Cultural Heritage Coordination.

In this context, the licensing body IAT and the entrepreneur, also IAT, took off the undertaking of the coastal territory where it was intended to be installed. Territorial detachment occurs due to four factors: (1) absence of Coastal Ecological-Economic Zoning (ZEEC); (2) absence of a State Coastal Management Plan; (3) lack of consideration of “Paraná Mar e Costa” (Coastal Management Proposal) and (4) lack of integration of territorial planning instruments, which must necessarily be considered in the environmental licensing:

- **Regional.** PDSL and Coastal Hydrographic Basin Plan.

- **Local.** Atlantic Forest Municipal Plan; Master Plan for Integrated Development of Paranaguá and Municipal Plan for Basic Sanitation and
- **Sectorial.** Orla Project; Management Plans for UC and IV PAF-ZC - Federal Action Plan for the Coastal Zone. In the case under examination, the IAT's gaze was focused only on speeding up the undertaking, without deepening the examination of its territory.

The ZEE aims to subsidize the management of public policies, as a political and technical instrument that enables the incorporation of environmental issues into the strategic planning of the state government, being part of the National Policy of the Ministry of Environment (Article 9, I). However, State Decree no. 5793, which published the Coastal ZEE, did not consider the coastal and marine area, dealing only with the territory of the mainland. Thus, Paraná, unlike states such as São Paulo and Santa Catarina, does not have the ZEEC, which even damages marine environmental licensing procedures.

The State Coastal Management Plan is provided for in State Law No. 13164/2001, which provides for the coastal zone of the Paraná State, in which it is considered the set of activities and institutional procedures that, through specific instruments, allow the implementation of the State Policy for the region, guiding the process of occupation and rational use of the natural resources of the Coastal Zone of the Paraná State. Having proposed the term of reference, so far, the State has not yet taken the necessary measures for the preparation and execution of the PEGC, which reflects a major problem, not only about zoning, but to the environmental licensing procedures of the estuarine environment. Paraná Mar e Costa (2006) was published by the State as a preliminary proposal for coastal and marine zoning. In the study, there are 10 zonings, highlighting the areas ZM7 (Coastal Zone of General Use), ZM8 (Coastal Zone of Special Use), and ZM9 (Coastal Intervention

Zone). The “Paraná Mar e Costa”, however, despite its technical value and careful art, did not become an official instrument because it was not published as a ZEEC or an integral part of the PEGC, which is absent in the Paraná State.

The Integration of Territorial Planning Instruments requires the analysis of overlapping and conflicts of zoning tools and proposals for strategic planning and territory management, which must consider regional, local, and sectorial plans, in environmental licensing procedures. Neither IBAMA nor IAT carried out such work spontaneously, except when expressly recommended by the Prosecutor's Office.

In this case, the Management Plans for the UC stand out, bearing in mind that there are Municipal, State, and Federal Conservation Units close to the project (Table 1).

Finally, the IAT does not adequately observe the dictates of the IV PAF-ZC (Triennium 2017-2019), an agenda coordinated by the Coastal Management Secretariat/MMA and conducted by the Integration Group for Coastal Management (GI-GERCO), especially the Action Plan for the Combating Litter at Sea.

### Public class actions

#### ***Public class action nº 50561654720214047000***

The IAT, which is the Paraná State environmental agency, launched the Bidding Notice No. 49/2021, in the amount of US\$ 77,861,223.28 to contract a company for the execution of the work of “Matinhos Seafront Recovery”. In summary, the environmental licensing procedures are null, since the relevant environmental legislation establishes the obligation to carry out an EIA/RIMA, not only before the preparation of the basic and executive projects but also before the implementation or expansion of works, especially complex ones, costly and of immense environmental impact.

**Table 1.** Municipal, State and Federal Conservation Units close to the Matinhos Seafront Recovery project.

Name	Type	Scope	Local
Restinga Municipal Park	Park	Municipal	Pontal do Paraná
Ilha do Valadares Municipal Park	Park	Municipal	Paranaguá
Linear Municipal Park of Emboguaçu	Park	Municipal	Paranaguá
Lagoa do Parado Natural Municipal Park	Park	Municipal	Guaratuba
Praia Grande Municipal Park	Park	Municipal	Matinhos
Morro do Boi Municipal Park	Park	Municipal	Matinhos
Sertãozinho Municipal Park	Park	Municipal	Matinhos
Morro do Sambaqui Municipal Park	Park	Municipal	Matinhos
Tabuleiro Municipal Park	Park	Municipal	Matinhos
Guaratuba APA	Protection Area	State	Guaratuba
Rio da Onça Forest Park	Park	State	
ESEC Ilha do Mel	Ecological Station	State	Paranaguá
Ilha do Mel State Park	Park	State	Paranaguá
ESEC Guaraguaçu	Ecological Station	State	Paranaguá
Palmito State Park	Park	State	Paranaguá
Saint-Hilaire Lange National Park	Park	Federal	Matinhos, Guaratuba, Morretes e Paranaguá
Ilhas dos Currais Marine National Park	Park	Federal	Pontal do Paraná

On the merits, the objective of the class action was to obtain a verdict of conviction to refrain from the practice of any act that implies the continuity of the aforementioned environmental licensing procedure, as well as to refrain from promoting a bidding procedure for hiring a company for the execution or any intervention of public works related to the Basic and Executive Projects for the Recovery of the Matinhos City Seafront before the conclusion of a new EIA, the public hearings, the obtaining of prior consents from the intervening institutions and issuing valid Preliminary Permit or Installation Permit, due to the necessary logical sequence of carrying out the EIA and issuing of the Preliminary Permit and Installation Permit, before the preparation and execution of the basic and executive projects.

