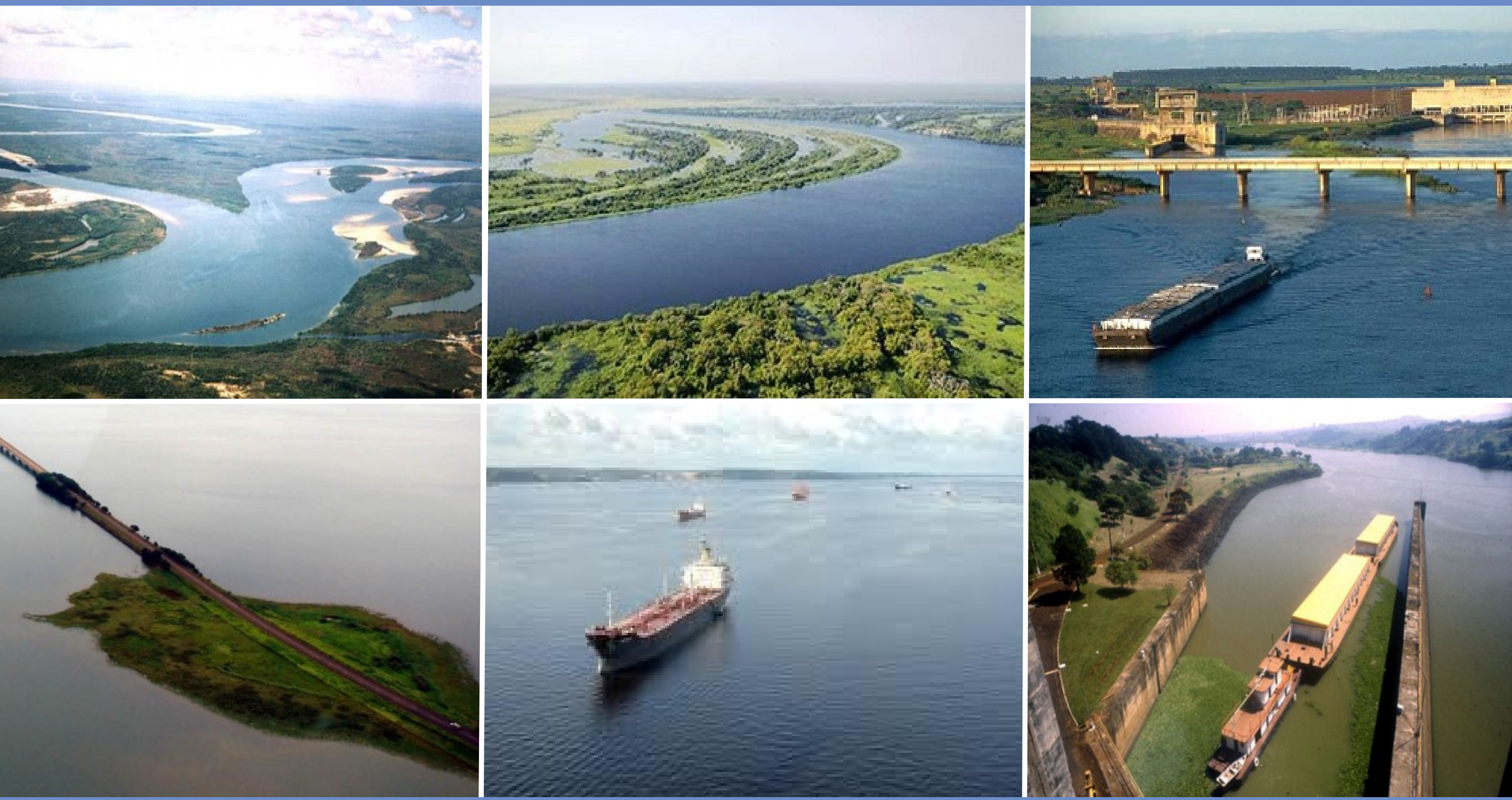
Ministério dos Transportes

PHE

Plano Hidroviário Estratégico

Inland Waterways Strategic Plan



Produto 3 - Relatório de Diagnóstico e Avaliação

Product 3 - Assessment and Diagnosis Report

Chapters 3.3 to 3.7

2013

Consórcio

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English Version

Ministério dos Transportes

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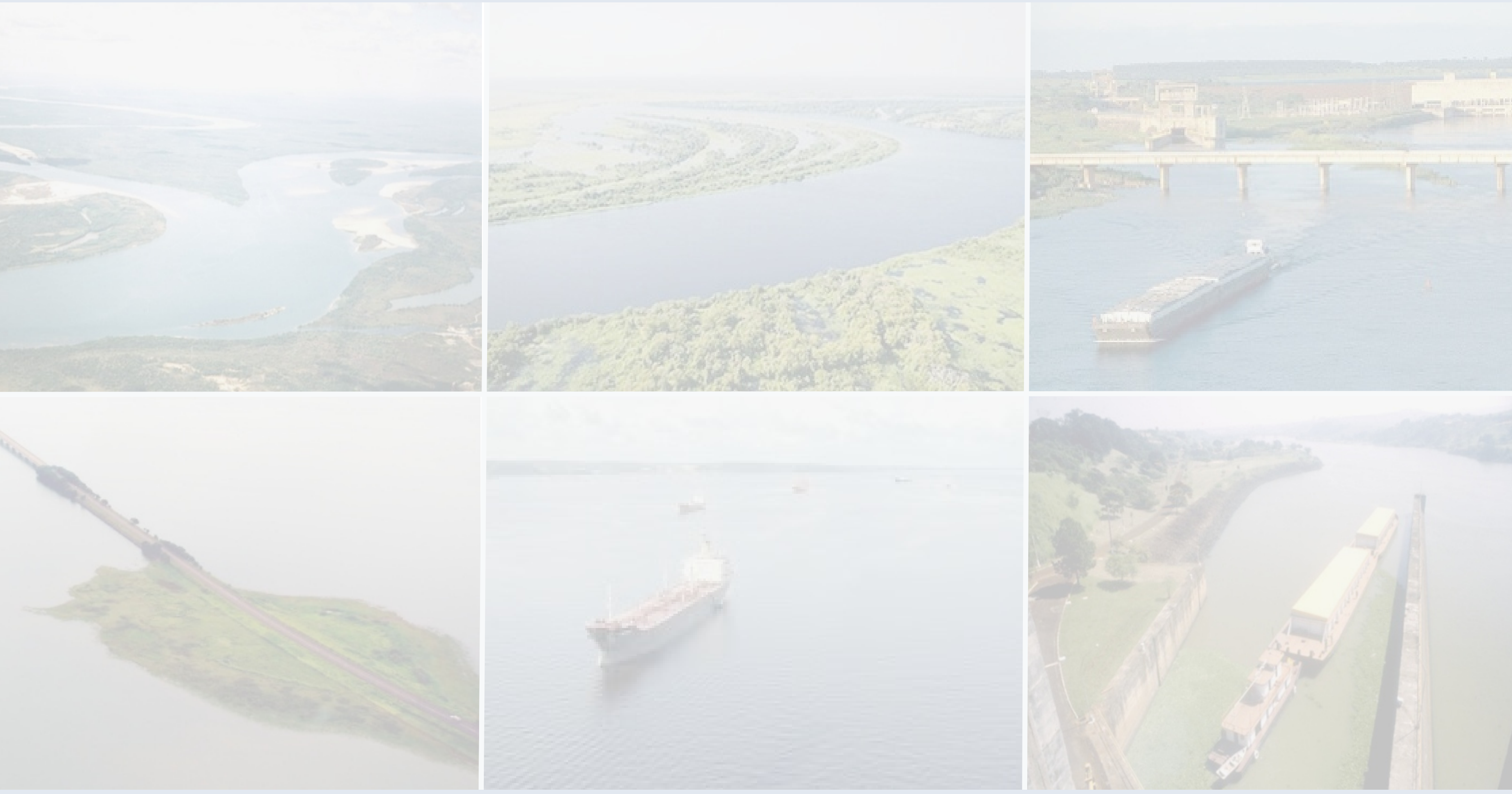
Plano Hidroviário Estratégico

Inland Waterways Strategic Plan



Produto 3 - Relatório de Diagnóstico e Avaliação

Product 3 - Assessment and Diagnosis Report

Chapters 3.3 to 3.7

2013

Consórcio

ARCADIS logos

English Version

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ACRONYMS

AES - AES Eletropaulo

AHIMOC- Administração das Hidrovias da Amazônia Ocidental

AHIMOR – Administração das Hidrovias da Amazônia Oriental

AHINOR – Administração das Hidrovias do Nordeste

AHIPAR – Administração da Hidrovia do Paraguai

AHRANA – Administração da Hidrovia do Paraná

AHSFRA – Administração das Hidrovias do São Francisco

AHSUL – Administração das Hidrovias do Sul

ANA – Agência nacional de Aguas

ANEEL - Agência Nacional de Energia Elétrica

ANTAQ - Agencia Nacional de Transportes Aquaviários

ANTT - Agência Nacional de Transportes Terrestres

ANVISA - Agência Nacional de Vigilância Sanitária

ARCON - Agência de Regulação e Controle de Serviços Públicos do Estado do Pará

BNDES - Banco Nacional de Desenvolvimento Econômico e Social

CAP - Conselho de Autoridade Portuária

CBH - Comitês das Bacias Hidrográficas

CDP - Companhia Docas do Pará

CEHIDRO - Conselho Estadual de Recursos Hídricos

CEMIG - Companhia Energética de Minas Gerais

CENAT - Comissão Executiva para a Navegação do Tietê-Paraná

CENTRAN - Centro de Excelência em Engenharia de Transportes

CERH - Conselho Estadual de Recursos Hídricos

CESP - Companhia Energética de São Paulo

CETESB - Companhia de Tecnologia de Saneamento Ambiental

CF – Constituição Federal

CGTMO - Coordenação Geral de Transportes, Mineração e Obras Civis

CHESF - Companhia Hidroelétrica do São Francisco

CIH - Comitê Intergovernamental da Hidrovia Paraguai-Paraná

CNA - Confederação da Agricultura e Pecuária do Brasil

CNRH - Conselho Nacional de Recursos Hídricos

CODESP - Companhia Docas do Estado de São Paulo

CODESUL - Conselho de Desenvolvimento e Integração do Sul

CODEVASF - Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba

CODOMAR – Companhia Docas do Maranhão

CONAMA – Conselho Nacional de Meio Ambiente

CONAPORTOS - Comissão Nacional das Autoridades nos Portos

CONERH - Conselho Estadual de Recursos Hídricos

CONSETRANS - Conselho Nacional de Secretários de Transportes

COPPE - Coordenação de Programas e Projetos Estratégicos

CPAOR - Capitania dos Portos da Amazônia Oriental

CPH - Companhia de Portos e Hidrovias do Estado do Pará

DAQ – Departamento Aquaviário

DH - Departamento Hidroviário

DILIC - Despacho do Diretor da Diretoria de Licenciamento Ambiental

DNIT - Departamento Nacional de Infraestrutura de Transportes

DNIT – Departamento Nacional de Infraestrutura de Transportes

DNPM - Departamento Nacional de Produção Mineral

EAS - Estudos Ambientais Simplificados

EIA/RIMA - Estudo de Impacto Ambiental/ Relatório de Impacto Ambiental

EMAP - Empresa Maranhense de Administração Portuária

EPE - Empresa de Pesquisa Energética

EPL - Empresa de Planejamento e Logística

EVTEA - Estudo de Viabilidade Técnica Econômica e Ambiental

FONPLATA – Fundo Financeiro para o Desenvolvimento da Bacia do Prata

FUNAI - Fundação Nacional do Índio

GEOUT - Gerência de Outorga

IBAMA - Instituto Brasileiro do Meio Ambiente

ICMBio – Instituto Chico Mendes de Biodiversidade

IIRSA - Iniciativa para a Integração da Infraestrutura Regional Sul-americana

INCRA - Instituto Nacional de Colonização e Reforma Agrária

INPH – Instituto Nacional de Pesquisas Hidroviárias

IPHAN - Instituto do Patrimônio Histórico e Artístico Nacional

LI – Licença de Instalação

LO – Licença de Operação

LP - Licença Prévia

MD - Ministério da Defesa

MDA - Ministério do Desenvolvimento Agrário

MDL – Mecanismos de Desenvolvimento Limpo

MERCOSUL – Mercado Comum do Sul

MI - Ministério da Integração Nacional

MINC – Ministério da Cultura

MJ – Ministério da Justiça

MMA - Ministério do Meio Ambiente

MPA - Ministério da Pesca e Agricultura

MPF - Ministério Público Federal

MPF - Ministério Público Federal

MRE - Ministério das Relações Exteriores

MS – Ministério da Saúde

MT - Ministério dos Transportes

ONG's – Organizações Não Governamentais

ONS - Operador Nacional do Sistema Elétrico

PBA - Plano Básico Ambiental

PEI - Planos de Emergência Individual

PHE – Plano Hidroviário Estratégico

PNLT - Plano Nacional de Logística e Transportes

PNMA - Política Nacional de Meio Ambiente

PR – Presidente de Republica

RAP – Relatórios Ambientais Preliminares

SEP - Secretaria Especial de Portos

SFAT - Secretaria de Fomento para Ações de Transportes

SISNAMA - Sistema Nacional do Meio Ambiente

SNGRH - Sistema Nacional de Gerenciamento de Recursos Hídricos

SNPH – Superintendência Estadual de Navegação, Portos e Hidrovias

SNRH - Sistema Nacional de Recursos Hídricos

SOPH - Sociedade de Portos e Hidrovias do Estado de Rondônia

SRF – Secretaria da Receita Federal

STF – Supremo Tribunal Federal

TCU – Tribunal de contas da União

TR - Termo de Referência

TUP – Terminal de Uso Privativo

UC - Unidade de Conservação

LIST OF FIGURES

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INDEX

3.3 MADEIRA WATERWAY SYSTEM

3.3.1 Physical system, social, and environmental aspects of the river

The future Madeira Waterway System is composed of 3 potential waterways formed by the navigable sections of Guaporé, Madeira, and Marmoré Rivers, located within the limits of the Madeira hydrographic basin.

The Madeira River basin has an area of 689,328 km^2. It is located between the Amazon (99%) and the Cerrado (1%) biomes. Its limits cut through the states of Acre (AC), Amazonas (AM), Mato Grosso (MT), Pará (PA), and Rondônia (RO).

The Madeira River is currently a waterway under good conditions connecting Porto Velho to the Amazon River and, consequently, to the Atlantic Ocean. The river water level varies significantly between the flood and dry seasons. During the dry season, the main obstructions to navigation emerge, such as rapids and stone outcrops, which are presented especially between the municipalities of Humaitá (AM) (section 82) and Porto Velho (RO) (section 107). The Madeira River also has erosion problems on its banks, increasing the sediment volume on the riverbed and on the bottom and problems with the transport of tree trunks, caused by the floods in the basin.

Making the Mamoré and Guaporé rivers waterways feasible depends on the construction of a lock system at Santo Antônio (section 108) and Jirau (section 119) HPPs, on the Madeira River, apart from overcoming natural obstructions, such as a number of rapids on the Mamoré River and extense, low-depth sections on the Guaporé River.

The analyses and studies carried out to characterize the physical, social, and environmental conditions of the potential waterways in the Madeira Waterway System followed the methodologies presented in Chapter 1 – item 1.3 – Methodology, of this report.

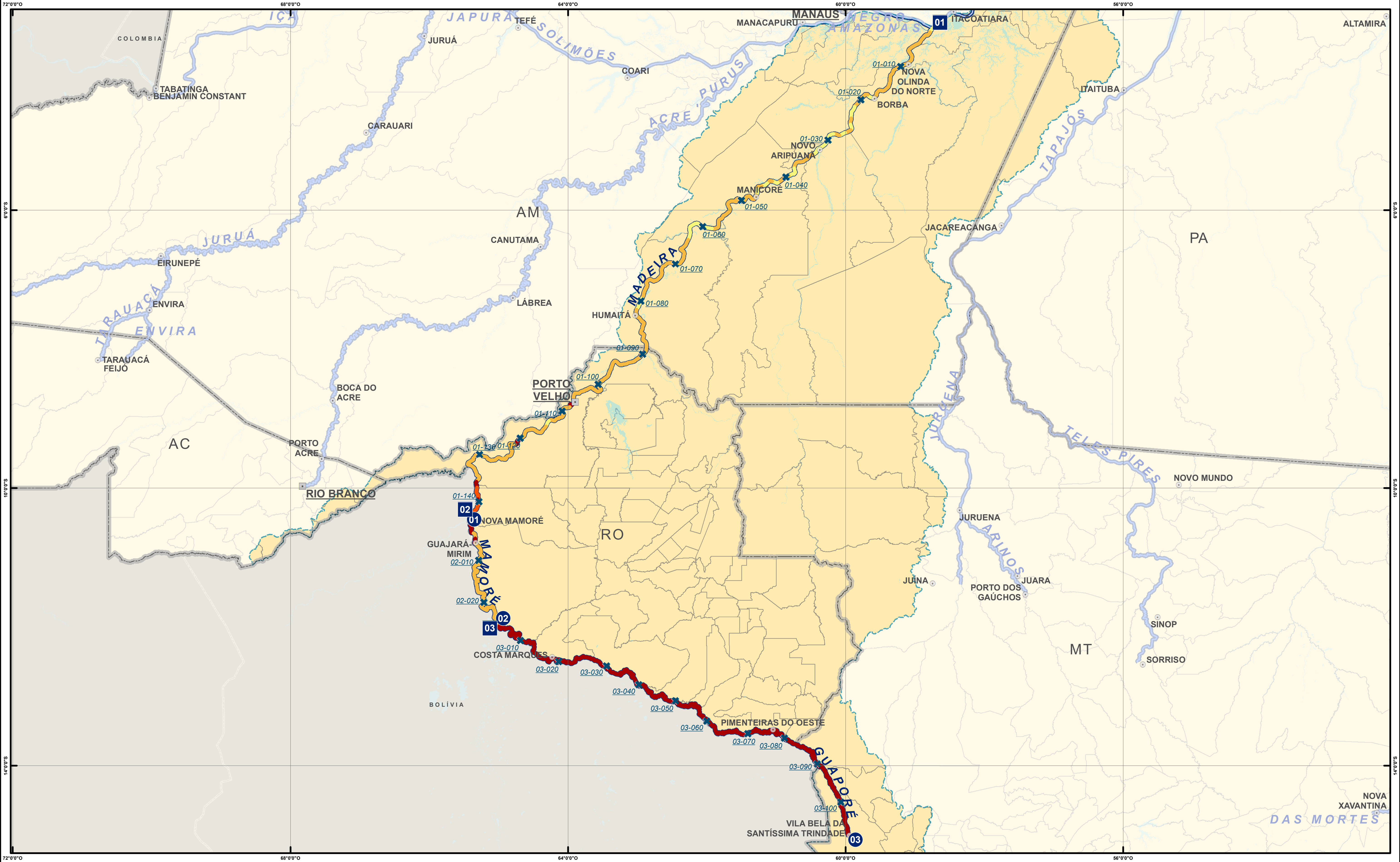
Due to the vast amount of information collected and analyzed, this chapter presents a summary of the main results and conclusions for each river studied.

The CD annexed to this report (Step C: Assessment and Diagnosis) contains a table in the .xls format containing more details about all the variables and information analyzed for each river and each section studied.

The Linear Diagram Diagrams in this chapter summarize the mentioned table, according to the methodology presented in chapter 1, item 1.3, of this report.

As a product of the final stage of the Strategic Waterway Plan (Step F: Preparation of the final strategic plan), a Georeferenced Database is presented with all the information in the table in the CD attached to this report.