In this sense, any kind of authorization or environmental license for the afore-mentioned undertaking must meet conditions and requirements established in the environmental legislation, by National Council for the Environment (CONAMA) Resolution nº 01/1986, CONAMA Resolution nº 297/1997, SEMA Resolution nº 31/1998, CEMA Resolution nº 107/2020, including, prior and valid consent from the State Council for Historical and Artistic Heritage/Cultural Heritage Coordination (CEPHA), Coastal Territorial Development Council (COLIT), Water and Land Institute/Natural Protection Department, ICMBio, Historical and Artistic Heritage Institute (IPHAN), Navy, Municipality of Matinhos and SPU, to prevent damage to health and the environment, the historical and landscape heritage, and

safeguard the integrity of the population, affected by the risks caused by the undertaking.

In addition, the environmental licensing procedure directly violates the principles of public administration, especially the principles of legality, impersonality, morality, publicity, and economy, since the EIA is a legal instrument, which must consider technological and locational alternatives and even the non-completion of the constructions. Furthermore, it should be added that the Public Notice nº 49/2021 was launched, in the amount of US\$ 77,861,223.28; to contract a specialized company for the execution of the work of the Matinhos City Seafront Recovery Projects. This public notice, however, was intended for hiring a company only for the first stage of the work. Thus, there was a public notice released before the knowledge about the viability of the projects and the environmentally less impactful layouts, as well as the best technology available on the market for their execution.

The resources for the implementation of the projects would come from a loan of US\$ 326,370,757 (RUS\$ 1,6 billion reais), negotiated by the State, together with the Bank of Brazil (Banco do Brasil) and the Federal Savings Bank (Caixa Econômica Federal), which received the seal of approval from the National Treasury Secretariat, favorable opinion from the National Monetary Council (CMN) and guarantee from the Union. Such financial institutions are signatories to the Equator Principles, the International Finance Corporation – IFC, the Green Protocol, and the UN Global Compact, and therefore need to consider the environmental and social impact of their loans. Finally, the Federal Court of Accounts precedents determine the need to issue a prior license before the elaboration of the basic and executive projects, as well as the start of public works, which was violated by the defendants. The referred class action was based upon four Technical Notes, issued by the UFPR.

On August 17, 2021, the judge issued a preliminary decision and: (a) recognized the competence of the federal jurisdictional; (b) considered legal the active joinder of the Federal and State Prosecutor's Office; (c) determined the subpoena of the ICMBio; National Foundation of Indigenous People; IPHAN; National Institute of Colonization and Agrarian Reform; National Waterway Transport Agency; Union Heritage Secretariat and IAT to express any interest in the litigation, assisting any of the parties and (d) the postponement of the preliminary injunction and, therefore, the judge ordered a response from the defendants before the final decision about the preliminary requests.

On August, 3rd, 2022, almost a year after the class action proposal, the judge issued another decision and: (a) recognized the competence of the federal jurisdictional; (b) considered legal the joint participation of the Federal and State Prosecutor's Office; (c) declared the passive legitimacy of IBAMA, IAT, the Paraná State, Bank of Brazil and Federal Savings Bank; (d) applied the double guarantee theory, in regard to the civil servants, based upon Supreme Court's precedents; (e) determined the inclusion of Consórcio Sambaqui, who won the bid; (f) determined the reversal of the burden of proof; (g) highlighted that the administrative licensing process should have been submitted to the scrutiny of the Federal Environmental Agency (IBAMA) since the State Environmental Agency (Instituto Ambiental do Paraná - IAP) merged with the Paraná Water Institute (Instituto das Águas do Paraná) and gave rise to the Water and Land Institute (h) postponed the analysis of the conflict of interests and negligence of civil servants; (i) registered the significant modification of the work, over the period from 2010 to 2021, which was well demonstrated by the increase in the cost of the project, from US\$ 4,483,179.67 to US\$ 98,543,570.50; (j) denied the request for suspension of the enterprise; (k) determined that IBAMA should

assume the conduction of licensing process to avoid the situation of self-licensing, and finally (l) determined that the defendants (Sambaqui Consortium, IAT and the Paraná State) should provide a detailed report regarding the current situation of the works, phases, respective schedules regarding their progress, with emphasis on the measures adopted for environment protection of nature and detail the value of the financial investment already promoted as well.

***Public class action Nº 5004607-65.2023.4.04.7000***

On February 1st, 2023, the MPF, based upon the Civil Inquiry Nº 1.25.000.005198/2022-15 proposed a public class action with an injunction request for the annulment of environmental authorizations against the IAT, his Coastal Regional Manager, and Paraná State, due to illegal acts of granting environmental permits which authorized the suppression of native sand dune vegetation, because it is exotic vegetation. The plaintiff requested the annulment of the suppression authorizations regarding the government political project "Novo Litoral do Paraná", which implies that areas of native vegetation of sand dune will be removed. And it concluded by asking for the conviction of all defendants to pay adequate damages, whether material or moral, including the collective moral damage due to the suppression of native vegetation and harm to the government treasury.

Later, the State Prosecutor's Office requested to enter the dispute as co-author (ulterior joint-litigation), which was granted by the federal judge. Furthermore, it should be mentioned that the MPF sent the Written Notice nº 10.117/2022-PRPR, on December 16th, 2022, to the IAT's President and recommended immediate annulment/revocation of authorizations mentioned above, at least, until the verification, by the environmental agency with attribution for the licensing, of the inadequate execution of vegetation transplantation, with identification of any damaged seedlings, carrying out a floristic and

faunal inventory, evaluation and realization of an alternative project that avoids, as much as possible, the removal of native vegetation that, if made, must be done manually, mitigating and compensatory measures that have already been or will be adopted due to the intervention in the Permanent Preservation Area (APP), as determined by (CONAMA Resolution 369/2006) (MPF, 2022a).

The MPF understands that such a measure is parallel and cumulative to this request and does not violate the decision in the Public Class Action nº 5056165-47.2021.4.04.7000 since it is not a licensing act but an annulment of an illicit administrative act committed by itself (MPF, 2022b).

On February, 18th, 2023, the judge issued the decision and: (a) declared the connection with the Public Class Action Nº 5056165-47.2021.4.04.7000/PR; (b) ordered the summons of the Federal Union, IBAMA, ICMBio, and the City of Matinhos, as assistants of the parties; (c) admitted the non-governmental organization NGO CEDEA (Centro de Estudos Defesa e Educacao Ambiental), in the litigation, as *amicus curiae*; and (d) granted the request for preliminary injunction postulated by the plaintiff and determined the maintenance of the sand dune vegetation suppression, on the coast of Matinhos, to check whether the measure was being promoted following the projects already presented and regarding the rules applicable to the case.

**UFPR technical scientific notes**

***Technical note nº 01 (01/2020)***

On September 17, 2020, the UFPR Rectory issued the Official Letter No. 44/2020, through which it forwarded the Technical Note Nº 01 (September, 3rd, 2020), elaborated by the professors appointed by the Earth Science Sector, Biological Science Sector, Coastal Sector and Center for the Study of the Sea, referring to the Matinhos Seafront Urban Revitalization Project, launched by the IAT. The First

Technical Note was issued on March, 9th, 2021, through the technical-scientific position of Professors and Researchers, from different areas of knowledge, of the UFPR.

In this note, the authors registered that the alleged revitalization of the Matinhos waterfront, required the carrying out of infrastructure works of great magnitude, with obvious environmental, cultural, and economic impacts and, therefore, social. The complexity of the constructions would require an improved, up-to-date, and transparent technical discussion, far beyond the interests of an executive or business nature, to optimize any decision-making about the coastline. In this sense, they argue that infrastructure works must be guided by the best scientific knowledge, by strict compliance with legal rules, by the collective public interest, and by the good practices of territorial management recognized in Paraná State and elsewhere. These criteria are even more relevant when they involve significant modifications to the natural environment, its dynamics, and the environmental services provided (UFPR, Technical Note Nº 01, 2020).

The Environmental Impact Assessment (AMB, 2009) was based on the Paranacidade project, about which CEPHA presented its first interventions. Initially, CEPHA recognized the social interest of the undertaking but already warned of the environmental and landscape inconveniences of implementing current guides and artificial replenishment in certain sectors of the waterfront. The Project, however, remained shelved for a few years, having only been resumed in 2019, when the current State Governor presented a new proposal to the Ministry of Regional Development (IAT-PR Project). However, the IAT project gave a completely different dimension to the intervention works on the Matinhos waterfront.

Thus, it was recorded that the current proposal (2019) for intervention adds an artificial canal, current guides, and spikes that were not part of the orig-

inal proposal, and which had already been categorically discarded by environmental technical studies or by landscape opinions or regulations of CEPHA itself. The authors of the Technical Note sought to emphasize the need to prepare a new environmental licensing procedure since the environmental studies carried out in the scope of the infrastructure work to revitalize the Matinhos waterfront date back more than 10 years.

Finally, the authors elaborated thirteen recommendations to contribute to the best address of the Matinhos Waterfront Revitalization Project, concluding that infrastructure projects, especially those carried out using public resources, must be based on good information, and not the contrary. In addition, they must be supported by the legal and scientific apparatus and backed up by consultations and clarifications to the population, indicating their interest in generating results for the collective good and for present and future generations. The opinion recommended by the researchers is the cancellation of the work execution procedures and a new licensing and environmental feasibility procedure, seeking to improve the diagnosis and scenarios, legally based and validated by the technical and advisory instances of coastal governance, officially implemented, and dedicated to alternatives for problem resolution.

The Technical Note brought the following recommendations, disregarded by the IAT: (a) Maintenance of the beach dynamic range without occupation; (b) Beach dynamic range recovery; (c) Implementation of adequate access to the beach; (d) Technical clarifications on seabed and shoreline dynamics scenarios; (e) Joint construction of instruments to guarantee ways of life preservation; (f) On Matinhos central beach, north of Ponta of Matinhos, resume the works of COLIT (2001); (g) In the northern sector of the arch-beach, close to Ponta of Matinhos, seek alternative solutions to the breakwater, to promote the recovery of the beach; (h) On

the canal of Avenue Paraná, where the construction of a pair of chain guides is proposed, in addition to the non-construction of this infrastructure; (i) Evaluate the real need to implement current guides at the mouth of the Matinhos River; (j) In the Flamingo and Riviera beaches and, eventually, further north where there may be erosion problems and it would not be possible to retreat the occupation, it is proposed to build transversal works with a topographic profile and dimensions similar to the beach profile; (k) Non-intervention in the Saint-Etienne beach; (l) With regard to the artificial feeding (fattening) project on the beach, a new assessment of its necessity is suggested and (m) It is recommended that decision-making on undertakings of this nature follow the official technical guidelines available within the scope of the Interministerial Commission for Sea Resources (CIRM), as well as the GI-GERCO for the entire Brazilian coast zone.

**Technical note nº 02 (02/2020)**

The Second Technical Note (September 30th, 2020), and its annexes were based upon the responses of the Government of the Paraná State to the questions presented by the UFPR Working Group and aim to contribute to the construction of solutions for the problem of coastal erosion in its complexity (UFPR,

Technical Note Nº 02, 2020). The construction of the chain guides is identified as one of the main problems of the 2019 IAT-Project, which predicts the construction of three pairs of chain guides. Such current guides would be built to reduce the floods in the coastal plain of the Municipality of Matinhos. Figure 9, from the note, illustrates the situation.

However, the members of the GT-UFPR pointed out some questions about the construction of the current guides. One of them is that the current guides are not coastal erosion control works, on the contrary, they impact the coastal dynamics and must cause irreversible and permanent negative impacts, as they interrupt the coastal drift. Besides, the blocking of the littoral drift should cause the accumulation of sand on the south side of the current guides and deficit, and consequent coastal erosion, on the north side. Finally, to restore equilibrium in the balance of sediments along the beach arch, it will become necessary to transfer a huge amount of sand, a demand that would be annual and permanent, which would result in a real risk of transferring the erosion problem to other beaches. In this sense, the authors explained that the solution is reckless from an environmental point of view, as it would be yet another anthropic intervention on a natural process, which will disrupt the dynamic equilibrium of the beach profile.