The main characteristics concerning the navigability conditions of the waterways composing the Madeira WS may be seen together on the Linear Diagram diagram below.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 01 Rio Madeira
- 02 02 Rio Mamoré
- 03 03 Rio Guaporé

Bacias do SH Madeira

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 40 80 160 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

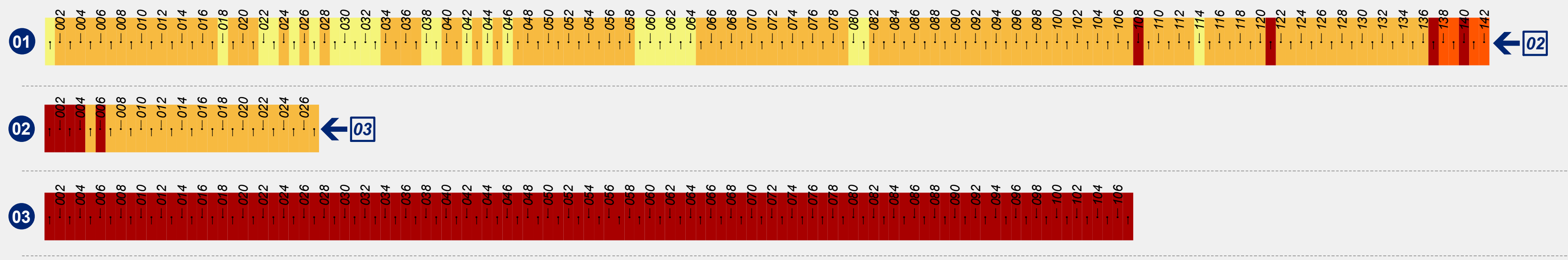
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:5.500.000	SH MADEIRA	MAI/2013



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	*ALTO DE:*	*MÉDIA DE:*	*BAIXA DE:*	
Sinuosidade; ou	*Sinuosidade; ou*	*Sinuosidade; ou*	*Sinuosidade; ou*	*Ausência das ocorrências*
Profundidade mínima; ou	*Profundidade mínima; ou*	*Profundidade mínima; ou*	*Profundidade mínima; ou*	
Empecilhos à navegação (construções); ou	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	
Energia do rio; ou	*Energia do rio; ou*	*Energia do rio; ou*	*Energia do rio; ou*	
Leito do rio; ou	*Leito do rio; ou*	*Leito do rio; ou*	*Leito do rio; ou*	
Assoreamento; ou	*Assoreamento; ou*	*Assoreamento; ou*	*Assoreamento; ou*	
Anteparos naturais; ou	*Anteparos naturais; ou*	*Anteparos naturais; ou*	*Anteparos naturais; ou*	
Largura mínima do rio.	*Largura mínima do rio.*	*Largura mínima do rio.*	*Largura mínima do rio.*	

CONVENÇÕES CARTOGRÁFICAS

01 Rio Madeira
02 Rio Mamoré
03 Rio Guaporé

X Confluências

Numeração dos trechos
nº < Jusante
nº > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH MADEIRA	MAI/2013

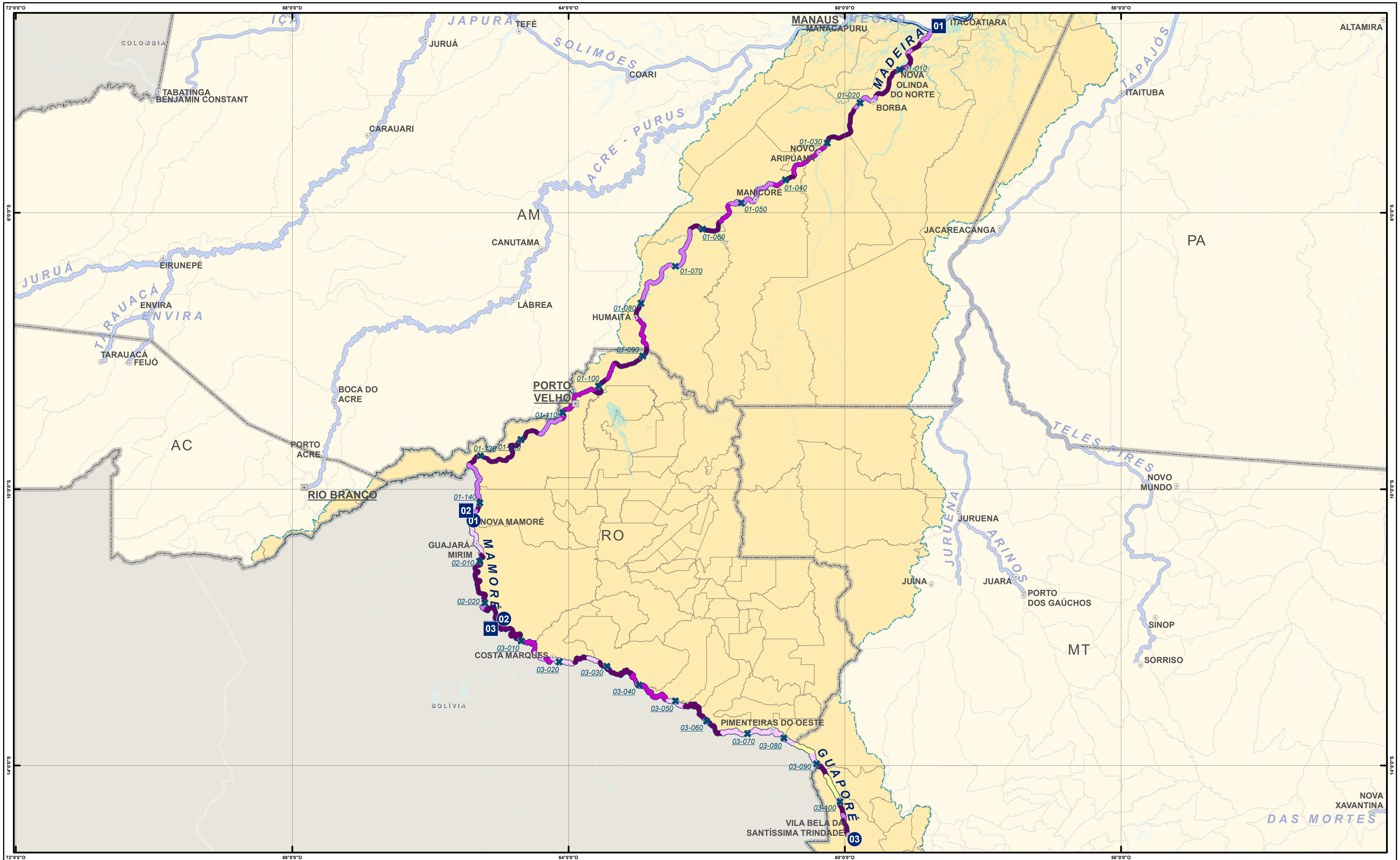
The limits of the basin cross the territory of 105 municipalities, 6 of which are in Acre, 24 in Amazonas, 18 in Mato Grosso, 5 in Pará, and 52 in Rondônia. The total population in the municipalities is 3,327,096. The most important cities are the state capital, Porto Velho (RO), accounting for 12.78% of the total, and the municipality of Santarém, second most important city in the state of Pará and seat of the metropolitan region of Santarém, accounting for 8.78% of the population in the basin.

The FIRJAN (2010) indexes range from 0.38 in Beruri (PA) to 0.80 in Porto Velho (RO). The average for the basin is 0.58.

On the Madeira River basin, larger concentrations of Indigenous Lands were identified in the studied region, a total of 75 territories, located especially near the Madeira, Mamoré, and Ji-Paraná Rivers. Among the ethnic groups in this region, the Mura, Apurinã, Diahui, and Munduruku are noteworthy.

Eighty-seven (87) Conservation Units are also found – being 60 of Sustainable Use and 27 of Integral Protection – located especially in the surroundings of the Indigenous Lands, forming large tracts of protected lands. Also noteworthy, apart from the legally protected (CUs and ILs) lands, are signs of conservationist importance within the limits of the basin, especially in the states of Pará and Rondônia, confirmed by the presence of a number of Biodiversity Conservation Priority Areas (128) with very high or extremely high action priority in the region.

The main social and environmental characteristics to consider in order to foster the integrated planning of possible interventions necessary in the region where the Madeira WS is can be seen together on the Linear Diagram diagram below.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Madeira
- 02 Rio Mamoré
- 03 Rio Guaporé

- Bacias do SH Madeira

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 40 80 160 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

Oceano Pacífico
Oceano Atlântico

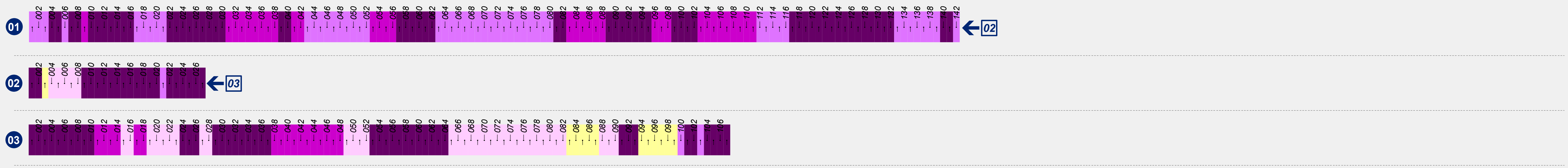
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:5.500.000	SH MADEIRA	MAI/2013



VULNERABILIDADE SOCIOAMBIENTAL

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
UC - proteção integral; ou Terra indígena	*UC - uso sustentável; ou Comunidade quilombola*	*Assentamento INCRA; ou Vulnerabilidade ao desmatamento; ou Cavidades naturais*	*APCB; ou Mineração - Lavra e garimpo*	*Ausência das ocorrências*

CONVENÇÕES CARTOGRÁFICAS

01 Rio Madeira
02 Rio Mamoré
03 Rio Guaporé

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH MADEIRA	MAI/2013

On the Linear Diagram diagram, we can see that interventions in this region should consider the significant number of Indigenous Lands (most of them are along the Mamoré River, but also on the Guaporé River, where the it connects to the Mamoré, and also on some sections of the Madeira River), and of Integral Protection Conservation Units - plentiful along the Guaporé and Madeira Rivers.

The main characteristics of the potential waterways that will form the Madeira Waterway System are described below.

3.3.1.1 Guaporé Waterway

a) Navigability Diagnosis

The Guaporé River is on the Amazon basin. It is one of the tributaries of the Mamoré River, which is a tributary of the Madeira River. It crosses the states of Mato Grosso (MT) and Rondônia (RO) and is on the international border with Bolivia on sections 01 through 90.

The Guaporé River has its source on Chapada dos Parecis, in Mato Grosso, at 630m above sea level, and ends into the Mamoré River near Surpresa (RO) (section 26). Its total length is about 1,400km, approximately 1,100km of which are considered navigable for local, small-capacity vessels. This section goes from its mouth, on the Mamoré River, to Vila Bela da Santíssima Trindade (MT) (section 107).

The flood season occurs between January and June, and the low water levels between June and December, with a average run-off flow of about 2,000m^3/s, near its mouth (see Appendix VII, item 4.2.2).

The river section between the mouth and Vila Bela da Santíssima Trindade (MT) (section 107) is in a flood region, plain with low slopes. There are no rapids nor falls along the river. The Guaporé River, however, has a number of meanders, resulting in high sinuosity rates along the whole course of the river. The meanders are the result of erosion processes on the banks, forming large deposits, which stabilize on the bends. Generally speaking, during the high water periods, vast floods take place, advancing through the river terraces. During the low water levels, the river has low flows, between sinuous banks. Also noteworthy is the presence of so-called *cachalotes* – a collection of wood, leaves, and branches that floats during the floods and is deposited during the low water. The figure below shows the morphological behavior along the Guaporé River.

Figure 3.3.1: Meanders on the Guaporé River. (Brasil das Águas, 2007)

The Guaporé River is in a region of predominant alluvial deposits, the so-called Pantanal do rio Guaporé. The riverbed is predominantly sedimentary, with medium-high susceptibility to silting.

Minimum widths are about 600m near the mouth and about 50m near Vila Bela da Santíssima Trindade (MT) (section 107). The flows during the dry season affect navigation conditions. In Vila Bela da Santíssima Trindade (MT) (section 107), it is about $40m^3/s$.

Minimum depths are about 1m, during the dry season, especially on the upstream sections (section 50 upstream) and at the rocky passage of Príncipe da Beira (RO) (section 015), about 25km of extension and located 150km upstream from the mouth. The Guaporé River has extense sandbanks, fluvial islands, and rock outcrops that may impact in difficulties and restrictions. Several of these sandbanks are movable and vary according to the recurring floods on the basin.

There are no bridges or other constructions resulting in difficulties for navigation on the Guaporé River. However, the absence of locks at anto Antônio and the Jirau Hydroelectric Power Plants, on the Madeira River, consist on the greatest obstruction to make the Guaporé Waterway feasible.

b) Social and Environmental Vulnerabilities

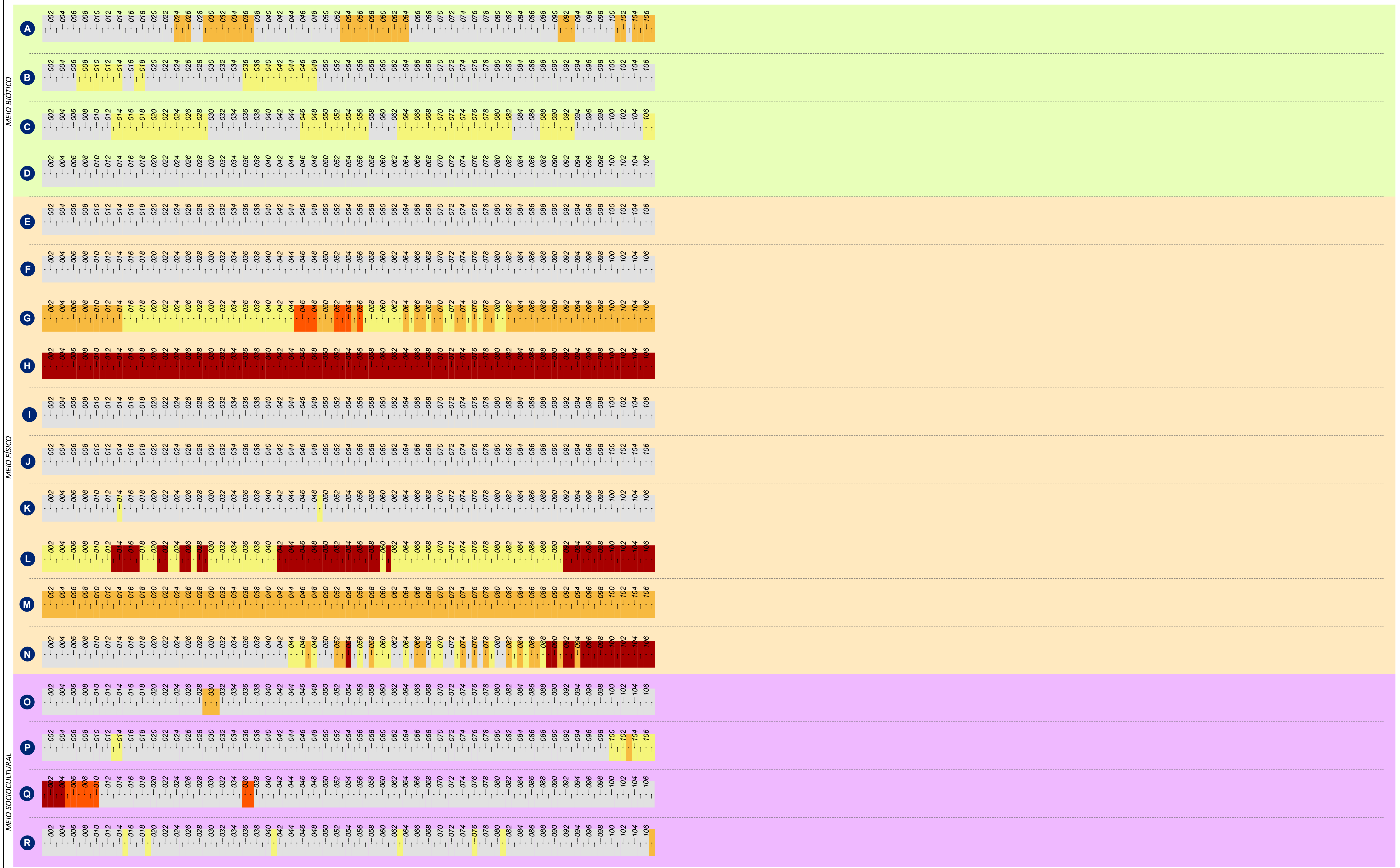
As previously stated, the future Guaporé Waterway is 1,062km long, crossing parts of the states of Rondônia and Mato Grosso. The waterway area considered for the study (10km to each side of the waterway axis) cuts through the territory of 10 municipalities, 3 in Mato Grosso and 7 in Rondônia.

Map 16: Guaporé Waterway Location

The population in these municipalities totals 155,312 inhabitants (IBGE, 2010), and the average FIRJAN (2010) index is 0.61.

For the vulnerability analysis, with regard to conservationist aspects, the surroundings of the waterway were divided into 107 sections. The most vulnerable sections are those with Integral Protection Conservation Units on sections 024 through 026, in the municipality of Costa Marques (RO), 029 through 037, in the municipality of São Francisco do Guaporé (RO), 053 through 064, in the municipalities of Alto Alegre dos Parecis (RO), Pimenteiras do Oeste (RO), and Alta Floresta d'Oeste (RO), 091 through 093 between Comodoro (MT) and Vila Bela de Santíssima Trindade (MT), and 101 through 102 and 104 through 107 in Vila Bela de Santíssima Trindade (MT), and those with Indigenous Lands in the municipalities of Guajará-Mirim (RO), sections 1 through 010, and São Francisco do Guaporé (RO), sections 036 through 037.

The main characteristics with regard to social and environmental vulnerabilities on the Guaporé Waterway can be seen together in the Linear Diagram diagram below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos
n° < Jusante
n° > Montante

Escala de ponderação dos temas
1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante
BA - Baixa
ME - Média
AL - Alta
MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES
ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO GUAPORÉ	MAI/2013

3.3.1.2 Madeira Waterway

a) Navigability Diagnosis

The Madeira River is one of the main tributaries on the right bank of the Amazon River, with about 1,420km of extension. It is formed by the confluence of the Mamoré and the Beni Rivers, near Nova Mamoré (RO) (section 142), and cuts through the states of Rondônia (RO), Amazonas (AM), and Mato Grosso (MT), and is on the border with Bolivia, from section 133 through 142. The Madeira name derives from the fact that, in the rainy season, the river level rises and floods large portions of the forest plain, bringing trunks and wood detritus from the forest.

According to AHIMOC, (the Western Amazon Waterways Administration), the Madeira Waterway has a navigable segment in good conditions, between Porto Velho (RO) (section 107) and its mouth, on the right margin of the Amazon River (near the municipality of Itacoatiara-AM). Approximately 180km of it is situated in the state of Rondônia and 876km in the state of Amazonas.

The water cycle in the Madeira River is quite defined: the floods are between February and May, and the dry season between July and November, with an average run-off flow of about 22,000m^3/s (see Appendix VII, item 4.2.1). During the flood season, the Madeira River is influenced by the Amazon River, which causes large flooded areas and high depths, flooding the rock outcrops and beaches that emerge during the dry season, on the most downstream sections of the river (sections 1 through 40). In the dry season, the water level can descend 12m, compared to the flood season, when obstructions emerge, such as sandbanks, rock outcrops and rapids on several sections throughout the river, which, although they do not interrupt navigation, delay journeys and may create risks to navigation; one example is a place known as Boca do Jacaré, on section 4, commented in Appendix VIII - Navigation, item 4.2.

The Madeira River has significant morphological alterations along its bed, also due to the water cycle. These alterations bring about considerable changes in the location of the sandbanks and other aggradation processes.

The Madeira River is in a geological region formed predominantly by alluvial deposits and sedimentary beds, especially between sections 1 and 100. Upstream from this section, the formations are predominant favorable to rocky and mixed beds. These conditions, in addition to the fact that the waterway is in a low slope place, indicate medium-high susceptibility to silting.

Generally speaking, the Madeira River has no sinuosity problems. Its sinuosity rates throughout its course are never higher than 1.3, with no abrupt narrowing.

There is no record of road or railroad bridges crossing the Madeira River.

The segment between the Madeira River mouth and Humaitá (AM) (sections 1 through 82) has minimum depths of about 3m. Between Humaitá (AM) and Porto Velho (RO) (sections 82 through 107), minimum depths can reach 2m. During the dry season, due to low depths, some natural barriers may result in greater difficulty to navigation. However, even in this segment, navigation of large convoys takes place, with up to 18,000 tons. During the flood season, average depths may reach 25m. The difficult passages for navigation on the Madeira River have signaling. The rocky outcrops between Humaitá (AM) and Porto Velho (RO) are the result of a transition zone between the Amazon Depression and the Plateau Region, which means greater slopes and harder rocks. The figures below show some sections with navigation difficulties during the dry season.

Figure 3.3.2: Rocky outcrops during the dry season (Portal rio Madeira, 2011)

Figure 3.3.3: Sandbanks emerging during the dry season (Portal CEN, 2013)

On Madeira River, during the flood season, a phenomenon takes place called "fallen lands" (*terras caídas*) – it consists of erosions on the banks, moving a large volume of sediments to the river chute; the sandier material forms sandbanks that obstruct navigation. The figure below shows an example of the erosion phenomenon along the banks of the Madeira River.

Figure 3.3.4: Erosions on the banks of the Madeira River (Appendix VIII – Navigation)

During the dry season, fires caused by agriculture may also affect navigation, because the smoke makes visual for navigation harder. At this time of the year, prospecting and mining activities, carried out on some sections of the Madeira River (from sections 45 upstream), bring about changes to the riverbed and bank configuration, making it difficult to have a real knowledge of the conditions of the bed, and, consequently, the commercial convoys best route. The prospecting rafts block the navigable bed, resulting in more difficulty for navigation. The transport of timber trunks, from the floods on the basin, is another factor complicating navigation.

From Porto Velho (RO) (section 107) upstream, there are two hydroelectric power plants: Santo Antônio and Jirau (sections 108 and 119, respectively) with no locks. Today, they are the most relevant physical bottleneck to navigation on this waterway, making the connection from the mouth of the Madeira River to the mouth of the Beni River, and to the Mamoré and Guaporé Rivers, impossible. The reservoirs at these hydroelectric plants have an average depth of about 10m. However, there are studies and projects to implement locks at these plants. The figure below shows the longitudinal profile of the Madeira River, focusing on the section of the implementation of the hydroelectric plants of Santo Antônio and Jirau.

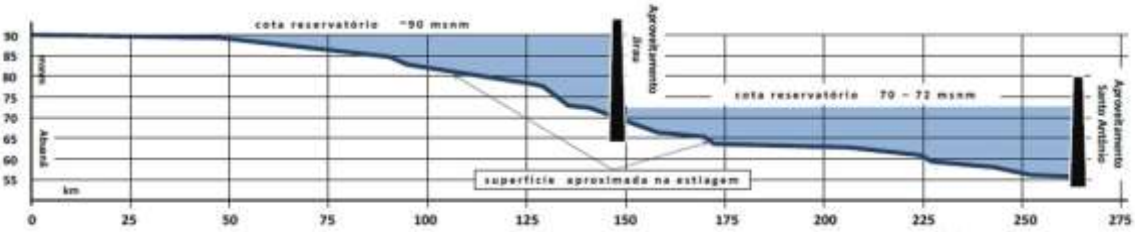
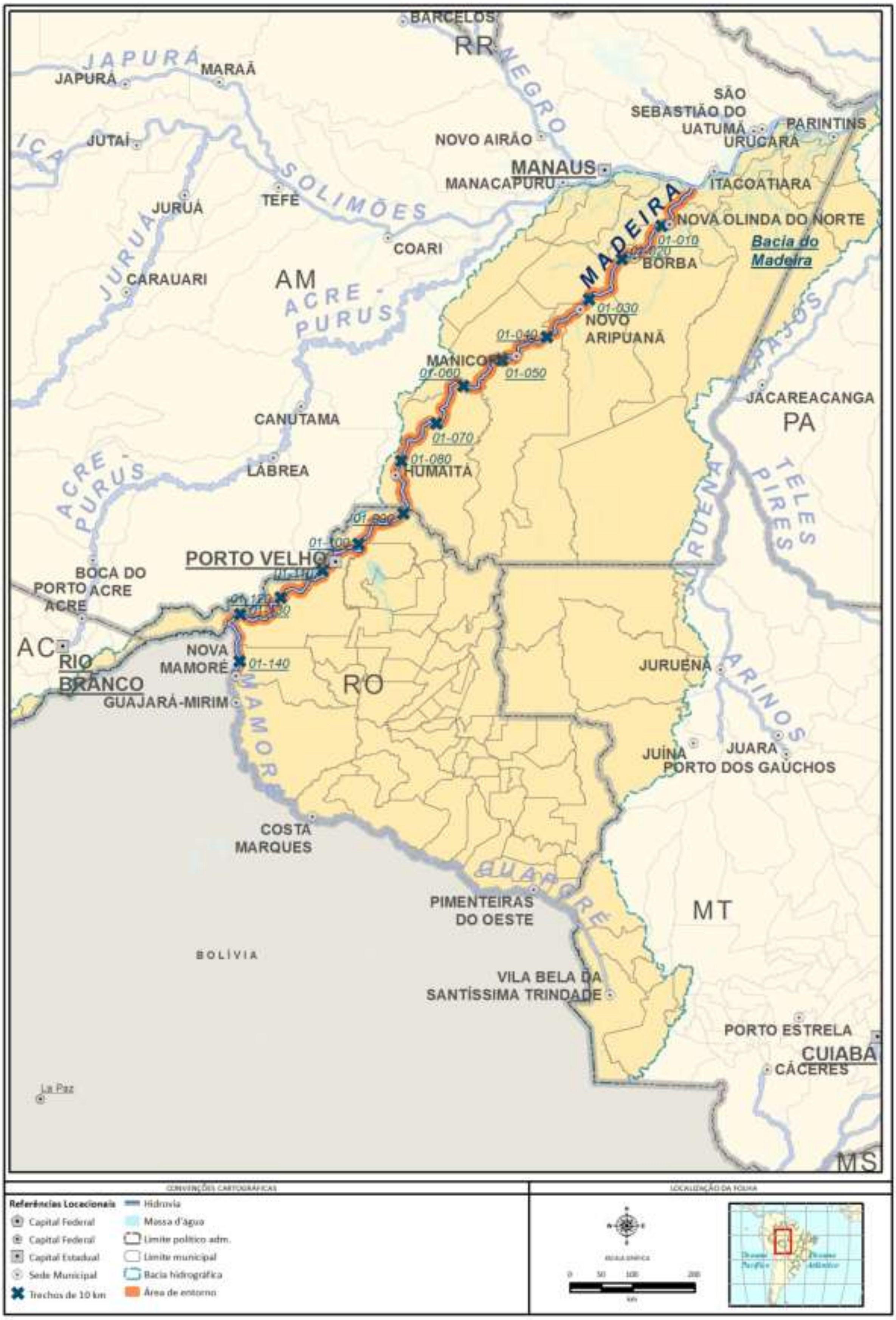


Figure 3.3.5: Longitudinal profile of the Madeira River between Porto Velho and Abunã

The Jirau hydroelectric power plant reservoir backwater will reach the municipality of Guajará Mirim (RO) (section 6 of the Mamoré River), when the reservoir is at its maximum level (WL 90.0m), or the municipality of Nova Abunã (RO) (section 138 of the Madeira River) when at its minimum level (WL 82.5m). On the segment between the two cities, there are long rocky outcrops and rapids, which, depending on the operation level at the Jirau hydroelectric power plant, may impede or restrict navigation on the section.

b) Social and Environmental Vulnerabilities

The future Madeira Waterway cuts through the territory of 11 municipalities, 8 in the state of Amazonas and 3 in the state of Rondônia, in the Amazon biome.



Map 17: Madeira Waterway Location

The population in these municipalities is 780,916 inhabitants (IBGE, 2010). The state capital, Porto Velho (RO) is the most populous municipality, accounting for 54.87% of the total and the average FIRJAN (2010) index is 0.54, close to those of the municipalities of the basin.

For the social and environmental vulnerability analysis, the waterway surroundings were divided into 142 sections. The most vulnerable sections, where there are Indigenous Lands, sections 4 through 5 (where the Mura ethnic group is found, in Parachuhuba), and 7 through 8 (the area called Miguel-Josefa, also belonging to the Mura), between the municipalities of Autazes (AM) and Nova Olinda do Norte (AM), 10 through 17 (the area called Coata-Laranjal of the Munduruku ethnic group), 22 through 30, in the municipality of Borba (AM), 39 through 40 (in the areas called Cunhã-Sapucaia, Arary, and Setemã where the Mura live), 57 through 62, in the municipality of Manicoré (where the areas called Torá and Lago Jaruaí are, home to the Apurinã and Mura ethnic groups), and 81 through 82 (areas known as Ipixuna and Nove de Janeiro, where the Diahui ethnic group lives), in Humaitá (AM).

There are also Integral Protection CUs on sections 89 through 95, 99 through 102, and 117 through 132 in Porto Velho (RO). There are also prospecting/minning activities between sections 23 and 142, between Borba (AM) and Nova Mamoré (RO). The most significant concentration of such activities is on section 128, in Porto Velho.

However, all the waterway surroundings are well preserved, as for plant coverage, according to the available mapping. Moreover, there are very high or extreme action priority APCBs along the waterway surroundings.

The main characteristics with regard to social and environmental vulnerabilities along the Madeira Waterway can be seen together on the Linear Diagram diagram below.

CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA 0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO MADEIRA	MAI/2013

3.3.1.3 Mamoré Waterway

a) Navigability Diagnosis

The Mamoré River is one of the river formers the Madeira River. It springs is situated in Cordilheira Real, on the Bolivian Andes, near the city of Santa Cruz de La Sierra, with the name Grande La Plata. Its course is 1,100km long, drawing a long, regular bend between the ranges of Cordilheira Real. Several tributaries flow into it, increasing its water volume. Down from the Andes, it forms falls and violent rapids up to the plain of Guaporé, where its course becomes calm and navigable up to the municipality of Guajará-Mirim (RO), where it meets new obstructions such as the rapids and falls, in Guajará-Açú, Guajará-Mirim, and Bananeiras.

The Mamoré Waterway corresponds to the segment between its confluence with the Beni River, forming the Madeira River, and the mouth of the Guaporé River, with about 270km of extension.

This segment of the Mamoré River has poor navigability conditions today. The most critical segment is between sections 1 and 6, where there is a number of rapids and rock outcrops, insurmountable for commercial vessels, with low depths, minimum widths of 300m and high run-off speed. The average flow of the river is about 8,000 m^3/s and the flood period is between February and May (see Appendix VII, item 4.2.2), in accordance with the Madeira River hydrological regime.

The Mamoré River, on the segment studied, is in a region with plenty of alluvial deposits and river plains. The riverbed is predominantly sedimentary, with medium susceptibility to aggradation.

Sinuosity is a negative factor all along the Mamoré River. Upstream from section 11, where the river is in a plain region, slopes are low and there are a number of meanders. Minimum widths range between 300 and 600m.

The Mamoré River, between its confluence with the Beni River and the municipality of Guajará Mirim (RO) (sections 1 through 6), presents a series of rapids and rocky outcrops, which impede commercial navigation. Minimum depths on this section are lower than 1m. The figure below illustrates this obstruction.

Figure 3.3.6: Mamoré River Rapids (Balneário do Célio, 2013)

Figure 3.3.7: Mamoré River Rapids (Panoramio, 2013)

The section between Guajará Mirim (RO) (section 6) and the Guaporé River mouth (section 27) is navigable by small vessels throughout the year, with minimum depths of about 2.5m. The Mamoré River has sandbanks all along its course and trunks, fixed and adrift, which may result in occasional difficulties, and there is aggradation throughout its course, especially upstream from section 6.

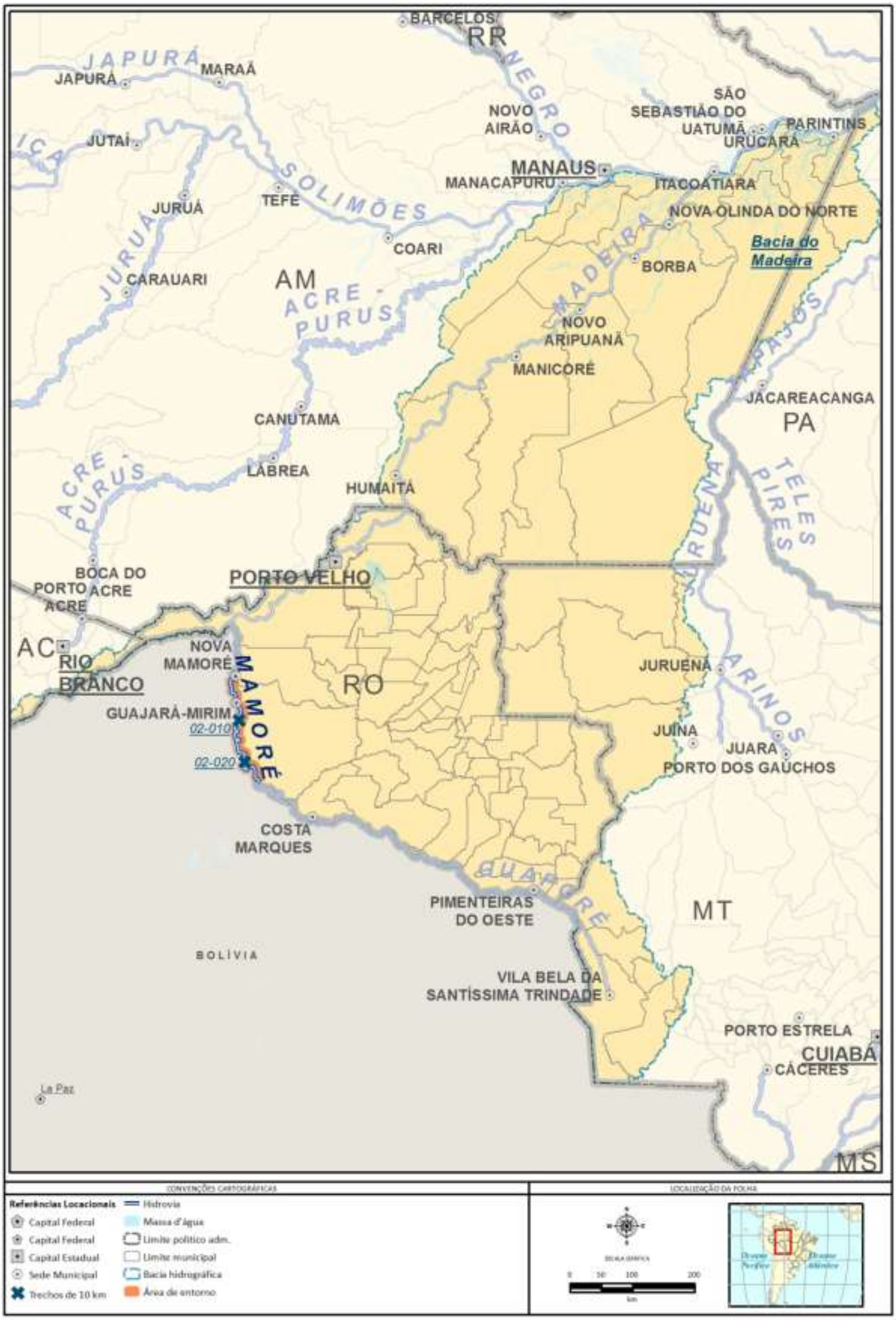
Figure 3.3.8: Mamoré River in Pampas del Beni. (Viajeiros, 2013)

There are no bridges or other constructions that may result in difficulties to navigation on the Mamoré River. However, because the Santo Antônio and the Jirau HPPs, on the Madeira River, have no locks, they represent in the greatest obstruction to make the Mamoré Waterway feasible.

The implementation of a hydroelectric power plant near the municipality of Guajará Mirim (RO) is being planned, which will use the rapids on the Mamoré River in hydroelectric power generation. The construction of this binational hydroelectric power plant will flood the main natural barrier on the Mamoré River – a series of rapids from section 1 through 6 and, and in case of being equipped with a locks system, will create adequate navigability conditions all along the Mamoré River.

b) Social and Environmental Vulnerabilities

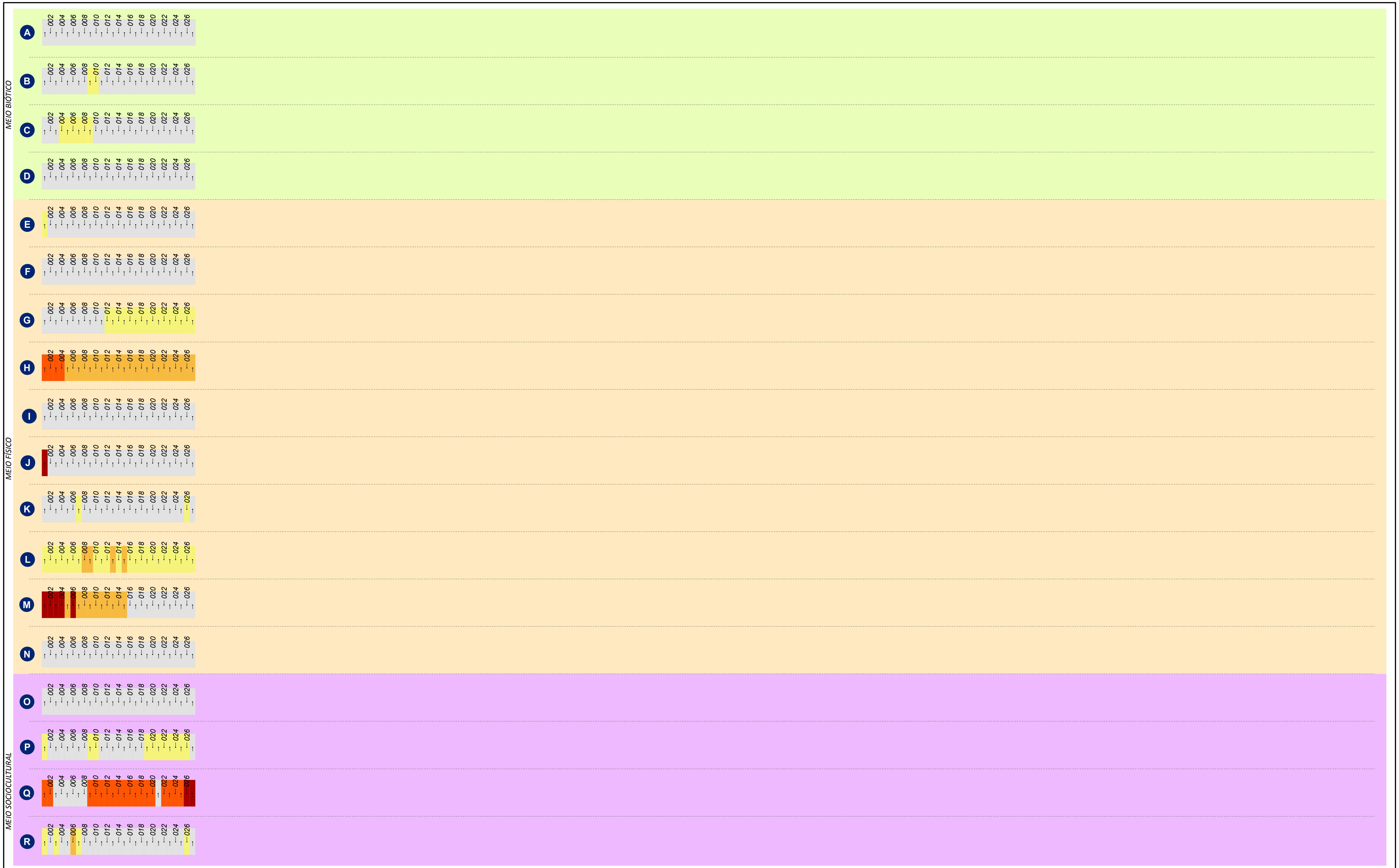
This future waterway, considered in its 262km in length, and this area of study cuts through the territory of 2 municipalities in Rondônia: Guajará-Mirim, with 41,656 inhabitants and where the FIRJAN (2010) index is 0.57, and Nova Mamoré, with 22,546 inhabitants and a FIRJAN (2010) index of 0.53, which is similar to those of the municipalities on the basin.



Map 18: Mamoré Waterway Location

To analyze the social and environmental vulnerabilities of the waterway surroundings, they were divided into 27 sections. There are 4 Indigenous Lands (TI) located at the final portion of the waterway, in the municipality of Guajará-Mirim (RO). The presence of Indigenous Lands spreads across virtually the entire waterway, except for sections 3 through 8 and 21.

The main social and environmental vulnerabilities on the Mamoré Waterway can be seen together on the Linear Diagram diagram below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
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- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
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SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
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N° dos trechos

n° < Jusante

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Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

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REFERÊNCIAS

Fontes:
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- ANA, 2010
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ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO MAMORÉ	MAI/2013

3.3.2 Economy

3.3.2.1 Current inland waterways transport

On the Madeira River currently more than 4 million tons of goods are transported, of which 3.3 million tons are downstream and 0.7 million tons upstream.

Table 3.3.1: Commodities and destinations Madeira River 2011 (in 1.000 tons)

	Itacoatiara	Manaus	Porto Velho	Santarem	Total
Soy	1.783			460	2.243
Corn	649	0		153	803
Fuels			314		314
Semi RB		140	148		288
Cement			177		177
Cargo divers		97	1		98
Trucks		29	18		47
Fertilizers			38		38
Other Commodities		9	12	10	31
Total	**2.432**	**275**	**710**	**623**	**4.041**

Soy is the most imported downstream commodity with 2.2 million tons transported, followed by corn with 0.8 million tons, together 75% of total transported cargo over the Madeira River in 2011. Upstream cargo has its origin mainly in Manaus. For soy and corn, Itacoatiara and Santarém are the destinations. The other commodities have Porto Velho and, to a lesser extent, Manaus as destination.

3.3.2.2 Planned developments

Infrastructure

The infrastructure network in the Amazon region is not widely developed. Next to the main waterways Amazon, Tapajós and Madeira there are a few highways in the region. Public railways do not exist yet.

In the Madeira River, two large dams are under construction as part of the IIRSA regional integration project. The dam projects include large ship-locks capable of moving ocean going vessels between the impounded reservoir and the downstream river. If the project is completed, more than 4,000 km of waterways upstream from the dams in Brazil, Bolivia, and Peru would become navigable. This would increase the competitiveness of the Madeira waterway.

Economic developments

Rondônia and Mato Grosso are the two states most important for transport on the Madeira River. The two most important commodities originating from these states for the Madeira River are soy and corn. The exports from Rondônia and Mato Grosso of these commodities will almost double between 2011 and 2031. This potentially doubles the transport of soy bean on the Madeira River. Another factor will increase the transport even more. This is the so-called shift to the Northern ports: a shift from southeast ports (Vitoria, Santos, and Paranagua) to northern ports is expected. In 2015 and other forecasted years 50% of exports from Mato Grosso is expected to use the Northern ports. According to these forecasts 25% will go to Manaus and Santarém.

3.3.2.3 Future inland waterways transport

The potentially most important commodity groups for inland shipping on Madeira River are agricultural commodities soy and corn. Other commodities concern RoRo, cement and containers. In table 3.3.2 an overview is provided of all upstream and downstream transport projections on Madeira River.

Table 3.3.2: Overview transport forecasts Madeira River (in 1.000 tons)

	2011	2015	20123	2031
Soy	1.787[47]	3.121	4.055	4.987
Soy meal		1.204	1.473	1.740
Corn	760	1.482	1.891	2.227
Fertilizers	38	649	769	823
Other commodities	957	1.163	1.719	2.177
Total	**3.542**	**7.619**	**9.907**	**11.954**

3.3.3 Transport System

3.3.3.1 Transported Cargo

The transported cargo on the Madeira River is presented in Chapter 3.3.2. The current flows are mainly related to the agricultural sector in Mato Grosso and partially to the consumption in the Porto Velho region. In 2031, the potential cargo for the Madeira River will increase considerably. The volumes (exports of agricultural products and imports of fertilizers, as well as imports and exports of other commodities) are presented in the table that follows.

[47] This figure probably includes soy meal.

Table 3.3.3: Transported cargo in the Madeira waterway complex, in 1,000 tons (source: ANTAQ Report – Cargo transports on Brazilian Waterways 2011).

	2011	2031
Soybean	2,243	6,183
Corn	803	2,351
Other commodities (downstream)	285	648
Other commodities (downstream)	710	1,615
Total	**4,041**	**10,797**

3.3.3.2 Infrastructure

This item describes the current infrastructure on the Madeira River that, according to what is mentioned in Chapter 3.3.1, comprises the Madeira, Guaporé, and Mamoré Rivers, as well as the federal highways that are relevant for the region.

a) Waterway/River Infrastructure

The physical characteristics of the Madeira Waterway complex, as well as the dams that are being implemented and those planned have already been mentioned in Chapter 3.3.1. Thus, only the existing ports/terminals will be described.

Portos/Terminais

For the analysis of the Madeira Waterway System terminals the database resulting from the PNIH was used, and information collected during the interviews and coming from recent reports was aggregated. In this database, 15 terminals are listed, 3 of which do not provide information as to their status and 12 are in operation.

The analysis of the current status was made based on data from terminals classified as "Operative", the other were disregarded.

Lists of the ports/terminals that are in operation in the region, as well as the rivers that are located there and the land connections.

Table 3.3.4: List of Ports/Terminals in operation.

Port/Terminal	Type	Location	Land Connections
Porto Velho	Organized Port	Madeira River	BR-319 (Manaus – Porto Velho) BR-364 (Cuiabá – Porto Velho) BR-425 (Porto Velho – Guajará Mirim)
TUP Aquavia	Mixed private use terminal	Mamoré River	BR-425
TUP Belmonte	Mixed private use terminal	Madeira River	BR-364, BR-319, and BR-425
TUP Caima	Mixed private use terminal	Madeira River	BR-364, BR-319, and BR-425
TUP Cargill Agrícola	Mixed private use terminal	Madeira River	BR-364, BR-319 e BR-425
TUP Fogás	Mixed private use terminal	Madeira River	BR-364, BR-319, and BR-425
TUP Ipiranga Base of Porto Velho	Mixed private use terminal	Madeira River	BR-364, BR-319, and BR-425
TUP Passarão	Mixed private use terminal	Madeira River	BR-364, BR-319, and BR-425

The port of Porto Velho, which is administered by the SOPH through delegation of the state of Rondônia, is composed of three terminals: One of them is dedicated to the operation of Roll-on/Roll-off vessels; one is a yard for cranes with no mooring pier, and one is a general cargo terminal. Hermasa leased an area to handle agricultural bulks and fertilizers.