**Figure 9.** Current-Guides proposed for the artificial canal in Saint Etienne beach and Av. Paraná's canal (IAT, 2021).

The decline in occupation at Praia Central de Matinhos was another element present in the study but later discarded by the IAT-2019 Project. When questioning the Government of the Paraná State on this point, the authors obtained a response that distorted the proposal registered in the AMB/2009 EIA. This demonstrates the entrepreneur's profound lack of knowledge about the minutiae of the environmental licensing procedure. The sand deposit for artificial feeding of the beach is another weak point of the project, since, according to the Technical Note, a volume of sand of 3,222,250 m<sup>3</sup> is foreseen, however, there is no proof of the occurrence of a deposit of sand in volume and adequate characteristics to carry out the proposed feeding (UFPR, Technical Note Nº 02, 2020). In addition, the authors stated that the studies presented by the company Água & Minério Sondagens de Solo Ltda, in 2020, were superficial and that entrepreneurs run the risk of using public resources in a work without demonstrated technical viability. It was also found that the deposit for feeding the beach was not identified, which would be fundamental in any beach fattening work. In this regard, it was noted that the studies carried out in 2002 and 2009 were preliminary and depended on a survey to confirm the sand deposit.

Regarding the institutional procedure, the absence of the IAT-2019 Project being processed before COLIT and GI-GERCO, which are inter-institutional working groups focused on state coastal management was another illegality. The absence of public participation, and adherence to the municipal master plan and the Coastal Sustainable Development Plan (PDSL, 2019) are three more problematic aspects observed in the note. The planned works must affect the dynamics of use and urban occupation of the municipality, with repercussions on the valuation of the land and potential alteration of urban zoning, as a result of this, according to the City Statute, the consent of society would be essential. This is a very

sensitive illegality, which was strongly emphasized in the Technical Note Nº 02, 2020, since the IAT, through Information Nº 06/2020, stated that the requirement for popular participation had been met after carrying out an online consultation and holding a public hearing. All the events were accompanied by several Professors, who considered them far below the parameters required by the law, with no commitment to the democratic management of the city.

The importance of the Coastal Sustainable Development Plan was also highlighted, as the most robust planning instrument of the territory developed to date for the coast of Paraná. More than that, the authors of the note emphasized that in this plan, Matinhos' fattening work is not even addressed. In this sense, it is regrettable that current managers ignore the planning for the coastal territory carried out with great quality and that they seek to contemplate the most diverse perspectives. In this perspective, they recommended a permanent agenda for the incorporation of the CIRM document, in addition to monitoring and guidance from this institution for application on the coast of Paraná, from its technical and scientific institutions, competent personnel, and observing adherence to the legal instruments of territorial order.

Finally, the professors and researchers ratified the warning expressed earlier, due to the serious environmental, landscape, and financial consequences of the undertaking, as well as for the quality of life of the affected population, especially in the long term. The note ends with a strong recommendation to reformulate the project's conceptual proposal and restart the environmental licensing procedure.

#### ***Technical note nº 03 (03/2021)***

On June 22, 2021, the Third Technical Note was published, to complement the two others, in which the authors sought to incorporate some elements based on the information presented at the Public

Hearing held by the entrepreneur and the Technical Opinion on the recovery of the Matinhos waterfront, flood control, and urban revitalization. The purpose of this note, along with the previous ones, was to contribute to the construction of solutions for the problem of coastal erosion in its complexity. Before starting the considerations, the authors drew attention to the publicity narrative that had been launched by the government of the Paraná State, which hid the existence of specific interests in coastal engineering and landscaping and reinforced the secondary importance given to the social and environmental dimension and of waterfront conservation.

Initially, they clarified that the public hearing, once again, was held amid the COVID-19 pandemic, which, despite efforts for online transmission, could not be accessed by a significant portion of the population. Even when asked about the subject, entrepreneurs preferred silence. This also remained the case when doubts were raised regarding the compatibility of the constructions and the provisions of the Coastal Management Law (Law Nº 7661/98) and the City Statute (Law Nº 10257/2001).

Specifically, regarding the revitalization work on the Matinhos waterfront, the great difference between the work presented at the public hearing, compared to previous projects, is that the works were broken down into two stages. Even so, after the public hearing and field visits, new and worrying impacts were identified: (a) Impacts of two drainage canals in the Guaraguá River basin; (b) Natural restoration of the Caiobá beach and waterfront; (c) Impact of the works on surfing at Pico of Matinhos; (d) Efficiency of drainage canals in flood control; (e) Intervention at the mouth of the stream at Saint-Etienne beach.

#### ***Technical note nº 04 (04/2021)***

The UFPR Working Group presented the Technical Note Nº 4, on July 12th, 2021, based on the information provided at the Public Hearing on April 4,

2021, and in the Technical Opinion on the recovery of the Matinhos waterfront, flood control and urban revitalization by Technological Institute of Transport and Infrastructure of the Federal University of Paraná (ITTI-UFPR). Once again, the aim was to contribute to real solutions to the problem of coastal erosion in its complexity, without reducing it only to coastal engineering interventions. The first problem pointed out concerning the Technical Opinion presented by ITTI-UFPR, at the request of the Secretary of State for Sustainable Development and Tourism, is that it was produced by the same team that prepared the Previous Environmental Report (FUPEF, 2020). In addition to the obvious conflict of interests, the Technical Opinion reproduced the same concepts and the same methodology used in the Preliminary Environmental Report, which has already been analyzed in our second Technical Note.

As for the Impacts of the drainage channels on the Guaraguá River basin, the GT-UFPR sought to deepen the previous notes, underlining the real possibility of the artificial canal designed in the Saint-Etienne beach to changing the water circulation of the Guaraguá River considering that the canal can promote the salinization of some stretches of the basin, which would harm the sewage treatment plants located there.

Furthermore, researchers and professors made new considerations based on the Coastal Basin Plan, namely:

- Basin transfer: a new connection of the DNOS canal system with the sea through the projected Saint-Etienne canal is, in fact, a basin transfer, creating a “shortcut” of a few kilometers between the sea and the middle course of the Guaraguá River.
- High seawater flow: the opening of a canal in this flat and naturally poorly drained area is expected to cause a high influx of marine water, especially during spring tides and meteorological

tide events, which may flow northwards towards the Guaraguaçu River, which reinforces the possibility of a high flow of marine water with the interconnection of the basins.

- Salinization of the canals: the salinization of the canals can also occur gradually, by the penetration of saline marine water into the water table. This phenomenon can be observed in areas close to the mouth of the Matinhos River and at the northern mouth of the canal system, where the pioneer mangrove vegetation occurs, and salinization can also compromise the organic load dilution functions, the flow to the sea during low tides when the flow is reversed and bathability.
- Ecosystem services: the Guaraguaçu River basin and its artificial channels provide fundamental ecosystem services, such as supplying water to the coastal region, draining rainwater, and dilute all treated and diffused organic load from the coastal strip of three municipalities.
- Guaraguacu River: the Guaraguaçu River plays a preponderant role in the environmental health and the fishing production of the bay of Paranaguá, as well as in the tourist and economic potential of the coast, due to its ecological importance and the existence of UC of Integral Protection.

Finally, the authors emphasized the intervention in the full protection conservation unit of the Praia Grande Municipal Park, where the artificial drainage canal will be implanted in the Saint-Etienne beach. The highlighted issue is that the intervention will lead to its total mischaracterization, considering the dimensions and scope of the artificial canal. This condition requires that the environmental impacts on this Conservation Unit be evaluated before the eventual licensing of the work.

#### ***Technical note nº 05 (05/2022)***

The 5th Technical Note (UFPR-GT, 2022) is a response to the Prosecutor's Office Written Notice,

which requested a complementary technical note to clarify whether the damage caused to the works, which are being carried out on the Waterfront and caused to the environment, resulting from the cyclone, that occurred on the date of August 10th, 2022, were foreseen in the previous technical notes and what are the environmental and social consequences with the maintenance of the works.

It is relevant to clarify that the four previous Technical Notes, carefully prepared by the GT-UFPR at the Prosecutor's request, did not address the possible damage that could be caused to the works and the environment by extreme meteorological and oceanographic events. It explained that the entrepreneur must evaluate these possible damages in the context of the environmental impact studies of the enterprise. For this reason, to assess whether the extratropical cyclone caused unforeseen damage, it is necessary to check the environmental impact studies of the project. In this sense, it is worth mentioning that environmental impact studies must consider the increase in the intensity and frequency of extreme events caused by climate change. The scientists also pointed out that if damages have been predicted, it would be necessary to verify if they are within the corresponding standard or margin of error.

Furthermore, to check whether the changes in beach morphology caused by the cyclone are within the forecast, it should compare the forecasts with the actual beach changes after the cyclone, which could have been done by comparing the surface beach volume before and after the cyclone. As stated above, the entrepreneur had the obligation to measure technically and with due frequency the volumes and quality of the sediments that were disposed on the shore, especially while evaluating the effects of events of greater environmental energy, such as the one registered on August 10th, 2022, that impacted on the works of the beach profile. The note also asserted that the sand used to feed the beach must be verified whether

it meets the specifications set out in the project and if the granulation of the sand used for the feed is the same as the way predicted in the project, especially because they have already warned about the precariousness of knowledge about the existence of sand, in the platform deposit, with adequate volume and sedimentological characteristics for the execution of the work. The notes also addressed that the use of sand with a finer grain than expected and with higher carbonate levels than those originally found on the target shoreline may have caused sand losses greater than expected.

The paper went further to inquire if the schedule of the works was synchronized with the forecasts of the periods with the highest occurrence of high wave energy events and, also, the consequential impacts on the works. The comparison between the organization of the construction and the actual works is important to verify the respect not only to the previous studies but also to the historical surveys of oceanographic and meteorological data, that should guide the predictability of engineering activity efficiency at the beach, overall considering the periods of greater occurrence of extratropical cyclones for the region. Even more serious is the appointed inversion of the execution sequence of some of the works. For instance, in the project, it was foreseen that, first, the transversal works would be built – headlands and current guides – and later the artificial feeding of the beach would be carried out, which was supposed to avoid the beach sand loss, mainly due to coastal drift, which predominantly occurs from south to north, in Matinhos City.

In summary, the Technical Notes revealed very serious problems about the studies that support the environmental licensing of the project aimed at Revitalizing the Matinhos Waterfront. Given the above report, it is essential to recognize the substantial weaknesses pointed out by the authors, members of the elite of scientific production and knowledge in

the Paraná State, which has had the coast as an object of study for many years. Thus, in addition to all the formal weaknesses of the licensing, its material precariousness must also be considered for the Judiciary to intervene and prevent the perpetuation of all the irregularities that the entrepreneur intends to carry out, with a work of such environmental and financial impact.

#### ***Technical note nº 06 (01/2023)***

In January 2023, the Permanent Technical-Scientific Advisory Committee for the Territorial and Socio-environmental Development of the Coast of Paraná published the Technical Note nº 01/2023 whose object is the revitalization of the Matinhos waterfront carried out by the IAT, which resulted in serious environmental impacts, such as the suppression of sand dune with the implementation of a vegetation recovery project. In the Written Notice Nº 10029/2022, it was inquired: among the ripped sand dune vegetation, is it possible to state that there are non-exotic species? According to the study, that analyzed documents and images, there is clear evidence that there was deliberate and unjustifiable removal of native species from the sand dune in their herbaceous and shrubby form, especially *Dalbergia ecastophyllo*. On the other hand, the note exposed that there is no clear information or images that attest to the occurrence of exotic species.