The Caima, Fogás, and Ipiranga Base de Porto Velho TUPs move liquid bulks; the Belmonte and Passarão, general cargo; and the Cargill Agrícola, agricultural bulks. There is no information available on the type of handled cargo on the Aquavia TUP.

Hermasa and Cargill terminals are the main ones, handling about 91% of the region's total. It is worth highlighting that these companies have their own cargo, and at harvest time they prioritize it, something that may lead to unavailability of terminals for third parties.

The tables below present the handled cargo in the Porto Velho region in 2011. It can be deduced that the ports/terminals are predominantly oriented to the export of agricultural bulks, mainly soybean and corn, corresponding to more than 75% of the total. The rest of the cargo is related to internal consumption.

Table 3.3.5: Cargoes with Origin/Destination in Porto Velho , 2011, in 1,000 tons (Source : ANTAQ Report – Cargo transports on Brazilian Waterways 2011).

	Destination	Origin
Belém	0	121
Itacoatiara	2,432	38
Manaus	275	
Santarém	623	
Coari		42
Itaituba		41
Manaus		467
Total	**3,331**	**710**

Table 3.3.6: Origin/Destination in Porto Velho per commodity, 2011, in 1,000 tons (source : ANTAQ Report – Cargo transports on Brazilian Waterways 2011).

	Origin	Destination
Soybean	2,243	
Corn	803	
Fuels and mineral oils		315
Cement		177
Ro-Ro	140	148
General cargo	107	
Fertilizers		38
Trucks	29	18
Other commodities	9	14
Total	**3,331**	**710**

Highways

The highways that were chosen for analysis were based on routes for cargo transport, and may be either competitors or complementary to each other. Their description is presented below.

BR-364

BR-364 is an important diagonal Brazilian highway that starts in Limeira-SP, at km 153 of the SP-330, going through the SP-310 up to km 292, where it enters SP-326 and goes up to the border with Minas Gerais, then crossing Goiás, Mato Grosso, Rondônia, and Acre until it ends in Rodrigues Alves, at the far/extreme west of that state; it is, thus, a highway of fundamental importance for the outflow of the production of the entire North and Midwest/Center-West region of the country.

One of its sections runs parallel to the Mamoré and Guaporé Rivers, connecting the northwest region of the state of Mato Grosso to/with the city of Porto Velho. This section stands out in the outflow of bulk production of the entire Brazilian Midwest/Center-West. It is a route that connects the producing region in the state of Mato Grosso with the city of Porto Velho, where the cargo is transferred to vessels that go on through the Madeira River.

Today, BR-364 is completely paved in the state of Rondônia and partially paved in the state of Mato Grosso. It has a single roadway all along its length, with the exception of a short section close to the city of Porto Velho, where there are already two roadways. The maintenance of the highway is unreliable and records of crashes are constant. Authorities keep constant services of "pothole repair", but due to the length of the highway, the demand for maintenance is far greater than what is currently done.

BR-230 (Transamazon Highway)

The Rodovia Transamazônica (BR-230) is the third longest highway in Brazil, 4,223 km long, connecting Cabedelo, in Paraíba, to Lábrea, in Amazonas, cutting seven Brazilian states, Paraíba, Ceará, Piauí, Maranhão, Tocantins, Pará and Amazonas. It starts in the city of Cabedelo, in Paraíba, and goes up to Lábrea, in Amazonas.

It is classified as a transversal highway. A good portion of the highway is not paved, especially in Pará and Amazonas. ONce it is not paved, traffic on the Rodovia Transamazônica is impracticable during the rainy season in the region (between October and March).

A section goes from Lábrea (AM) and, after cutting the Madeira River in the municipality of Humaitá (AM), runs parallel to the river up to the municipality of Itaituba (PA). It would be a competing route to the Madeira River for the outflow of cargo and passengers, but most of its length is not paved, making the traffic of vehicles impossible.

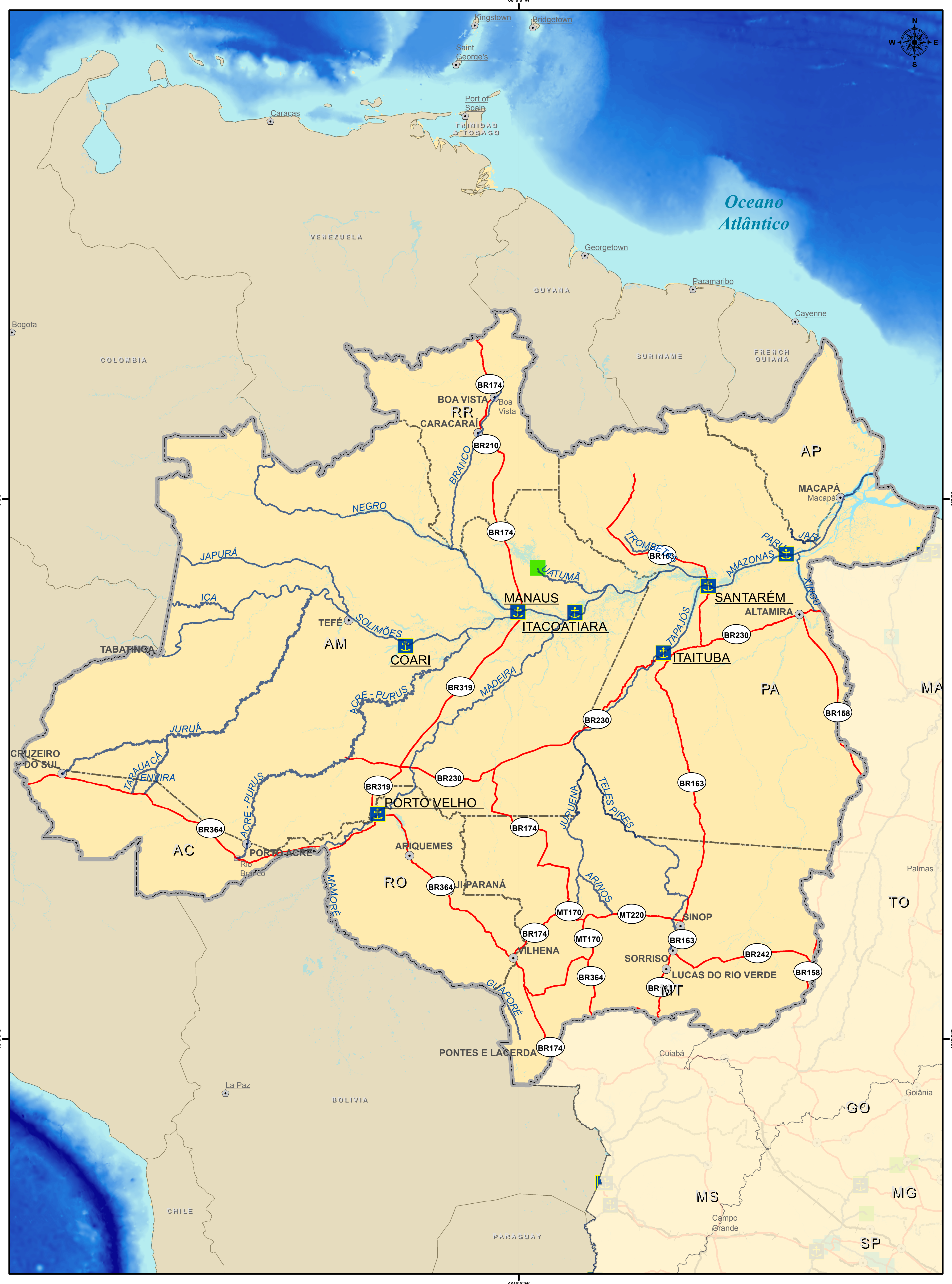
BR-319

BR-319 is a Brazilian federal highway that connects the cities of Manaus (AM) and Porto Velho (RO), in Northern Brazil. Along its route, the highway passes through the states of Amazonas and Rondônia. BR-319 is the only road connection available between Manaus and the state of Roraima with the rest of Brazil. The section between Manaus and the locality called Havelândia (at the municipality limit between Manicoré and Beruri) is concomitant to BR-174.

It is the main access to many cities in South Amazonas, such as Humaitá, Lábrea, Manicoré, Careiro, Manaquiri, Autazes, and Careiro da Várzea. It is 880.4 km long, 859.5 of which in Amazonas and 20.9 in Rondônia.

BR-319 was opened in 1973 during the Brazilian military regime, within the context of colonization of the Amazon. Some years later, the highway became in fact impracticable. In 2005, the federal government announced the recovery of the BR-319. The Works started in 2008, with two work fronts staring at the extremities of the highway.

Although it is a highway that competes with cargo transport through the Madeira River, since the latter runs parallel to the Madeira Waterway, it is not seen as an option since most of its length does not have conditions to stand regular traffic.



CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais

Barragem existentes
- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes
- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 80 160 320 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO AMAZONAS

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:11.000.000	- BRASIL -	JUL/2013

3.3.3.3 Characteristics of the Existing Fleet and the Operating Companies

The information relating the shipping companies that operate in this waterway system was obtained through interviews and secondary sources.

The ANTAQ database concerning the fleet is available for the Amazon hydrographic region as a whole, and there is a division by river only in the case of river crossing. It is not possible to distinguish the rivers in the case of longitudinal navigation, thus the data used were those obtained along the interviews.

The analysis of the existing fleet focused on the major shipping companies that do the cargo longitudinal transport - Hermasa, Transportes Bertolini, and CNA (Companhia de Navegação da Amazônia), because it was only for these companies that it was possible to identify the use of the Madeira River for transport.

Table 3.3.7: Major shipping companies – Madeira Waterway System (Source: Prepared from ANTAQ's Statistical Yearbook, 2011).

Shipping companies	Transport by third parties	Number of barges	Static capacity (ton)	Number of pusher tugboats	Idade Média (anos)
Transportes Bertolini	Yes	90	187,657	46	10,9
Companhia de Navegação da Amazônia - CNA	Yes	50	89,074	18	15,8
Hermasa Navegação da Amazônia	Yes	71	158,392	8	10,6

These companies operate not only in the Madeira Waterway System but also in the Amazonas WS. Therefore, the static capacity, number of barges and push boats correspond to the total.

Bertolini does the solid bulk transport between Santarém (PA) and Porto Velho (RO); CNA, the transport of liquid bulk between Manaus (AM) and Porto Velho (RO); and Hermasa, the transport of agricultural bulk between Porto Velho and Itacoatiara (AM) for exports, using fertilizers as return cargo.

Hermasa convoys used for navigation vary according to the Madeira River regime. As already presented in Chapter 3.3.1, navigation is full between December and July, when larger convoys are used, ranging from 16 to 20 barges, with a capacity of 32 thousand 39 thousand tons, respectively, and 3.6 m draft. The figure below presents this convoy, for the total lextension, a push boat with highest power (4000 BHP).

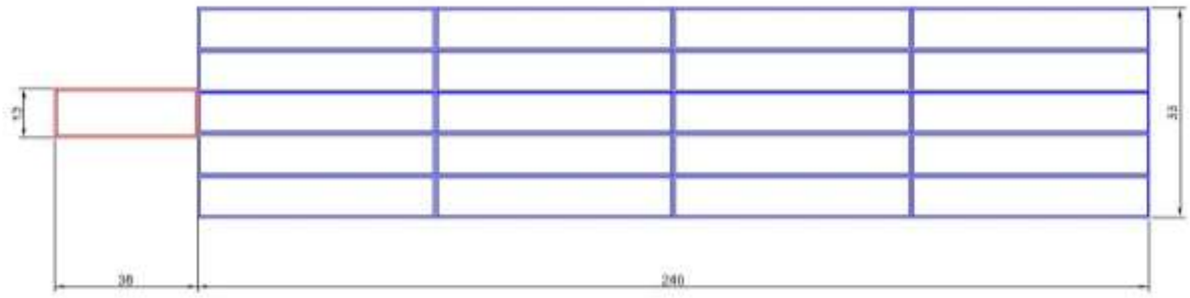


Figure 3.3.9: Hermasa convoy with 39 thousand tons

During the dry season, due to restrictions to navigation, smaller convoys are used, ranging from 12, to 9 or 6 barges, with a capacity of 2 thousand tons each, and 2.2m draft. At specific critical sections convoys of 6 barges must be split one by one, due to difficulties to navigate.

3.3.3.4 River Information Management System

As explained in Chapter 3.3.4, AHIMOC and SOPH functions is the maintenance of the Madeira River with regard to dredging and signaling works. However, some waterway users pointed out that there is no maintenance, impairing navigation guarantee.

The Navy, in its document titled "Normas e Procedimentos da Capitania Fluvial da Amazônia Ocidental" (Standards and procedures of the river captaincy of Eastern Amazônia) points out the restrictions to navigation during the night period (section between Porto Velho and Calama, and at the passage of the Pedral dos Marmelos, whenever the Madeira River ruler level, in Porto Velho, is below 4 meters), the sources for the obtainment of information referring to the measuring of the "river level ruler" (Delegacia Fluvial de Porto Velho or the Agência Fluvial de Humaitá), and also the location of the main rock outcrops (Navy Geographic Map).

Although there are data about the river, they are insufficient to guarantee navigation safety, leading some companies, like Hermasa, to invest in monitoring. Hermasa has vessels that measure depth at the 20 critical points during the 24 hours of the day and warn the convoys about existing problems.

3.3.3.5 Intermodal Competition

Based on the results presented in Chapter 3.3.2, the competitive products of the Madeira Waterway System consist of agricultural cargos from Mato Grosso directed to exports. Although in 2031 two million tons of other cargos will be transported, they will not be directed to imports (fertilizers) or exports (soybeans and corn).

For these agricultural cargos, the transport chain along the Madeira River consists of road transport from the microregion to Porto Velho and the subsequent waterway transport from the area of Porto Velho to other regions, such as Itacoatiara. For the competitiveness analysis a direct road transport from the microregion to Itacoatiara was the alternative considered.

For each significant microregion (production greater than 400,000 tons of soybeans per year or which contains at least one municipality that produces more than 100,000 tons per year) the transport distances were calculated for different alternatives. Based on these distances, the transport cost was calculated using a cost model (see Chapter 1.3.4). The results are presented in the following table, as well as the relation between multimodal transport cost along the Madeira River to Itacoatiara and the alternative of direct road transport.

Table 3.3.8: Transport costs between the Mato Grosso microregions and Itacoatiara (R$/ton)

Region	Microregion	Itacoatiara	Itacoatiara	Ratio
		multimodal	Road transport	multimodal/road
MT	Brasnorte	252	393	64%
	Alto Garças	368	509	72%
	Bom Jesus do Araguaia	419	548	76%
	Gaúcha do Norte	370	512	72%
	General Carneiro	380	521	73%
	Itiquira	367	508	72%
	Nova Maringá	307	448	68%
	Primavera do Leste	347	488	71%
	Querência	407	548	74%
	Sapezal	233	375	62%
	Sorriso	325	467	70%
	Tangará da Serra	264	405	65%
	Vera	335	477	70%

According to the analysis presented above, the multimodal transport was considered the lowest cost alternative. For every microregion in Mato Grosso, the multimodal transport to Itacoatiara is more competitive than only road transport.

3.3.4 Governance and Institutions

The Madeira Waterway System is highly important for regional development due to its strategic position. It is an important transport way for the population that lives in the towns or at the river banks. Located at the north corridor, the waterway is specialized in the transport of soybeans, corn, fertilizers, oil derivates, cement, fruits, electrical appliances, vehicles, frozen products, pebbles, drinks, among others. According to studies conducted by the Navy and the University of Rondônia (UNIR), there is potential to extend the waterway up to 3,000km, establishing a connection with Andean countries through interventions that promote navigability on the section of the Mamoré-Guaporé Rivers, which need investments for the rock demolition and dredging interventions to increase the draft.

According to their formal assignments, various national and federal agents are involved in the management of this waterway system, both the waterway issue itself and the port issue, each one being responsible for a specific area. It is worth emphasizing that these assignments reflect the content provided for by the legal text that defines them, in some cases it does not depict their actual operation. The following chart was developed to facilitate viewing the assignments of such agents:

Table 3.3.9: Matrix of formal assignment of the Madeira Waterway Agents

	Port Mgt	Inspection	Waterway Maintenance*	Licensing Process	Regulation
Waterway Administration (WA) – AHIMOC	■		■		
State Superintendency – SOPH	■	■	■		
Port/River Captaincy		■			
SEDAM				■	
DNIT/DAQ			■		■
ANTAQ		■			■
IBAMA				■	■
Other Agents**				■	

*Dredging, rock excavation, and signaling.
**This block includes all agents consulted by IBAMA in the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN and the Public Ministry/Prosecutor's Office).
Source: Consórcio Arcadis Logos, 2012.

Every institution will now have its assignments detailed, allowing to notice from the interaction of the different agents occasional task overlaps, and needs concerning the performance of other tasks.

The AHIMOC - Administração das Hidrovias da Amazônia Ocidental (Annex I) a federal agency linked to CODOMAR (Annex I) and to the Ministry of Transports/DNIT (Annex I), with headquarters in Manaus, is responsible for the promotion and development of the conduction, follow-up and inspection activities regarding studies, works and services of the Madeira waterway system and the Port Terminals of the river. Today, they operate mainly in this system, as it is a fundamental outflow route to the external consumer markets for the soybean production from the Midwest/Center-West, as well as from the Amazon region itself.

In Porto Velho there is the Sociedade de Portos e Hidrovias do Estado de Rondônia – SOPH (Annex I) headquarters, a public agency belonging to the State with administrative, technical, patrimonial and financial autonomy and whose purpose is to carry out the state policy of waterway transport, comprising the implementation, construction, maintenance and improvement of ports, waterways and navigable ways, as well as the administration and exploitation of the entire waterway infrastructure in the interior of the state of Rondônia. The SOPH was assigned also with inspecting and promoting the preservation of the natural resources that interact with port and waterway activities on the Madeira River. It relates directly and closely with the Navy through the Delegacia Fluvial de Porto Velho (Annex I) [the Porto Velho river station, which inspects the vessels and identifies the critical points in need of cleaning, dredging, rock excavation, signaling interventions, among others. The SOPH relates directly to the DNIT, often resulting in investment agreements to improve the infrastructure of the waterway and the port of Porto Velho itself. Through this tool the DNIT has been making the investments necessary to the maintenance of the waterway feasible, since resource transfer through the covenant established with CODOMAR is often complex and inefficient when it comes to making the works necessary to maintenance feasible, since such maintenance should be done by the Waterway Administrations (Annex I). This is because all the WAs are linked through a same covenant to CODOMAR, which in turn is linked to the DNIT, and any administrative irregularity (like, for instance, not providing monthly accounts) taking place in an Administration blocks fund transfer to all the others. Such procedure harms those administrations whose accounts are up-to-date because of the management of those that have not regularly provided accounts to CODOMAR, resulting in the fact that their local demands for waterway improvement are not met.

It is to be emphasized that, differently from what was seen in the Tietê-Paraná Waterway System, which has a committee to address with synergy issues concerning the waterway, in the Madeira Waterway System SOPH and AHIMOC usually act in a disarticulated way, often resulting in task fulfillment overlap or [else]non fulfillment, and the task is then left to the private initiative, increasing the cost for the companies and consequently for the final product, making it less competitive in the market.

Another institution that operates in this waterway is FENAVEGA (Federação Nacional das Empresas de Navegação Marítima, Fluvial, Lacustre e de Trafego Portuário) a higher grade class entity, (article 533 of Brazilian Labor Laws, founded in September 8, 1988) duly authorized to work with the primary purpose of coordinating the economic activities of river navigation. FENAVEGA advocates distinctive treatment for groups that operate in Northern and Northeastern Brazil by prioritizing the companies of both regions when transferring funds from the Fundo da Marinha Mercante [Merchant Navy fund]. It also targets greater integration among all transport modals and greater representativeness of the waterway transport before public and private institutions. FENAVEGA participates in the Confederação Nacional dos Transportes – CNT [national transport confederation] which also operates to encourage and support the integration among transport by road, rail, water, and air.

To carry on the interventions on the waterways, which may be improving the existing infrastructure or building new terminals and ports, it is necessary to obtain an authorization form the responsible environmental agency. in the case of the Madeira Waterway such agency is IBAMA, when the design may impact more than one state or country; SEDAM – Secretaria Estadual de Desenvolvimento Ambiental de Rondônia (Annex I), when it is the case of spot interventions located in Rondônia; and for the state of Amazonas, the responsible agency is SDS – Secretaria do Meio Ambiente e Desenvolvimento Sustentável (Annex I).

SEDAM, besides issuing the environmental licensing, also performs the Environmental Monitoring and the Environmental Protection of the works in the state. The CRH – Conselho de Recursos Hídricos de Rondônia, a consulting and deliberative agency created in 2011 and approved by the internal rule in August 2012 (State Law 255/2012; Decree 10114/2012) is under its responsibility, with the purpose of debating multiple water use among the water users in search of the best solution for everybody.

No Hydrographic Basin Committee was found in the Madeira Waterway System, even after searching through the Internet.

In November 2012, AHIMOC was able to renew its operation license issued in 2006 to carry out: maintenance dredging in the Madeira Waterway, removal of submersed timber, implementation and maintenance of the beaconage, and installation and maintenance of nautical signaling on the river banks. Such interventions were not yet carried out because the system is very slow, both regarding the release of grants and the obtainment of renewal of an environmental license and the Waterway Administration ended up missing the best occasion (dredging should be executed during the low waters period in order to ensure longer stability for the channel; when the water level is rising, especially in sedimentary rivers, the morphology of the beds is altered very quickly, reducing dredging efficiency). Thus, missing the proper time means being in the rising waters period during the execution of the dredging and having to postpone the intervention.