The MPF also inquired regarding the ecological restoration technique used, and provide data on whether it is suitable for the site, especially in the hypothesis that there is exotic vegetation mixed with native vegetation. The scientists, in response, explained that the restoration technique used was not adequate, since it removed typical native species from the sand dune vegetation and destroyed the deposit layer of propagules of local species. In that sense, they proposed the promotion of the revitalization of the existing vegetation, through the removal of residues,

construction, and maintenance of trails for pedestrians, especially to avoid vegetation trampling and destruction. Also, it would be important to conduct natural regeneration, with possible densification in areas with fewer individuals. However, in the case of exotic species (not yet proved), they should be manually removed to preserve the native vegetation.

The note highlighted that even though the legislation allows intervention in Permanent Preservation Areas, in specific cases of public utility, still the sand dunes are extremely sensitive, and reduced systems and with a very important role in the adaptation of coastal regions to climate changes.

### Remote Sensing

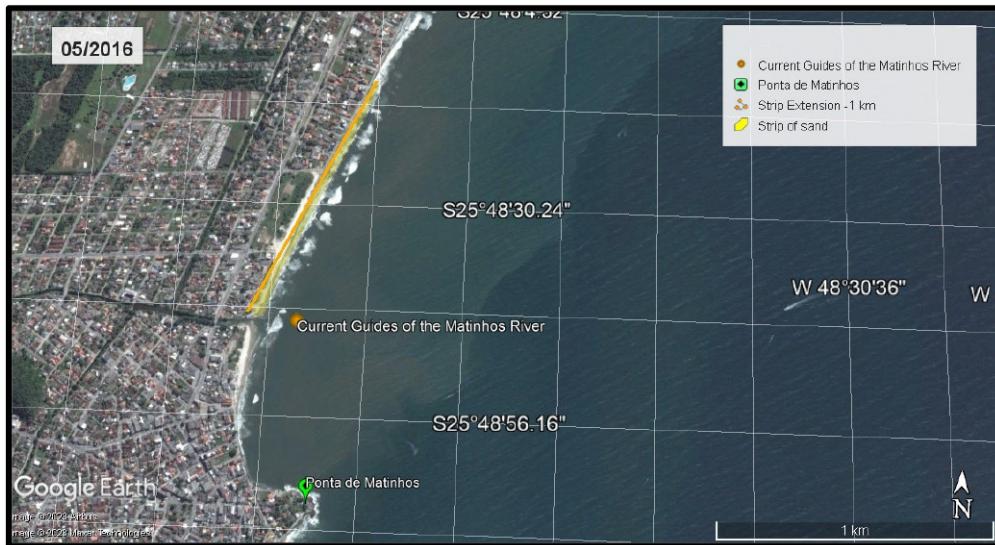
The process of coastline expansion or receding to the sea will cause changes in the land and sea pattern of the coastline. Land-to-sea retreat or sea-to-land retreat was referred to as land invasion or transgression (Sui *et al.*, 2020). Because of that, shoreline studies are fundamental part of cost work projects, to understand how human engineering interventions af-

fect and are affected by natural changes. For example, Harley *et al.* (2019) studied shoreline changes in Australia using smartphones for coastal monitoring and photographic records. For most coastlines, limited observation data exists to provide an understanding of the rates and magnitudes of shoreline response due to extreme storms and longer-term coastal processes (Barnard *et al.*, 2015; Turner *et al.*, 2016 apud Harley *et al.*, 2019).

In this case, using Google Earth Pro, it was possible to obtain the historical variation of the sandy beach strip at Matinhos Beach (Praia de Matinhos), located next to Ponta de Matinhos, within the coastal area of the "Works for the Recovery of the Seafront of Matinhos, Paraná" project. A significant increase can be observed between the years 2014 (Figure 10) and 2016 (Figure 11) in the number of houses and buildings along the shoreline. Furthermore, since 2014, it has not been possible to identify the presence of native sand dune vegetation through the images. Native sand dune vegetation acts as a natural barrier against coastal erosion, responsible for retaining sediments



**Figure 10.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in February 2014. The yellow polygon represents the strip of sand at the time.



**Figure 11.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in May 2016. The yellow polygon represents the strip of sand at the time.

along the coast and in estuaries. Despite this, between the years 2014 and 2021, it can be noticed that there is an ascending and descending pattern in the width of the beach strip at the location. The variation of the sandy beach strip in coastal areas is a natural and seasonal movement, with variations dependent on tides, waves, storms, climate, or precipitation.

When analyzing the area of the beach strip at the marked location in yellow (1 kilometer since the Matinhos River foz for north) it was observed that there was a variation ranging between  $42.89 \text{ m}^2$  (2014) to  $88.23 \text{ m}^2$  (2023). However, there was a big variation between these years. In Figure 12, in July 2017 the area is  $47.20 \text{ m}^2$ . And nine months after, in April 2018 (Figure 13), the area decreased to  $38.89 \text{ m}^2$ .