Waterway signaling and bathymetry, most of the times, are performed by private companies (AMAGGI – Hermasa SA). The DNIT usually makes a small part of signaling implementation, the rest is made by private companies that navigate on the waterway. They also execute the bathymetry, since the nautical charts available are out-of-date, making navigation based on them impossible. Updating nautical charts should be assigned to the Navy..

The Navy (Annex I), through the Capitania Fluvial da Amazônia Ocidental (Annex I) [western Amazon river captaincy] and the Delegacia Fluvial de Porto Velho (Annex I), inspects the vessels that travel on the waterway and whether the implemented signaling is in accordance with its standards. IIf not, they report to either SOPH or AHIMOC, depending on the section where the problem occurs.

Various hydroelectric power plants are being implemented throughout the waterway. With the implementation of Santo Antônio and Jirau, the maintenance of the water level was impaired, and also the concentration of submersed timber on the waterway banks increased, often destroying signaling buoys as well as the very terminals located on the banks. Trying to promote technical solutions for the problems faced arising from the construction of the Santo Antônio and Jirau hydroeletric power plants (UHEs), the ANA created the Comitê Técnico de Assoreamento do Rio (not yet effective) [technical committee for river silting] and IBAMA, the Comitê Técnico de Transposição dos Troncos, responsible for debating and solving issues coming from the excess of trunks [placed]in the dam and released all at the same time on the river bed, something that causes problems to waterway users, including riparian inhabitants. Moreover, the Agência Nacional das Águas, jointly with DNIT, ANTAQ, IBAMA and local representations discusses the issue of the “marolas”, small waves provoked on the river after the Santo Antônio hydroelectric power plant (UHE) was built. SIVAM – Sistema de Vigilância da Amazônia prepares studies to analyze the Madeira River before and after the hydroelectric power plants (UHEs), using satellite images and bathymetry.

In spite of all these initiatives adopted to solve problems, the construction of hydroelectric power plants on potential waterways still inhibits private initiative from investing in them. This happens because one does not know whether the cited councils/committees will really work or will be just façades, without real improvements.

3.3.5 SWOT Madeira Waterway System

Strengths	Weaknesses
• The Madeira waterway system is in operation up to Porto Velho without significant need for interventions. • The Madeira River has low sinuosity and slope, reasonable width and depth (> 2m) in most of its extension. • The main restrictions to navigation on the Madeira River are between Porto Velho and its mouth, and are signaled. • The Mamoré River is navigable between Guajará-Mirim and the meeting point with the Guaporé River. • The cost of multimodal transport (highway + waterway) from the Mato Grosso production regions up to Itacoatiara corresponds to about 65% of the direct highway transport cost. • From Porto Velho on, the cargo destined to be exported has the best outflow alternative in river transport.	• Insufficient highway infrastructure (for the outflow of agricultural products) from Mato Grosso to Porto Velho. There are only BR 364 and BR 174, both in poor conservation state. This can reduce the attractiveness of this waterway system, as compared to the other systems in condition to meet the demand for outflow coming from Mato Grosso. • Madeira River – Many trunks floating on the river in the rainy season. – There are restrictions to navigation between Porto Velho and Humaitá during the dry season, when declivity is higher. – The Santo Antônio and Jirau dams (sections 108 and 121) have no locks, thus making navigation impossible upstream of Porto Velho. – Depending on the Jirau dam reservoir level, the section between Abunã and Nova Mamoré can become non navigable. • Mamoré River The section between Nova Mamoré and Guajará-Mirim has many rapids and is not navigable, but the rest of the Mamoré River is navigable with minimum depth of 2 meters. • Guaporé River: it is very sinuous and has sections with minimum depth of 1 m in the dry season. • AHIMOC faces difficulties to work, imposed by the lack of access to financial and human resources (due to the covenant signed between DNIT/DAQ and CODOMAR). • The limited cooperation between AHIMOC and SOPH in/at waterway maintenance results in poor coordination of the actions. • Interventions in this region must consider the significant presence of indigenous communities (along the Mamoré River; on the Guaporé, near the junction with the Mamoré River; and also at some sections of the Madeira River), as well as Integral Protection Conservation Areas (on the Guaporé and Madeira Rivers). • The development of the Tapajós WS may compete for the transport of the same cargo that is today transported through the Madeira WS (from Porto Velho on).

Opportunities	Threats
– Load Potential in 2031 – Soy → 6.2 million tons – Corn → 2.4 million tons – Fertilizers → 0.8 million ton – Other → 2.2 million tons • Once the Madeira waterway system is located in important environmental area of conservation (Amazon region), the intensified use of this river as a waterway can reduce the need for roads construction, which have a higher environmental impact due to the removal of the native vegetation. • If Santo Antônio and Jirau HPPs are equipped with locks, the navigation system of this in the three rivers (Madeira and Mamore Guapore) can be connected. • There is a dam planned to be built in Mamore River, connecting Jirau reservoir to Guapore River, which can facilitate navigation in the region. No new dam planned are planned to be built downstream of Porto Velho and there are not impediments to navigation on this stretch, except those that require only the maintenance of the waterway.	• If the Santo Antônio and Jirau locks are not built, the use of the Mamoré and Guaporé Rivers as a waterway will be discouraged, making the cargo be taken to Porto Velho by highway, as it is today. • The operation of the hydroelectric power plants may cause problems to navigation (altering the hydraulic regime of the river). • Intensifying inland navigation may stimulate changing the use of the lands that surround the rivers, something that may conflict with the zoning anticipated for the region, that foresees, to a large extent, the sustainable use of the lands (ZEE). • Since the Madeira WS is primarily an international WS, bilateral agreements (Brazil-Bolivia) must be negotiated to avoid, among others, the transport of illegal cargo along the waterway.

3.4 THE TAPAJÓS WATERWAY SYSTEM

3.4.1 Physical system of the river and social and environmental aspects

The Tapajós Waterway System is composed of four waterways formed by stretches with navigability potential of the Arinos, Juruena, Tapajós and Teles-Pires Rivers, with these waterways located within the limits of the Tapajós River hydrographic basin.

The Tapajós River basin has an area of 532,173 km², covering the states of Amazonas (AM), Rondônia (RO), Pará (PA) and Mato Grosso (MT). Within its limits are found the territories of 81 municipalities: 2 in Amazonas 1 in Rondônia, 18 in Pará and 60 in Mato Grosso. The basin is located partially within the Amazon biome (79%) and in the Cerrado biome (21%).

The Tapajós waterway has a strategic geographic position, connecting large centers of Brazilian agricultural production to the Amazon River and, consequently, to the Atlantic Ocean. However, navigation is only feasible currently from the city of Santarém, at the meeting of the Tapajós and Amazon Rivers, to the city of Itaituba, on the Tapajós River, close to 280 km. in length. Upstream of this city, the Tapajós River and its main tributaries (the Teles Pires and Juruena Rivers) have a number of rock outcroppings, rapids and low falls, unpassable by commercial vessels. Being rivers considered strategic from the Brazilian power sector point of view, a number of hydroelectric power plants are planned for these rivers, which will make navigation possible over extensive segments of these rivers, being necessary, however, compatibility of the solutions adopted by the power sector with the measures necessary to make the Tapajós waterway feasible, as well as additional measures in the river stretches not expected to be flooded by reservoirs.

The analyses and studies conducted for characterization of the physical, social and environmental conditions of the potential waterways of the Tapajós Waterway System followed the methodologies presented in Chapter 1 – Item 1.3 – Methodology, of this report.

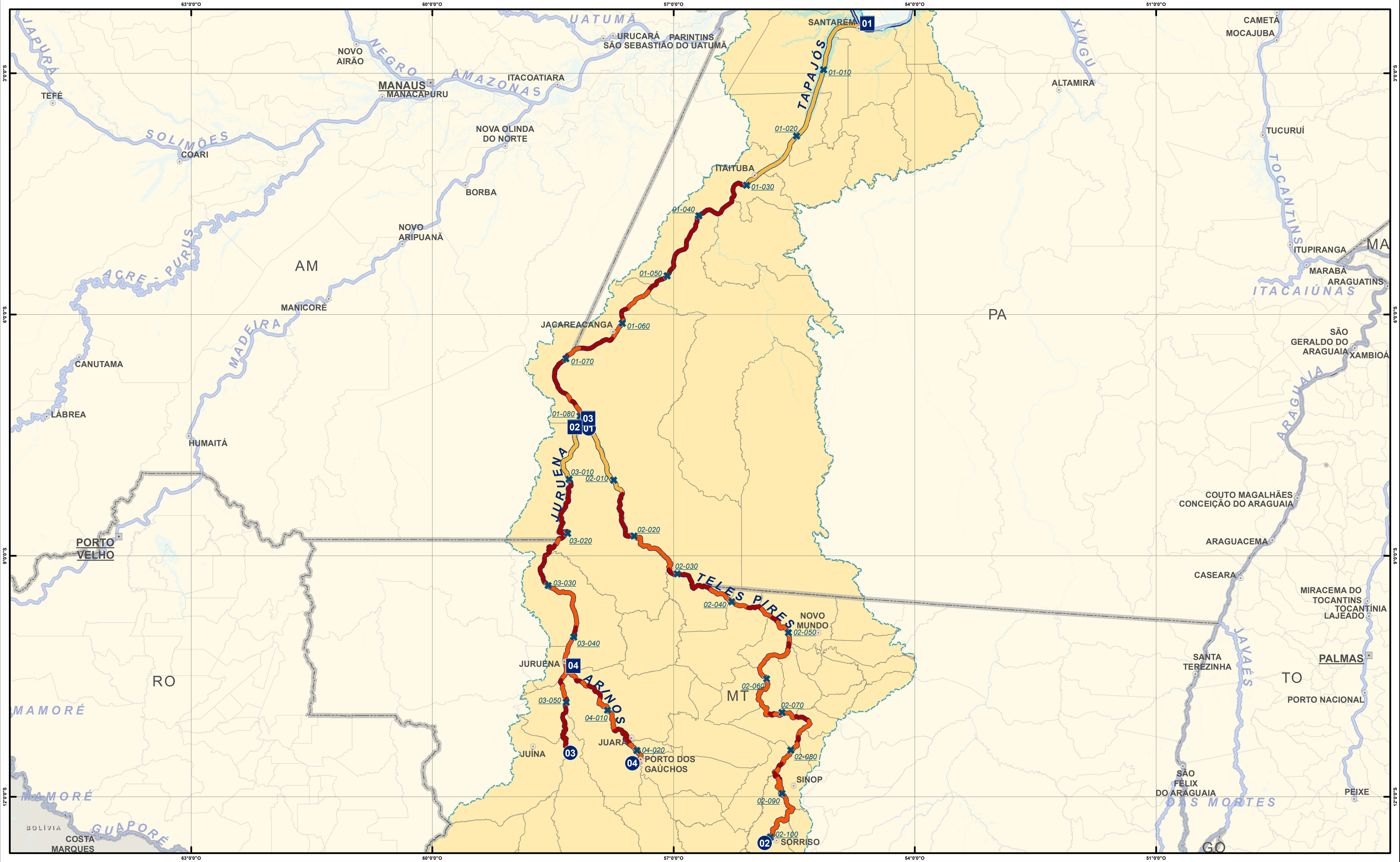
Due to the large volume of collected and analyzed information, we present in this chapter the summary of the main results and the conclusions arrived at for each river under study.

In the CD attached to the present report (Step C: Assessment and diagnosis) a table is presented in the .xls format containing all the variables and information analyzed for each river and each stretch under study in more detail.

The Linear diagrams contained in this chapter synthesize the above mentioned table, obeying the methodology presented in Chapter 1, Item 1.3 of this report.

As a product of the Strategic Waterway Plan final step (Step F: Preparation of the final strategic plan) a database is presented with georeferenced data containing all the information existing in the table of the CD attached to the present report.

The main characteristics with regard to the physical conditions of navigability of the waterways composing the Tapajós WS can be seen in the one-line diagram presented below.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Tapajós
- 02 Rio Teles Pires
- 03 Rio Juruena
- 04 Rio Arinos

Bacias do SH Tapajós

Trechos de 10 km (xx-yyy)
xx: n° do rio
yyy: n° do trecho
*km = yyy * 10*

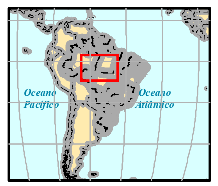
Escala de ponderação dos temas
1 - 5 (baixa - alta)
- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionésimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 40 80 160 km
SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA



MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
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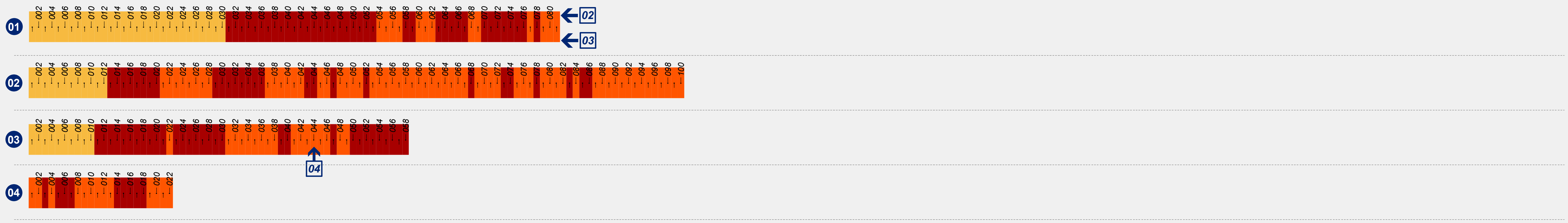

DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	*ALTO DE:*	*MÉDIA DE:*	*BAIXA DE:*	
Sinuosidade; ou	*Sinuosidade; ou*	*Sinuosidade; ou*	*Sinuosidade; ou*	*Ausência das ocorrências*
Profundidade mínima; ou	*Profundidade mínima; ou*	*Profundidade mínima; ou*	*Profundidade mínima; ou*	
Empecilhos à navegação (construções); ou	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	
Energia do rio; ou	*Energia do rio; ou*	*Energia do rio; ou*	*Energia do rio; ou*	
Leito do rio; ou	*Leito do rio; ou*	*Leito do rio; ou*	*Leito do rio; ou*	
Assoreamento; ou	*Assoreamento; ou*	*Assoreamento; ou*	*Assoreamento; ou*	
Anteparos naturais; ou	*Anteparos naturais; ou*	*Anteparos naturais; ou*	*Anteparos naturais; ou*	
Largura mínima do rio.	*Largura mínima do rio.*	*Largura mínima do rio.*	*Largura mínima do rio.*	

CONVENÇÕES CARTOGRÁFICAS

01 Rio Tapajós
02 Rio Teles Pires
03 Rio Juruena
04 Rio Arinos

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA 0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

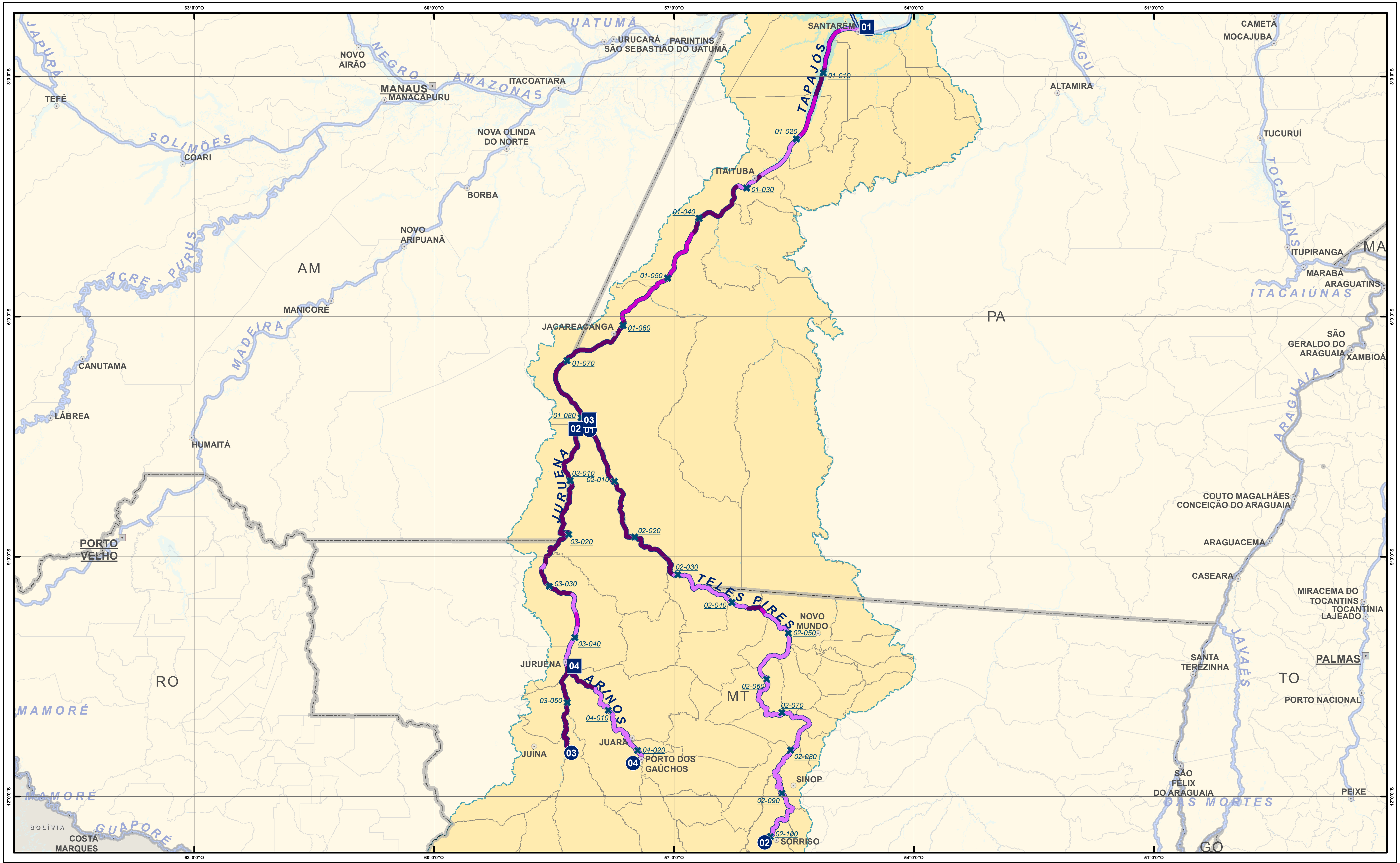
EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH TAPAJÓS	MAI/2013

The total population of the municipalities in this basin is 1,161,713 inhabitants (IBGE, 2010). In general, the municipalities are small. According to the REGIC/IBGE (2007), of these the municipality of Sinop (MT), with the largest population, 9.48% of the basin total, is worth highlighting.

With regard to the FIRJAN index (2010), the municipalities in the state of Mato Grosso have better results, with the municipality of Lucas do Rio Verde (MT) the one with the highest value, one of the highest in the entire country, 0.90. In general, the basin has an average of 0.68 and the municipality of Beltera (PA) has the worst ranking, 0.41 for this index.

Within the Tapajós River basin are 35 Indigeneous Lands, 27 Conservation Units (9 of Integral Protection and 18 of Sustainable Use), 238 INCRA settlements and the largest number of mining activities in the entire study area, 12,000, explained in part by the concentration of gold veins in the region.

The main social and environmental characteristics which are worth highlighting to support integrated planning of any interventions necessary in the region where the Tapajós WS is located can be seen together in the one-line diagram presented below.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
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- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

X Jusante
X Montante

01 Rio Tapajós
02 Rio Teles Pires
03 Rio Juruena
04 Rio Arinos

Bacias do SH Tapajós

Trechos de 10 km (xx-yyy)
xx: n° do rio
yyy: n° do trecho
km = yyy * 10

Escala de ponderação dos temas
1 - 5 (baixa - alta)
- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartográfica Integrada do Brasil ao Milionésimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 40 80 160 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

Oceano Pacífico
Oceano Atlântico

MINISTÉRIO DOS TRANSPORTES
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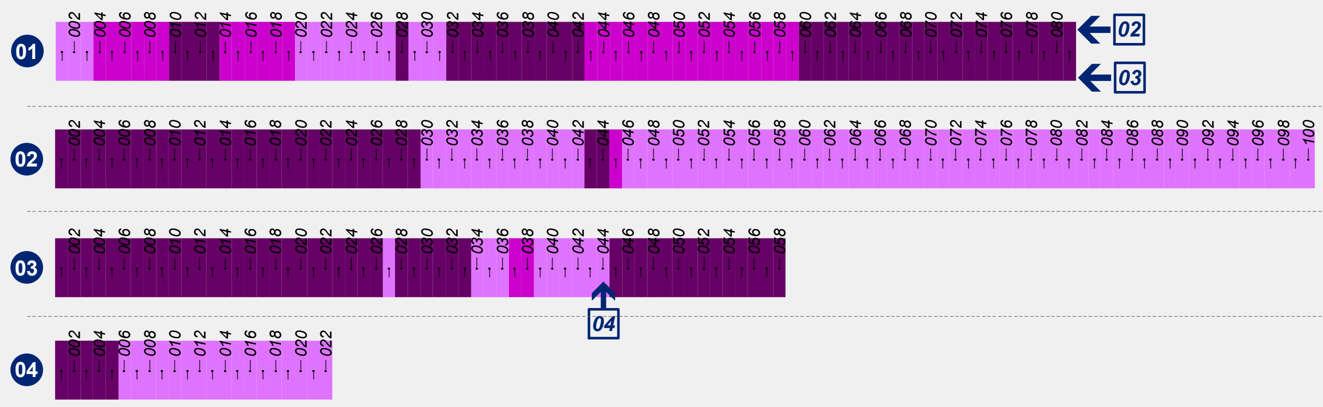
PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:4.750.000	SH TAPAJÓS	MAI/2013



VULNERABILIDADE SOCIOAMBIENTAL

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
UC - proteção integral; ou	*UC - uso sustentável; ou*	*Assentamento INCRA; ou*	*APCB; ou*	*Ausência das ocorrências*
Terra indígena	*Comunidade quilombola*	*Vulnerabilidade ao desmatamento; ou*	*Mineração - Lavra e garimpo*	
		Cavidades naturais		

CONVENÇÕES CARTOGRÁFICAS

01 Rio Tapajós
02 Rio Teles Pires
03 Rio Juruena
04 Rio Arinos

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH TAPAJÓS	MAI/2013

By means of the one-line diagram of the Teles Pires-Tapajós WS, we can see that, although both the Teles Pires and Juruena Rivers have considerable vulnerabilities from the social and environmental point of view, the Teles Pires River, since it is longer and closer to the producing market, may be the better alternative for waterway transport in the region. The municipality of Jacareacanga, at the confluence of the Juruena, Teles Pires and Tapajós Rivers, has an important presence of Indigenous Lands. Upstream from the municipality of Juruena, on the Juruena River, there is also an important concentration of indigenous lands.

The main characteristics of the waterways composing the Teles Pires-Tapajós Waterway System are described below.

3.4.1.1 The Teles Pires Waterway

a) Navigability Diagnosis

The Teles Pires River is one of the formers of the Tapajós River and part of the Amazon basin. Its source is found in the state of Mato Grosso, in the Azul and Finca Faca mountains. Its mouth is at the confluence with the Juruena River, near Barra de São Manoel (AM), forming the Tapajós River. The Teles Pires River basin passes along the states of Mato Grosso and Pará and is the natural border between the two states for approximately 300 km. (Stretches 1 to 33).

The flood period takes place between December and May and the hydrological behavior is quite homogeneous along the course of the river. The average flow near its mouth is about 3,700 m^3/second (see Appendix VII, Item 4.3.2).

The Teles Pires River is found in a plateau region, with very hard rocks along the entire river. Due to the high declivities and the geological composition of the region, few concentrations of sandbanks are seen along the river, mainly between Stretches 15 and 61. In the complementary stretches (1 to 14 and 61 to 100), the declivities are lower and the bed is predominantly sedimentary. The susceptibility to silting is considered low along the entire river.

The stretch of the Teles Pires waterway considerd in this study corresponds to the segment between its confluence with the Juruena River and the city of Sorriso (MT), with an extension of approximately 1,000 km.

The Teles-Pires River has low rates of sinuosity, with the more upstream stretches of the waterway being more critical (Stretches 87 to 100), where the declivities are lower than in the downstream stretches, and the river has meanders. In addition, the large number of rock outcroppings and river islands along the entire river makes the route more sinuous than expected. The minimum widths verified near the mouth are close to 700 m. and on the order of 80 m. in the upstream stretches (94 to 100). Narrowings are seen along the river.

In the lower Teles Pires (Stretches 1 to 14), the bed is predominantly sandy and there are less risks for navigation. The depths, however, are very reduced during dry spells, when numerous sandbanks appear in the river bed.

From this segment upstream (Stretches 15 to 100), the Teles Pires River has steep banks, with a rocky bottom and pronounced slopes. There are many stretches with rapids, especially the

Rasteira rapids (Stretches 18 and 19), which are found within the Cayabi indigenous reserve, and Sete Quedas (Stretch 33), where the São Manoel UHE will be built, making navigation impossible at these points. Between the areas with numerous rapids, there are occassional stretches that allow navigation, with minimum depths of 1.5 m., however, with considerable difficulty due to the large number of rocks along the river chute. The following figures show these obstacles.

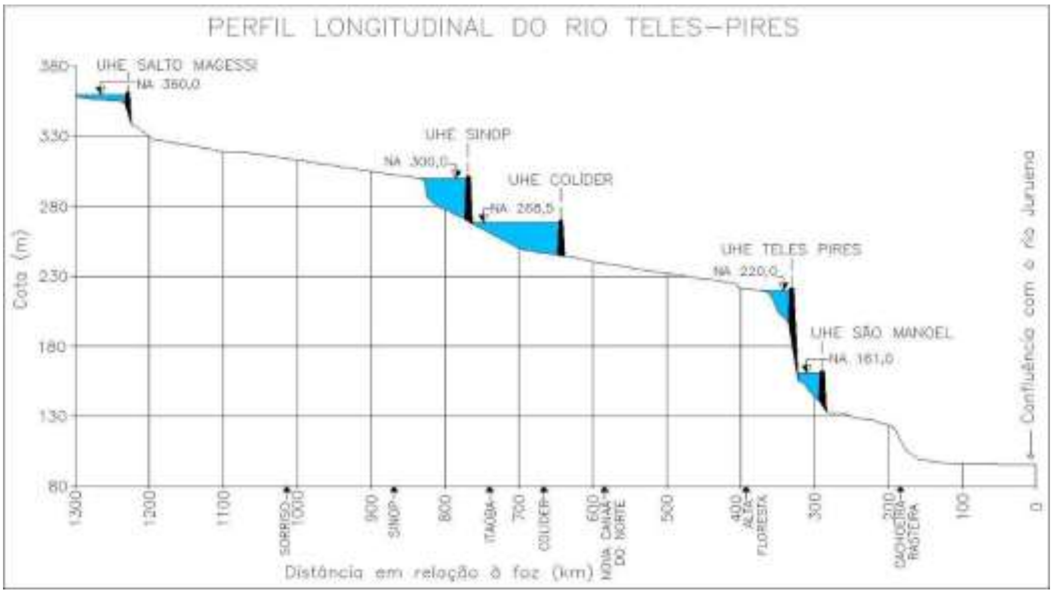
Figure 3.4.1: Sete Quedas Rapids, Stretch 33 (EPE, 2009)

Figure 3.4.2: Series of rapids on the Teles Pires River (EPE, 2009)

Figure 3.4.3: Rocky crossing (Stretch 73) (Panoramio, 2013)

The Teles Pires River currently has four bridges (Stretches 61,88, 89 and 95) and one footbridge (Stretch 62). These should be reformed or rebuilt to allow the passage of commercial convoys.

Due to the hydroelectric power potential existing along the Teles Pires River, it is being studied for construction of 5 hydroelectric power plants (the São Manoel, Teles Pires, Colider, Sinop and Maguessi UHEs), with close to 3.4 GW of installed power. The following figure presents the division of falls defined in the inventory studies of the Teles Pires River.



LONGITUNDINAL PROFILE OF THE TELES-PIRES RIVER
Elevation (m.)
Confluence with the Juruena River
Distance from the mouth (km.)

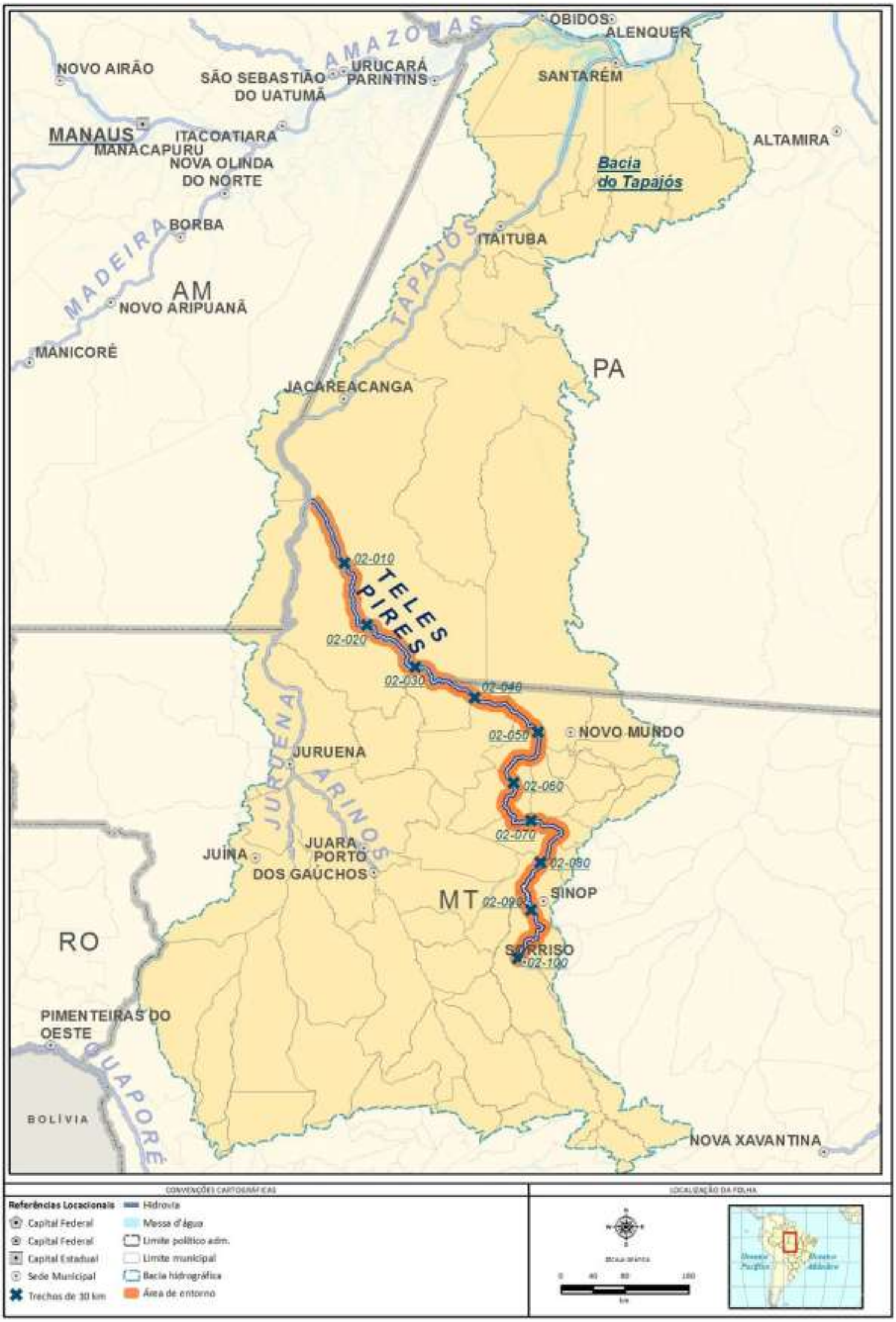
Figure 3.4.4: Division of falls of the Teles River

Construction of these UHEs, if they are equipped with locks, will make navigation feasible on some stretches of the Teles Pires. However, since the dams are located just downstream of the rapids and designed at water level, the reservoirs will be reduced, with small areas of flooding. Consequently, even with the damming, long stretches of free current will remain, both in the rocky and sandy terrain, with poor navigability conditions. Together with the high variation of flows over the hydrological year, these long stretches in free current, even with interventions such as dredging and rock excavation, will not be sufficient to offer secure navigation durin dry periods or when the plants are operating close to a steady flow.

b) Social and Environmental Vulnerabilities

The potential Teles-Pires Waterway crosses part of the states of Pará and Mato Grosso, within the limits of the Amazon biome. It travels through the territory of 15 municipalities, 14 in the state of Mato Grosso and one in the state of Pará (see figure below).

The total population is 359,246 inhabitants (IBGE, 2010), with the city of Sinop (MT) being the most populous with 31% of the total. The average FIRJAN index (2010) for the municipalities is 0.68, the highest value found is 0.85 in Sorriso (MT) and the lowest, 0.44 in Jacareacanga (PA).



Map 19: Teles-Pires Waterway location

For analysis of the vulnerability, with regard to conservation aspects, the area around the waterway was divided into 100 stretches of 10 km², in which the presence of 2 Integral Protection Conservation Units located in the initial Stretches 1 to 8 in the municipality of Apiacás (MT), near the confluence with the Juruena River, was identified, and in the central Stretches 43 and 44 between the municipalities of Novo Mundo and Alta Floresta, both in Mato Grosso.

Four Indigenous Lands are also located in the initial stretches of the waterway from Stretch 1 to Stretch 29 in the municipality of Jacareacanga (PA).

It should be emphasized that the area around the waterway has low rates of deforestation, according to the available mapping.

The distribution of the occurrences in relation to the variables analyzed can be better observed in the one-line diagram presented below.

CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante
BA - Baixa
ME - Média
AL - Alta
MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO TELES PIRES	MAI/2013

3.4.1.2 The Tapajós Waterway

a) Navigability Diagnosis

The Tapajós River is one of the main tributaries on the right bank of the Amazon. It is born at the confluence of the Juruena and Teles Pires Rivers, on the border of the states of Pará, Amazonas and Mato Grosso. It runs 810 km. to where it discharges into the right bank of the Amazon River in the municipality of Santarém (PA), close to 950 km. from Belém (PA) and 750 km. from Manaus.

The flood period takes place between January and May and the hydrological behavior is quite homogeneous along the course of the river, since there are no major tributaries along the river, with the exception of the Jamanxim River. The average flow of the Tapajós River is on the order of 9,000 m^3/s. (see Appendix VII, Item 4.3.1).

The Tapajós River is not very sinuous, with sinuosity rates that do not exceed 1.3. The most sinuous stretches are those located in the rapids area (Stretches 32 to 37). The river has average widths on the order of 10 km in the stretch between its mouth and the city of Aveiro (PA) (Stretches 1 to 17), and between 0.5 and 2 km. from this city to the confluence of the Juruena and Teles Pires Rivers. Due to the presence of rocky outcroppings, there may be stretches with important narrowing that were not perceived by this study.

The river is found in an area with little infrastructure and is accessed only by highways BR-230 and BR-163, which parallel the river.

The Tapajós River has low rates of sediment transport, making the waters crystalline and resulting in few sandbanks. The river is found in a geological area formed of very hard rocks of granite origin and the river bed has rocky and sedimentary characteristics. The main alluvial deposits are found in the stretches from the mouth to the proximity of Itaituba (Stretches 1 to 28).

The Tapajós Waterway is planned to cover the entire length of the river. According to the AHIMOR, the convoy-type adopted for the waterway has a length of 200 m., with 24 m. at the mouth. The minimum design draft is 1.50 m., increasing to 2.50 m. during the high-water period, representing a load capacity of 7,500 tons per convoy.

In summary, the Tapajós River does not have navigability conditions upstream of the São Luís do Tapajós rapids.

The main impediments to navigation consist of the São Luís do Tapajós rapids (Stretches 33 and 340 and the Chacorão rapids (Stretches 70 to 73), unpassable by commercial vessels, which condition three characterstic segments of the river.

The first segment, considered as the Lower Tapajós, corresponds to the stretch between Santarém (PA), in Stretch 1, and Itaituba (PA), Stretch 28. This stretch is navigable without major difficulty the entire year and has minimum depths of 2.5 m., an average declivity of 4 cm./km. and a large number of river islands. Even ocean-going vessels, with much greater drafts, can enter the stretch during high waters. The influence of the tide, recorded at the mouth of the Tapajós, causes an oscillation of approximately 0.40 m. However, at the peak of the low waters, the river may present some difficulties with regard to maintenance of greater drafts.

In the second segment between the São Luís do Tapajós and Chacorão rapids, close to 420 km. in length, the river has an average declivity of 15 cm./km. and contains many rocky outcroppings, low falls, and some sandbanks, which are unpassable by vessels. The minimum depth in this stretch reaches 1.5 m.

Figure 3.4.5: The São Luís do Tapajós rapids (Stretches 33 and 34) (Panoramio, 2013)

Figure 3.4.6: Rocky crossings in the Tapajós River (Stretch 34). (Amazônia é isso, 2013)

Figure 3.4.7: Beaches and sandbanks in the Tapajós River (Amazônia é isso, 2013)

Mining activities are seen in the river bed in this segment of the river. This activity may interfere with navigation conditions in stretches of the river and result in major difficulties.

The third stretch between the Chacorão rapids and the confluence of the Juruena and Teles Pires Rivers, close to 80 km. in length, has characteristics similar to the second stretch, with an average declivity of 15 cm./km. and various stone outcroppings, river islands and sandbanks that restrict navigation. No low falls or rapids of the magnitude found in the second stretch were found. The minimum depth is estimated at close to 1.5 m.

Due to the various rapids existing in the Tapajós River, it has hydroelectric power potential and will be the target of construction of 3 hydroelectric power plants (the São Luís do Tapajós, Jatobá and Chacorão UHEs), totaling close to 12 GW. These plants will flood many of the rapids and, if they have locks, allow navigation over extensive stretches of the Tapajós River. With the exception of the stretch between Jacareacanga (PA) and the Chacorão UHE dam, close to 80 km. in length, which will not be flooded and has important natural obstacles. The following figure shows the division of falls approved in the Tapajós Hydroelectic Inventory.

Rio	Aproveitamento		Níveis d'Água		Potência (MW)
			Montante	Jusante	
Tapajós	TPJ-325	São Luiz do Tapajós	50,0	14,1	6.133
	TPJ-445	Jatobá	66,0	50,0	2.338
	TPJ-685	Chacorão	96,0	70,4	3.336

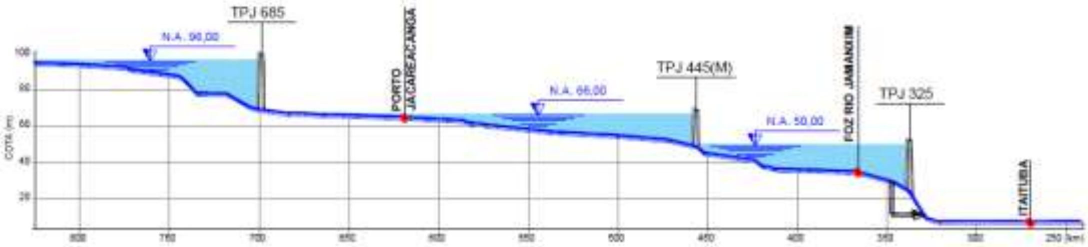


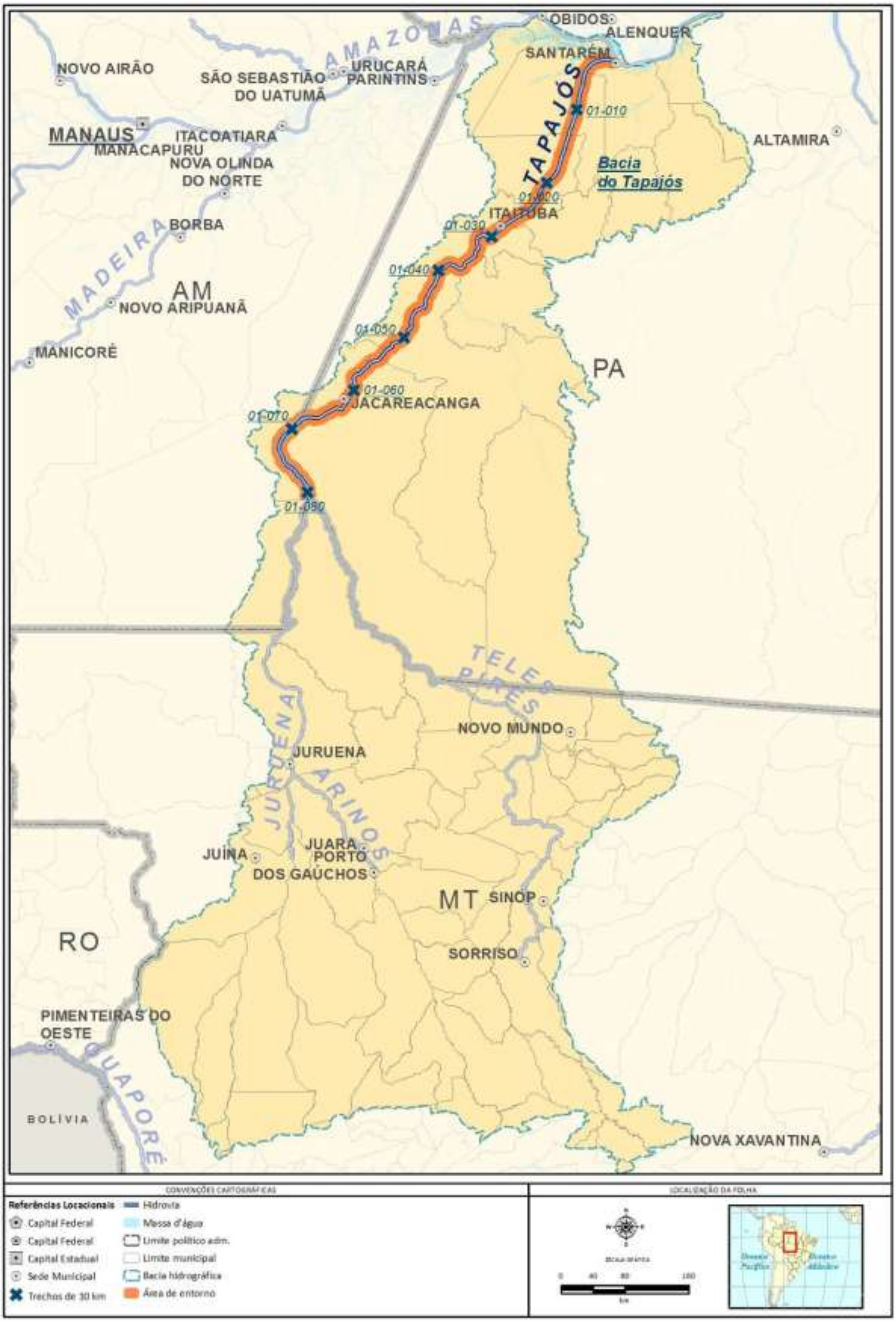
Figure 3.4.8: Division of falls of the Tapajós River (Araújo et al, 2013)

It should be emphasized that downstream of the São Luís do Tapajós UHE, there is a 20 km. stretch of rapids with a difference of 14.5 m., whose hydroelectric power potential will not be exploited. It may represent an impediment to navigation since it has a number of rock outcroppings and rapids that result in shallow depths, narrowing and high runoff speeds. The figure below shows this obstacle.

Figure 3.4.9: Rock outcroppings downstream of the future São Luís do Tapajós UHE (Stretches 32 and 33) (Amazônia é isso, 2013)

b) Social and Environmental Vulnerabilities

The future Tapajós Waterway crosses the states of Amazonas, Pará and Mato Grosso, within the limits of the Amazon biome. Ten municipalities are crossed by the waterway, with 2 in Amazonas, 7 in Pará and 1 in Mato Grosso. They have a total population of 574,115 inhabitants (IBGE, 2010) and the municipality of Santarém (PA) is the most populous, responsible for 51.31% of the total.