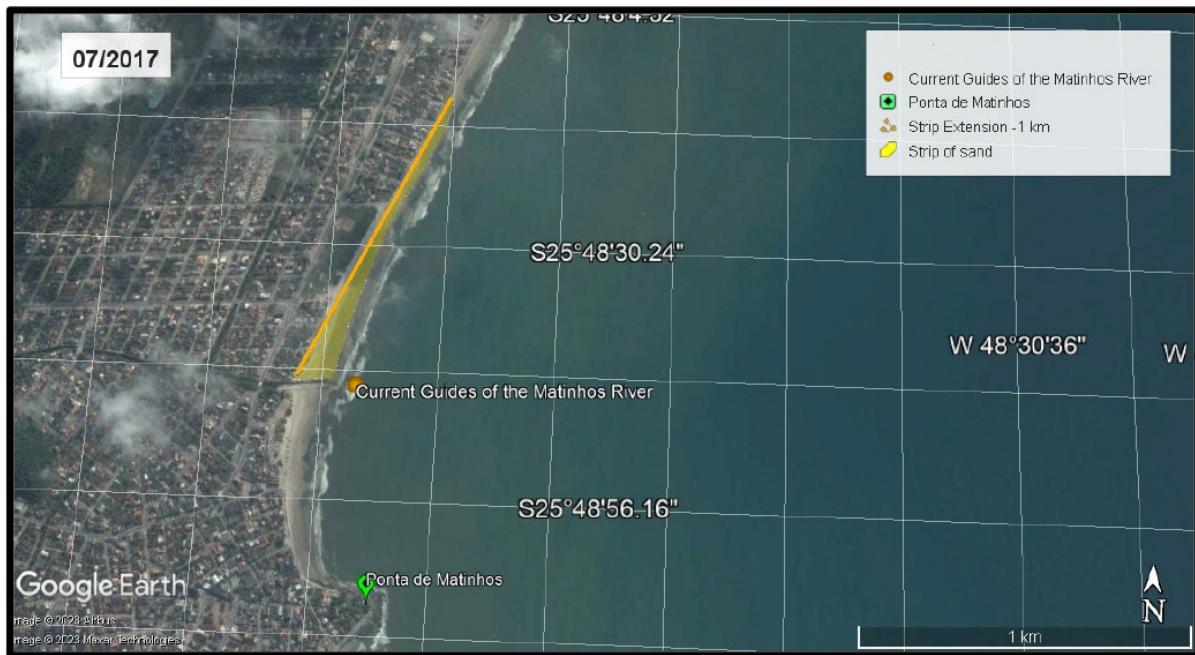
Between 2018 and 2019 (Figure 14) there was an increase of more than double the area of the sand strip, reaching  $78.83 \text{ m}^2$ . From 2019 to 2021 there was a variation of decrease followed by increase, which shows natural variability. However, it is im-

portant to remember that seasonal changes during the year are also a factor that influences the width of the sand strip. In 2020 (Figure 15) the area is  $45.91 \text{ m}^2$  and in 2021 (Figure 16) the area is  $61.08 \text{ m}^2$ .

In 2022, the projects began to be built and before that, the Current Guides of the Matinhos River, which was non-existent, began to be built, as shown in Figure 17. In October 2022, beach fattening had already been carried out in the location chosen for this analysis. And with that, the area that was previously  $61.08 \text{ m}^2$  became  $122.31 \text{ m}^2$ .

However, just 6 months after the beach nourishment project, there was a 27% decrease in the beach strip, resulting in  $88.23 \text{ m}^2$  in April 2023 (Figure 18).

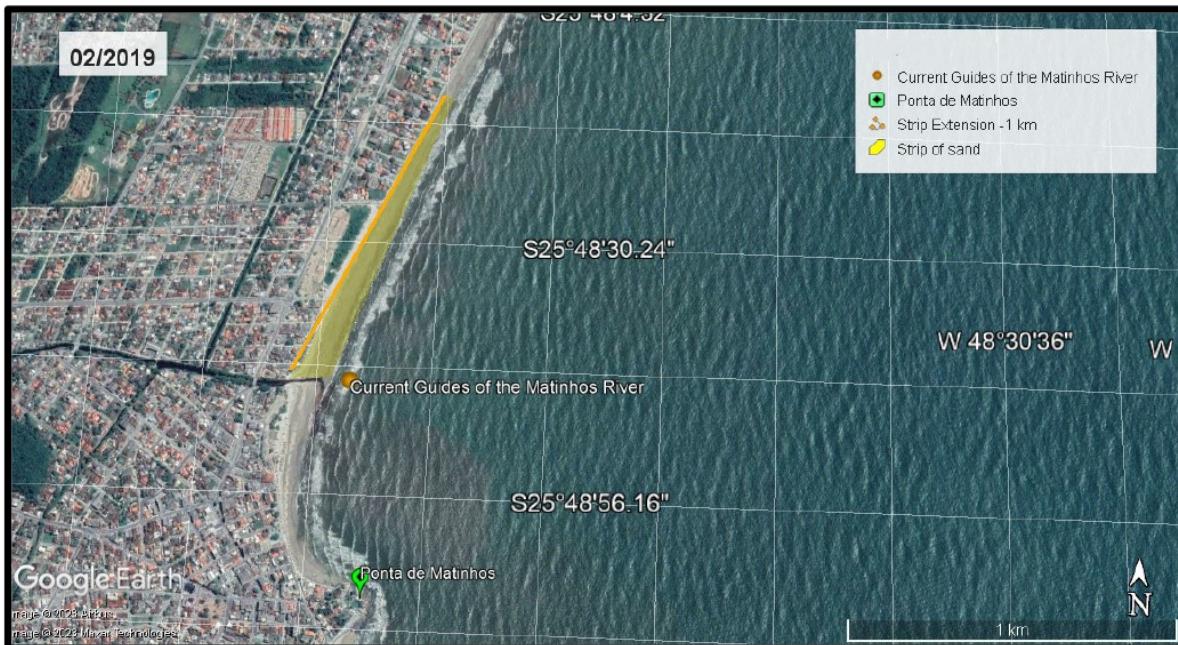
Multitemporal shoreline variability studies, as done by Vos et al. (2019) are a necessity for projects like the one analyzed in this work. It is of interest to engineers, scientists, and decision-makers. Through the images, it was possible to perceive the variability and loss of sediment after fattening on Matinhos beach.