Map 20: Tapajós Waterway location

For the vulnerability analysis with respect to the conservation aspects, the area around the waterway was divided into 81 stretches of 10 km^2. Within the variables analyzed, the presence of Integral Protection Conservation Units between Stretches 32 and 42 in Itaituba (PA) and 75 to 81 in the municipality of Maués (AM) is worth highlighting. Indigenous Lands in Stretches 11 to 13, in the municipality of Belterra (PA), 28 in the municipality of Itaituba (PA), 62 to 64 and 69 to 81 covering the municipalities of Maués (AM) and Jacareacanga (PA) were also identified. In addition to these more restrictive occurrences, from the environmental point of view, there are Sustainable Use CUs in Stretches 5 to 19, between Santarém (PA) and Aveiro (PA), and in Stretches 33 to 60, between Itatuba (PA) and Jacareacanga (PA), on the banks of this waterway, as well as INCRA settlements along the entire waterway, except where the ILs and Integral Protection CUs are located.

The distribution of the occurrences in relation to the variables analyzed can be better observed in the one-line diagram presented below.

CONVENÇÕES CARTOGRÁFICAS

BIÓTICO

- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO

- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais

SOCIOCULTURAL

- N Largura do rio
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO TAPAJÓS	MAI/2013

3.4.1.3 The Juruena Waterway

a) Navigability Diagnosis

The Juruena River is one of the formers of the Tapajós River and part of the Amazon basin. Its source is located on the northern slopes of the Serra dos Parecis (MT) at altitudes close to 700 m. Its mouth is at the confluence with the Teles Pires River, near Barra de São Manoel (AM), forming the Tapajós River. The Juruena River basin passes through the states of Mato Grosso, Amazonas and Rondônia and is the natural border between these two later states for approximately 210 km. (Stretches 1 to 21).

The flood period takes place between December and May and the hydrological behavior is quite homogeneous along the river. The average flow is close to 3,000 m^3/second (see Appendix VII, Item 4.3.3). Among its tributaries, the Arinos River stands out. It has water contributions greater than those of the Juruena River itself.

The Juruena River is found in a plateau region, with very hard rocks along the entire river. In the more downstream stretches (Stretches 1 to 10), the river continues through predominantly sedimentary terrain. Upstream from this segment are many rock formations, such that the river bed has both sedimentary and rocky characteristics. Due to the high declivities and the geological composition of the bed and river banks, only a few, disperse concentrations of sandbanks are found. Susceptibility to silting is considered low along the river.

The Juruena Waterway consists of the stretch from its mouth at the confluence with the Teles Pires River and the locality of Fontanilla (MT), close to 580 km. in length.

The current physical conditions of the Juruena River make commercial navigation unfeasible.

The main impediments to commercial navigation consist of low falls and rapids that are frequent along the entire Juruena River, with greater intensity from Stretch 10 upstream. The following figures illustrate some of these obstacles.

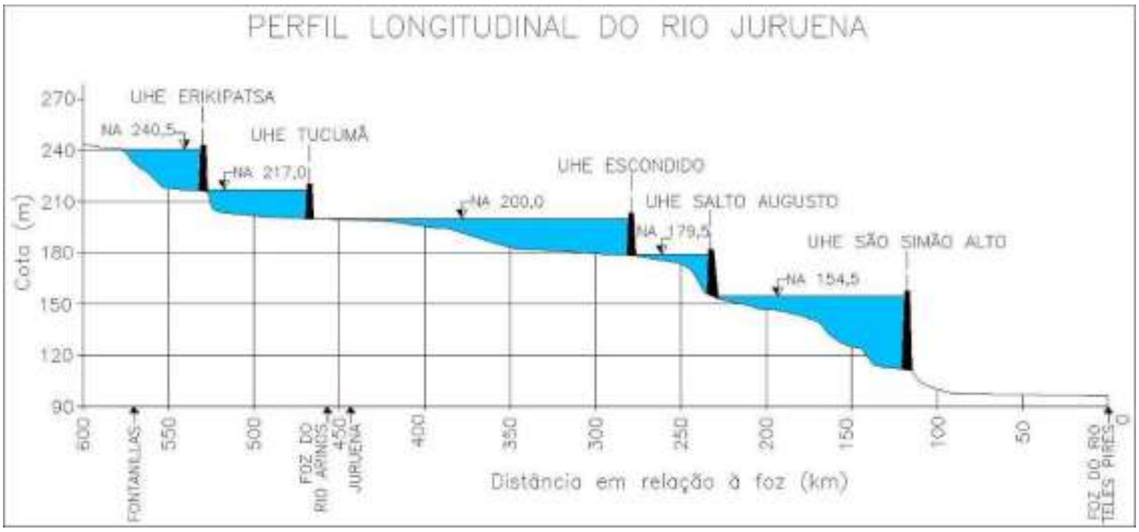
Figure 3.4.10: São Simão Falls (Stretch 12) (Panoramio, 2013)

Figure 3.4.11: Augusto Low Falls (Stretch 24) Source: (Panoramio, 2013)

The river has low rates of sinuosity, with the more upstream stretches of the waterway being more critical and where the widths are also smaller. The large number of rock outcroppings can make the route more sinuous than expected. The minimum widths verified near the mouth are close to 800 m. and on the order of 50 m. in the upstream stretches. Narrowing is seen along the river.

There are currently no bridges or other infrastructure built along the Juruena River in the stretch under study.

Due to the hydroelectric power potential existing along the Juruena River, it is being studied for construction of five hydroelectric power plants (the São Simão Alto, Salto Augusto, Escondido, Tucumã and Erikipatsa UHEs). These will be built in the areas of rapids and low falls existing along the river. The following figure shows the participation of falls approved for the Juruena River.



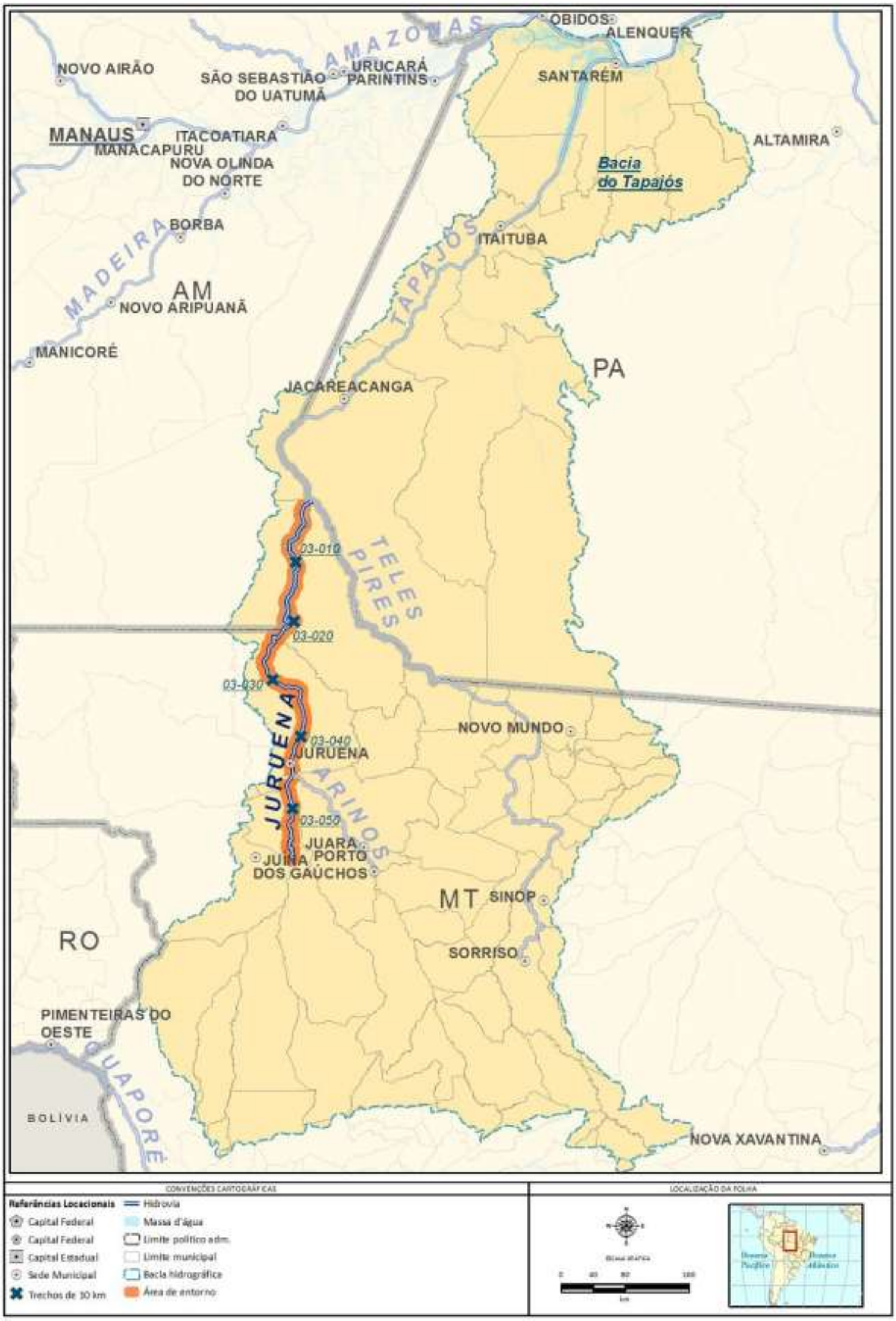
LONGITUNDINAL PROFILE OF THE JURUENA RIVER
Elevation (m.)
Distance from the mouth (km.)

Figure 3.4.12: Longitudinal profile of the Juruena River

Construction of these UHEs, if they are equipped with locks, will make navigation feasible on long stretches of the Juruena River, however, even with construction of these UHEs, there will be non-flooded stretches with possible natural obstacles and impediments to navigation. The most critical stretch corresponds to the segment between the end of the Chacorão UHE backwaters, on the Tapajós River, and the São Simão Alto dam (Stretch 12), on the Juruena River, totaling close to 180 km., with a 15 m. difference in level. It has impediments to navigation like rock outcroppings and rocky crossings, in addition to low falls.

b) Social and Environmental Vulnerabilities

The future Juruena Waterway crosses the territory of 10 municipalities, 2 in the state of Amazonas and 8 in the state of Mato Grosso, between the Amazon and Cerrado biomes.



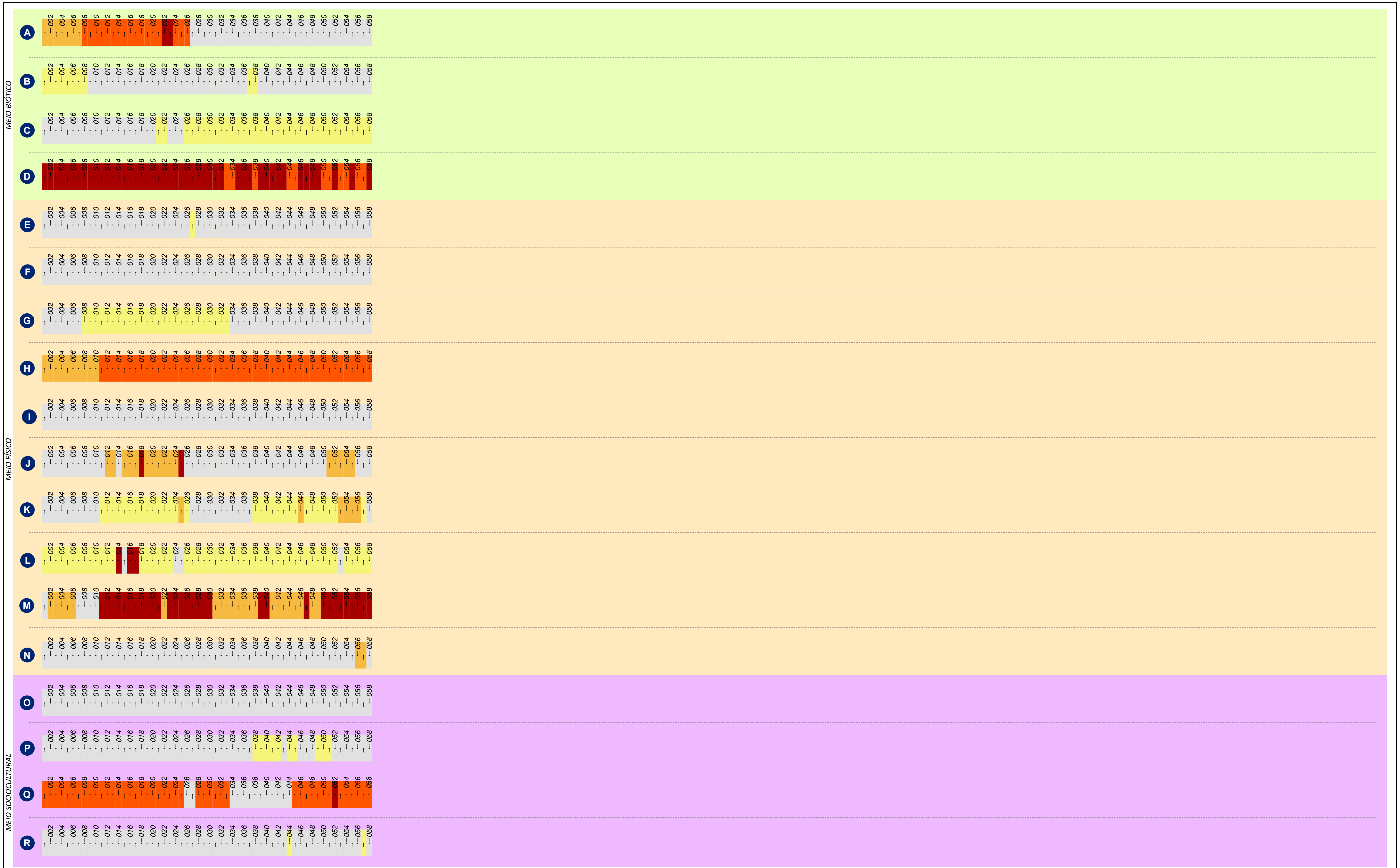
Map 21: Juruena Waterway location

Consórcio ARCADIS logos

The total population of these municipalities is 212,271 inhabitants (IBGE, 2010) and the average FIRJAN index (2010) is 0.64.

The area under study of this waterway is composed of 58 stretches of 10 km². The surroundings of the chute have low deforestation rates in which Integral Protection Conservation Units are found between Stretches 1 to 24, in the municipalities of Apuí (AM) and Jacareacanga (PA), which also have Indigenous Lands. These are also present in Stretches 28 to 32 in Cotriguaçu (MT) and in Stretches 45 to 58, covering the Mato Grosso municipalities of Juruena, Castanheira, Juara, Brasnorte and Juína. The waterway is most fragile from the environmental point of view of this WS, because the licensing processes for navigation support works tend to be more complex and time-consuming.

The distribution of the occurrences in relation to the variables analyzed can be better observed in the one-line diagram presented below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais

SOCIOCULTURAL
- N Largura do rio
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO JURUENA	MAI/2013

3.4.1.4 The Arinos Waterway

a) Navigability Diagnosis

The Arinos River is the main tributary of the Juruena River and is located in the state of Mato Grosso. Its source is in the tableland of the foothilss of the Serra Azul, to the North of Cuiabá (MT). It runs close to 760 km. until it runs into the Juruena River, still within Mato Grosso territory, close to the city of Juruena (MT).

The flood period is typical of the Juruena River basin, occurring from December to May. The average flow is close to 1,500 m^3/second (see Appendix VII, Item 4.3.4).

The Arinos Waterway considered in this study corresponds to the stretch from its mouth to the city of Porto dos Gaúchos (MT), with a length of approximately 220 km.

This river has poor navigability conditions for commercial vessels, with navigation mainly by small fishing vessels.

The Arinos River has average sinuosity rates of close to 1.3, which are constant along the course of the river. The minimum widths are constant, on the order of 150 m. The average declivity is close to 20 cm./km., but with low falls and flatter stretches. The bed formation is predominantly rocky and susceptibility to silting is considered average.

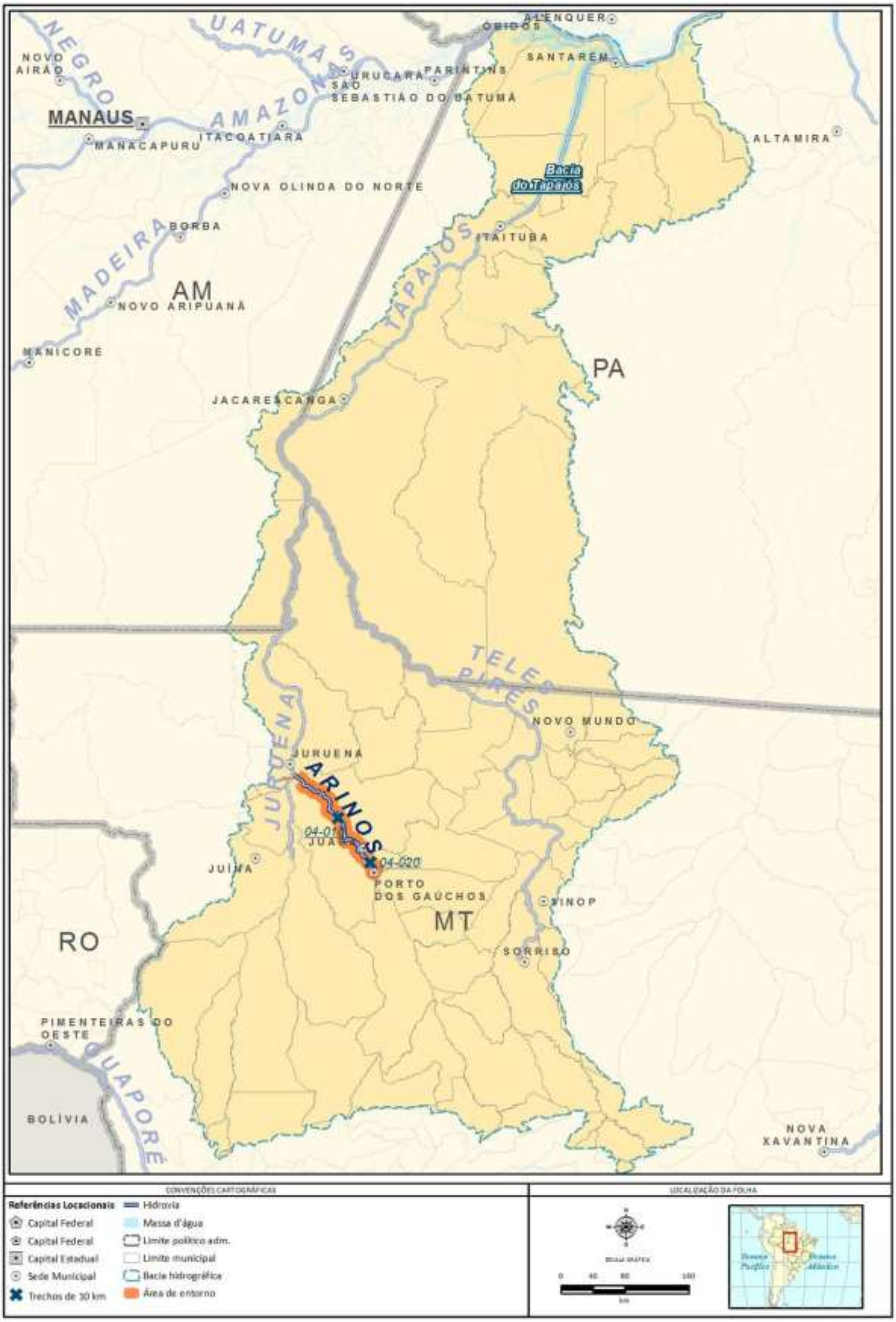
The Arinos River has a number of low falls and rapids that impede commercial navigation in many stretches of the river. They can even make the route narrower and more sinuous than expected. The minimum depth is very variable as a function of the existing obstacles and is estimated at close to 1.5 m., and may be less in stretches of low falls and rapids.

There are two bridges, in Stretches 18 and 22, that will make interventions necessary to allow the passage of commercial vessels.

In addition, the feasibility of this waterway is linked to the navigation conditions of the Juruena River.

b) Social and Environmental Vulnerabilities

The Arinos Waterway crosses 4 municipalities in the state of Mato Grosso, within the limits of the Amazon biome.