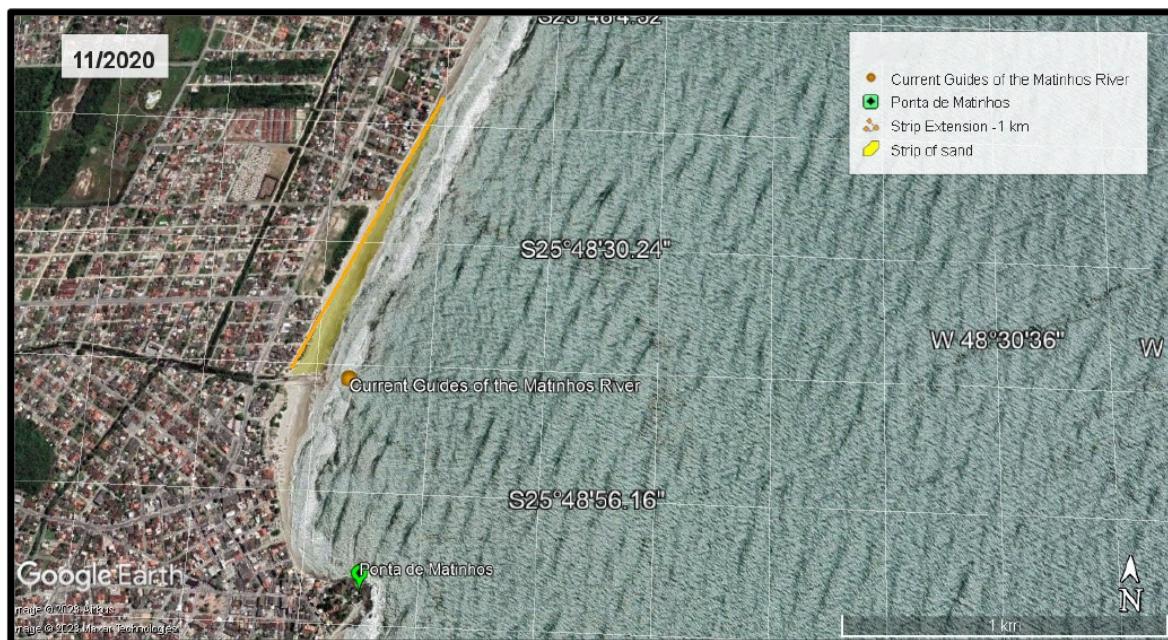
**Figure 12.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in July 2017.  
The yellow polygon represents the strip of sand at the time.



**Figure 13.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in April 2018.  
The yellow polygon represents the strip of sand at the time.



**Figure 14.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in February 2019.  
The yellow polygon represents the strip of sand at the time.



**Figure 15.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in November 2020.  
The yellow polygon represents the strip of sand at the time.



**Figure 16.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in June 2021.  
The yellow polygon represents the strip of sand at the time.



**Figure 17.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in October 2022.  
The yellow polygon represents the strip of sand at the time



**Figure 18.** Satellite image at Praia de Matinhos, between Ponta de Matinhos and Balneário Flamingo, in April 2023. The yellow polygon represents the strip of sand at the time.

#### 4. Conclusion

This case reflects an economic finding: people respond to incentives, which means that defendants also act according to the evaluation of transaction costs and incentives. Initially, just to pinpoint and summarize the main factors of the conflicts that were addressed in the class action:

- In the construction projects, civil servants acted, at the same time, as contracted engineers, entrepreneurs, and licensors, concomitantly, indicating a metamorphosis of roles.
- Omnipotently and with a clear conflict of interest, the IAT acts, at the same time, as entrepreneur and licensor, that is, it licenses itself (self-license), even without a technical team of effective servants and with the ability to authorize such a complex undertaking, as demanded by the State Court of Auditors.

- The quantity, complexity, and lack of transparency of environmental licensing, projects, studies, and bidding processes.
- The total cost of the project was approximately US\$ 4,4 million (Paranacidade, 2009), of which around US\$ 1,63 million for semi-flexible works, US\$ 2,45 million for artificial fattening, and around US\$ 400,000 for urbanization and landscaping. On the other hand, the budget for the new projects, for 2020, was estimated, according to the Paraná News Agency (2020), at US\$ 98,54 million, an increase of 22 times, an amount that must be applied in two phases of work. The resources for the execution of the projects will come from the loan of US\$ 326,370,757 (RUS\$ 1.6 billion) traded by the State, together with the Bank of Brazil and Federal Savings Bank, an ope-

ration authorized by the Legislative Assembly. The Bidding Notice N° 49/2021 estimated the value of US\$ 77,861,223 for the payment of the first phase of the works.

All the procedures presented, and the existing irregularities demonstrate the illegality of the bidding and the licensing processes, which were not properly tackled, by the government, despite administrative recommendations and two class actions. In the case of the Matinhos beach nourishment, the lack of a prompt and effective injunction in the first lawsuit which was not granted by the judge incentivized the State to commit other illicit, not only issuing illegal authorizations but also suppressing the native sand dune vegetation. Therefore, a second lawsuit was proposed to nullify the illegal authorizations and indemnify the material and moral damages. In the recent case, the injunction order was granted to suspend the workings and illegal suppression authorizations.

In Technical Note No. 5 the researchers warn about the need for studies within the project to calculate the damage to the planned new structures, caused by natural processes and climate change. Satellite images prove the existence of seasonal variability in the

coastline and in the sand strip and in-depth studies on this topic have not been carried out by the entrepreneur. Image analysis reflects that erosion processes are continuous and not punctual, in this case just 6 months after the beach nourishment project, there was a 27% in decrease the beach strip.

Future work is needed to estimate the variation in the area between Caiobá City and Balneário Flórida, the strip in which the beach fattening was carried out. Furthermore, it is necessary to perform socio-economic studies to estimate the impacts after interventions with the artisanal fishing community and residents of the coastal strip. Because as we have seen, it is necessary to rethink more efficient strategies for the problem of coastal erosion on the coast of Matinhos, no longer being temporary, costly, and palliative measures.

Additionally, this paper had the objective, above all, to extol the contribution of the university to the investigation work of the Prosecutor's Office and demonstrate how indispensable this technical approach and support is to bring lawsuits to the court in irregularities cases of coastal management.

## 5. Acknowledgements

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