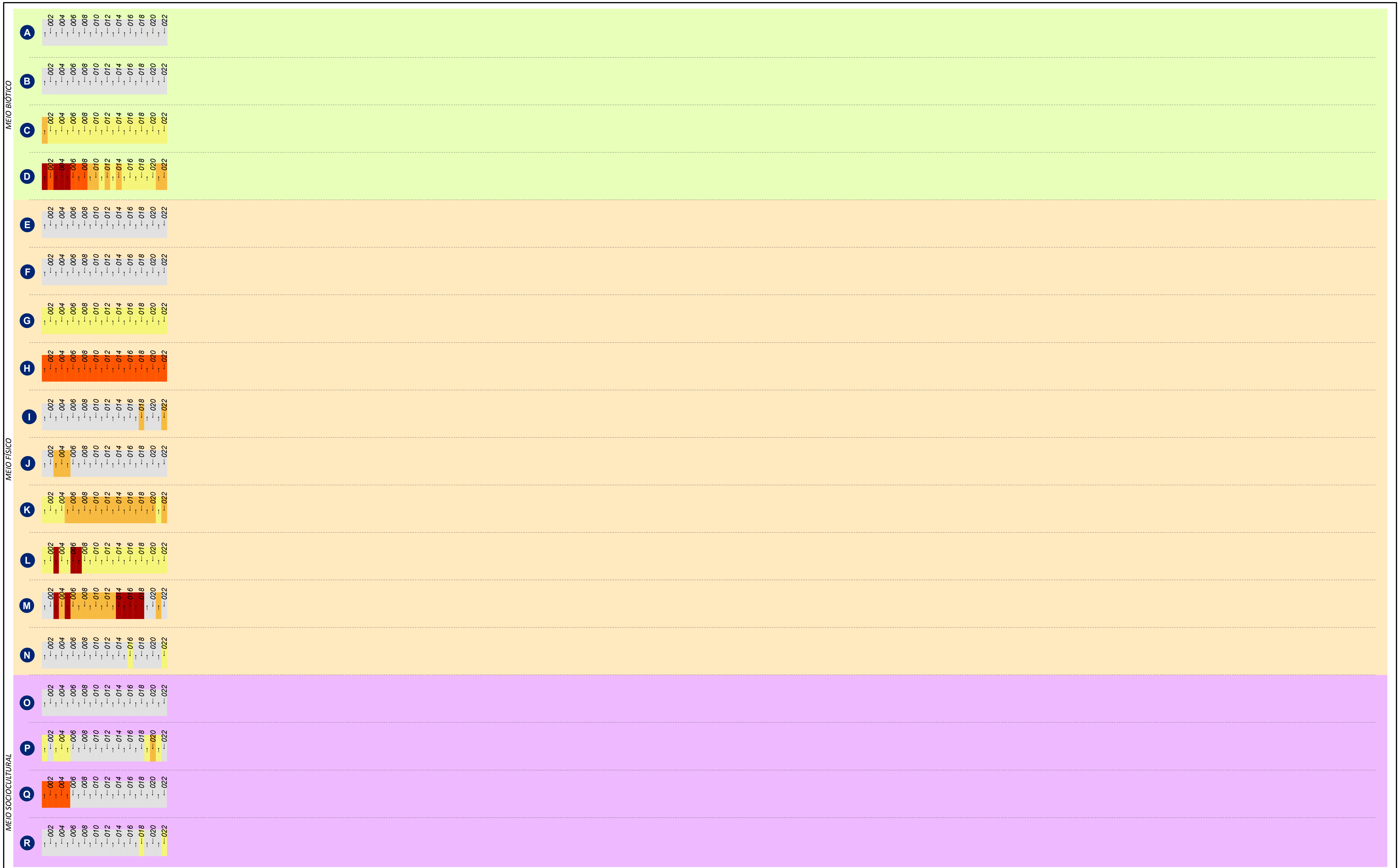


Map 22: Arinos Waterway location

The total population of these municipalities is 53,632 inhabitants (IBGE, 2010) and the FIRJAN index (2010) is 0.67, similar to the average for the basin.

The study area of this waterway is composed of 22 stretches of 10 km² in which the main environmental restriction is the occurrence of indigenous lands between Stretches 1 and 5, in the municipality of Juara (MT) (right bank). There are also Biodiversity Conservation Priority Areas of extreme and very high priority along the entire study area of the waterway, occurring in Stretches 1 to 5 only on the left bank. It is worth highlighting the fact that areas of well preserved plant cover are found in all the selected study area, with the most evident forested areas between Stretches 15 to 21 in which the plant cover is greater than 73%.

The distribution of the occurrences in relation to the variables analyzed can be better observed in the one-line diagram presented below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO ARINOS	MAI/2013

3.4.2 Economic Aspects

3.4.2.1 Current inland waterways transport

In 2011 the Tapajós waterway is not used intensively for inland water transport. Only 9.393 tons of petroleum coke has been transported from Barcarena to Itaituba. This seems to be the only flow of inland waterway transport on the Tapajós.

3.4.2.2 Planned developments

Infrastructure

The infrastructure network in the Amazon region is not widely developed. Next to the main waterways Amazon, Tapajós and Madeira there are a few highways in the region. Public railways do not exist yet.

The Tapajós waterway is currently navigable for 343 kilometers. However the Ministry of Transport has guaranteed an investment for building 4 new locks, thus making navigation feasible along 1,043km of river way, including Rio Teles Pires. Also a new port (Cachoeira Rasteira, MT), will be opened in Apiacás. This port is envisaged to be mainly used for the shipment of soy.

Economic developments

Mato Grosso is the most important state for potential transport on the Tapajós River. The two most important commodities originating from Mato Grosso for the Tapajós River are soy and corn. The exports from Mato Grosso of these commodities will almost double between 2011 and 2031. This is potential cargo for Tapajós River as well as Madeira River. Another factor that will enhance this potential river transport is the so-called shift to the Northern ports: a shift from southeast ports (Vitoria, Santos, and Paranagua) to northern ports is expected. In 2015 and other forecasted years 50% of exports from Mato Grosso is expected to use the Northern ports. According to these forecasts 25% will go to Manaus and Santarém.

3.4.2.3 Future inland waterways transport

From the analyses in the chapters before it becomes clear that the potentially most important commodity groups for inland shipping on the Tapajós River are: soy, soymeal and corn (exports) and fertilizers (imports).

Currently the Madeira River (Porto Velho – Santarém) is used for the transport of soy and corn to Santarém. However if planned improvements for the navigability of the Tapajos are completed, the Tapajós river can also play a role in the exports of soy and corn from Mato Grosso.

Table 3.4.1: Overview waterway potential Tapajós (in 1.000 tons)

	2011	2015	2023	2031
Soy	1.500	2.771	3.590	4.403
Soy meal	419	1.204	1.473	1.740
Corn	713	1.439	1.834	2.156
Fertilizers	-	649	769	823
Total	**2.632**	**6.063**	**7.666**	**9.122**

The total potential for the Tapajós is 9.1 million tons in 2031. 8.3 million tons downstream from ports in Mato Grosso to Santarém and 0.8 million tons from Santarém to Mato Grosso.

It should be noted that this is roughly the *same potential* as calculated for the Madeira River. Additional research in the next phase of the PHE project will have to conclude what the amounts and relative shares of cargo will be on Tapajós and Madeira River.

3.4.3 The Transport System

3.4.3.1 Transported Cargo

The cargo shipped through the Tapajós waterway system is presented in Chapter 3.4.2. Currently, it is limited to a specific volume of raw petroleum coke between Barcarena and Itaituba. However, the cargo potential of this system in 2031 will consist of that related to agricultural production in Mato Grosso. The export (agricultural products) and import (fertilizers) volumes are presented in the table below.

Table 3.4.2: Cargo Shipped Through the Tapajós Waterway System, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011) (2011 Cargo Transport on Brazilian Waterways)

Cargo	2011	2031
Soybeans	0	4,403
Soy meal	0	1,740
Corn	0	2,156
Fertilizers	0	823
Total	**0**	**9,122**

3.4.3.2 Infrastructure

This item describes the existing infrastructure of the Tapajós waterway system, which, as mentioned in Chapter 3.4.1, includes the Árinos, Juruena, Tapajós and Teles-Pires Rivers.

a) Waterway/River infrastructure

The physical characteristics of the Tapajós waterway complex, as well as the existing and planned dams, were already mentioned in Chapter 3.4.1. Consequently, only the existing ports/terminals and federal highways relevant to the region will be described.

Ports/Terminals

For the analysis of the Tapajós Waterway System terminals, the database resulting from the PNIH was utilized, and the information collected during the interviews and from recent reports was added. 11 terminals are listed in this base, 3 of which do not have information as to their status and 3 are operative. The number of terminals per status can be seen in the table below.

Table 3.4.3: Status of the Ports of the Tapajós Waterway System (Source: Developed based on the PNIH database, 2013)

Status	Quantity	Percentage
Operating	3	27%
Planned	5	45%
No information	3	27%
Total	**11**	**100%**

The analysis of the current status was made based on the data of the terminals classified as “Operative”; the remaining terminals were not considered.

The table below provides a list of the operating ports/terminals in the region, as well as the rivers on which they are located and the land connections.

Table 3.4.4: List of Operating Ports/Terminals

Port/Terminal	Type	Location	Land Connections
Itaituba	Public Port	Tapajós River	BR-230
Santarém	Organized Port	Tapajós River	BR-163 and BR-230

Santarém

The Port of Santarém is an organized port, under the administration of Companhia Docas do Pará (CDP), whose polygonal was defined by Decree 5.229 of October 5, 2004. This port's vocation is export of both solid bulk and general and containerized cargo, particularly wood. This port has a wharf exclusively for river operations.

The Tapajós River forms a natural access channel from its mouth on the Amazon River to the port, a distance of 3.1 km. The channel’s depth is 15 m. and its width is 1.8 km.

Within this port are: a liquid bulk terminal that has two platforms, one operated by Sociedade Fogás (butane gas) and the other by Equador and Petróleo Sabba (other fuels); a solid bulk terminal leased to Cargill, primarily for shipment of soybeans and corn; and a ro-ro terminal.

The port handled more than 1.1 million tons in 2011, with soybeans the primary product, as can be seen in the following tables.

Table 3.4.5: Inland Waterway Transport Destined for Santarém by Origin, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011) (2011 Cargo Transport on Brazilian Waterways)

	2011
Porto Velho	623
Manaus	436
Belém	81
Total	**1,140**

Table 3.4.6: Inland Waterway Transport Destined for Santarém by Cargo, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011) (2011 Cargo Transport on Brazilian Waterways)

Cargo	2011
Soybeans	715
Corn	153
Oil products	153
Ro-Ro	94
General cargo	23
Other commodities	1
Total	**1,140**

Itaituba

The port area of Itaituba is located 250 kilometers downstream of Santarém on the Tapajós River. This is the only navigable stretch of the river.

The Port of Itaituba is managed by Companhia Docas do Pará (CDP), located in the Miritituba (PA) region. This port is designed to operate only barges/ferries and small vessels.

In 2011, only 50,000 tons were transported, cement between Itaituba and Porto Velho and petroleum coke between Itaituba and the Port of Vila do Conde.

Table 3.4.7: Inland Waterway Transport of Cargo in the Tapajós Waterway System, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011) (Cargo Transporto in Brazilian Waterways)

Commodity	Origin	Destination	2011
Cement	Itaituba	Porto Velho	41
Raw petcoke	Barcarena	Itaituba	9

Highways

The highways that were considered complementary/competing are presented below.

BR-230 (Transamazon)

The highway has a stretch that cuts BR-174, paralleling the Tapajós River, crossing it at the city of Itaituba (PA), until reaching BR-163, which connects the highway to the city of Santarém (PA). It would be a competing route to the Tapajós River for transport of cargo and passengers, but the majority of its extension is unpaved, making vehicle traffic impossible. More details on this highway are available in Chapter 3.3, referring to the Madeira waterway system.

BR-163

BR-163 is a Brazilian longitudinal highway, 3,467 km. in length, with almost 1,000 km. unpaved, connecting Tenente Portela (RS) to Santarém (PA). It is paved to the city of Guarantã do Norte, in Mato Grosso, 728 km. from the state capital Cuiabá, in the extreme North of the state. From there, in the direction of Santarém (PA), there are 1,010 km. of unpaved road.

The road crosses one of the regions of the country richest in natural resources and economic potential, marked by the presence of important Brazilian biomes, such as the Amazon Forest and the Cerrado and the transition areas between them, as well as important hydrographic basins, such as the Amazon, Xingu and Teles Pires-Tapajós. It is of fundamental importance for the outflow of production from the Pará part of Brazil's northern region and the North of the Central-West region of Brazil.

When the stretch that connects the North of Mato Grosso to the city of Santarém (PA) is paved, it will serve as a transport alternative for shipping production from the state of Mato Grosso, mainly by connecting with the municipality of Itaituba, where various terminals are planned to handle bulk agricultural products and fertilizers that will be transported on the Tapajós Waterway. However, the route in at an initial stage of construction, without a forecast completion date. There is a stretch of BR-163 that runs parallel to BR-320 where paving has not begun. Due to the precariousness of the route, it is only drivable during the dry season.

3.4.3.3 Characteristics of the Existing Fleet and the Operating Companies

The information related to the navigation companies operating in this waterway system were obtained from interviews and secondary sources.

The ANTAQ database referring to the fleet is unavailable for the Amazon river region as a whole and there is only a division by river for crossing navigation. There is no differentiation for longitudinal navigation, consequently, data obtained from interviews was used.

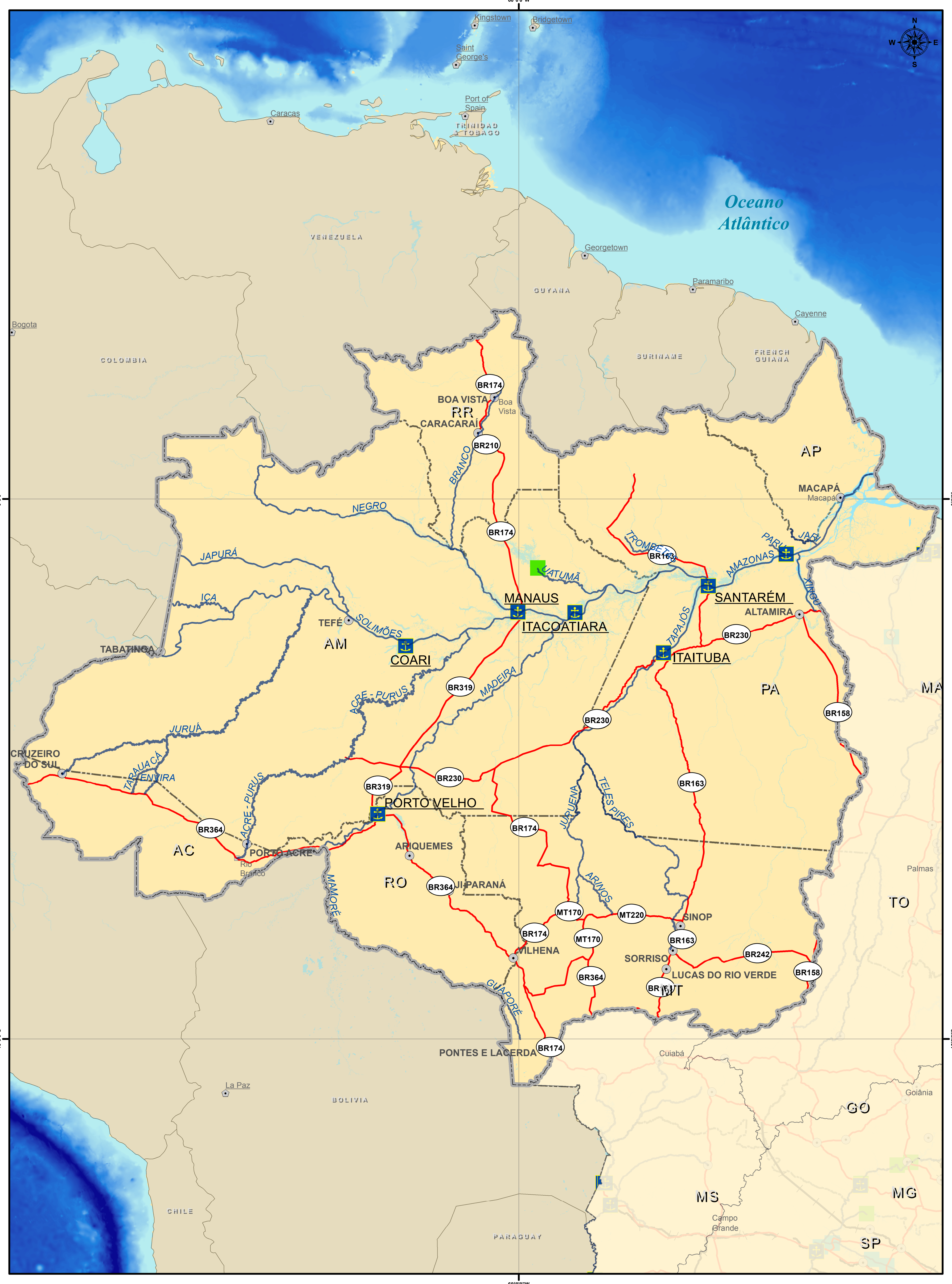
Only Rodonave Navegações LTDA makes the crossing of the Tapajós River between Itaituba and Miritituba, at highway BR-230.

Because the waterway system encompasses the Port of Santarém, it receives cargo from other systems, such as the Madeira and Amazon. In this way, some of the navigation companies that transport on them, also use the Tapajós system. Those identified are found in the table below.

Table 3.4.8: Navigation Companies – Tapajós Waterway System (Source: Prepared based on the ANTAQ Statistical Yearbook, 2011)

Navigation Company	Third PartyTransport	Number of Barges	Static Capacity (tons)	Number of Pusher Tugboats	Average age (years)
Transportes Bertolini	Yes	89	186,082	46	10,9
Paes Carvalho	Yes	NA	NA	NA	N/D
J. F. Oliveira Navegação	Yes	33	51,548	39	15

The Paes Carvalho convoy for the route used in this system (Miritituba (PA) – Port of Vila do Conde (PA)) varies from 4 to 6 barges, with 2,500 tons of capacity and a 3.5 m. draft, however the convoy formation was not made available.



CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais

Barragem existentes

- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes

- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 80 160 320 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

Oceano Atlântico

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO AMAZONAS

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:11.000.000	- BRASIL -	JUL/2013

3.4.3.4 River Information Management System

As addressed in Chapter 3.4.4, the Tapajós waterway system is administered by two entities, the AHIMOR and the Diretoria de Transportes Hidroviários (Waterway Transport Directorate), which are responsible, among other activities, for maintenance and monitoring of the waterway, such as signaling and dredging.

The Tapajós Waterway System is under the jurisdiction of the Capitania dos Portos da Amazônia Oriental (Port Capitaincy of the Eastern Amazon). There is a Diretoria de Hidrografia e Navegação (DHN) (Hydrography and Navigation Directorate) of the Brazilian Navy for the stretch of the Tapajós River currently navigable, however it is not electronic. The Navy is responsible for informing navigators about this system and also for ensuring safe navigation by inspecting both the waterway and vessels.

3.4.3.5 Intermodal Competition

Based on the results presented in Chapter 3.4.2, it can be concluded that the competitive cargos for the Tapajós waterway system are those related to Mato Grosso agricultural production. Based on the information obtained during the interviews with stakeholders and from the regional production data, it is assumed that Cachoeira Rasteira is a potential location for installation of a waterway terminal. This hypothesis will be tested and optimized in the next phase of the study.

There are two alternatives for cargo logistics along the Tapajós waterway system: use of highway transport from the producing microregions to the area of Cachoeira Rasteira, with subsequent shipment of the cargo on convoys to the Port of Santarém, or highway transport directly to Santarém.

For each significant microregion (production greater than 400,000 tons of soybeans per year or which contains at least one municipality that produces more than 100,000 tons per year), the transport distances were calculated for each alternative. Based on these distances, the total transport cost was calculated using the cost calculation model (see Chapter 1.3.4). The results are presented in the table below that also indicates the relationship between the multimodal and direct highway transport costs.

Table 3.4.9: Transport Cost from the Mato Grosso Microregions to Santarém (R$/ton).

Microregion	Santarém	Santarém	Santarém
	Multimodal	*Highway*	*Multimodal/highway*
Brasnorte	147	297	49%
Alto Garças	261	359	73%
Bom Jesus do Araguaia	193	277	69%
Gaúcha do Norte	236	334	71%
General Carneiro	276	361	76%
Itiquira	260	359	73%
Nova Maringá	181	299	61%
Primavera do Leste	228	326	70%
Querência	215	300	72%
Sapezal	166	326	51%
Sorriso	150	249	60%
Tangará da Serra	200	316	63%
Vera	148	247	60%

The multimodal alternative has the lowest cost considering the significant microregions as the origin. Its cost is on average 62% of that for the corresponding direct highway transport. The competitiveness of the multimodal alternative can be characterized as “good."

3.4.4 Governance and institutions

The Teles Pires–Juruena–Tapajós Waterway System, when operational, will connect the North of Mato Grosso to Santarém, in Pará. This corridor is of great importance in facilitating the outflow of grains, reducing the freight cost and making the Brazilian product more competitive in the foreign market.

Seeing this competitive advantage, one of the main promoters of implementation of the system is the Movimento Pró-Logística (Pro-Logistics Movement), formed mainly by Mato Grosso soybean producers. In 2010, the Movimento Pró-Logística requested a feasibility study for the waterway, asking that the document include the stretch between Cachoeira Rasteira and Sinop, in the North of Mato Grosso, as a means of expanding the waterway network.

To make this waterway system feasible and, subsequently, continued navigation on this waterway, various bodies, both federal and state, must be contacted, each with its responsibility and competence with regard to waterways. It is worth stressing that such responsibilities reflect the content anticipated by the legal text that defines them, not portraying, in some cases, their real work. To facilitate visualization of these agents and their area of operation, the figure below was prepared.

Table 3.4.10: Formal Attribution Matrix of Teles Pires – Juruena – Tapajós Waterway Agents

	Port administration	Inspection	Waterway maintenance*	Licensing Process	Regulation
Waterway Administration (WA) - AHIMOR					
Companhia Docas – Pará-CDP					
Capitania dos Portos da Amazônia Oriental					
Diretoria de Transportes Hidroviários do Pará - DTH					
Companhia de Portos e Hidrovias do Pará – CPH					
Environmental Secretariat					
DNIT/DAQ					
ANTAQ					
IBAMA					
Other Agents**					

*Dredging, rock excavation and signaling.
**This block includes all agents consulted by IBAMA in the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN and the Public Prosecutor's Office).
Source: Consórcio Arcadis Logos, 2012

The formal responsibilities of each of the agents are described in Annex I. The way these institutions Interact will be described below.

Since this is a waterway that crosses more than one state (Pará and Mato Grosso), the technical, economic and environmental feasibility study is conducted by the Administração Hidroviária da Amazônia Oriental (AHIMOR) (Annex I). The administration's responsibility is to conduct waterway feasibility studies and execute and monitor works, services and exploitation of inland navigable waterways, as well as river and lake ports assigned to it by the Ministry of Transportation, present in its area of operation.

At the state level, there is the Diretoria de Transportes Hidroviários (DTH) connected to the Secretaria de Transportes do Estado do Pará (Pará State Transportation Secretariat) (Annex I), with the main focus of determining waterway policy for the state for movement of both passengers and cargo. For this, it prepares, schedules and plans studies and projects; executes, directly or indirectly, the administration of ports, quays, ramps, shoulder piers, passenger terminals and port warehouses; undertakes engineering, clearance and signaling works to improve navigable waterways, as well as monitors the relevant actions of the federal and municipal governments, including those related to other uses of the water course, which are not navigational.

To supervise the port and waterway activities of this region, there is the Capitania dos Portos da Amazônia Oriental (CPAOR) (Annex I), a body tied to the Navy (Annex I), for the purpose of contributing, following the guidelines of the Merchant Marine itself, to the guidance, coordination and control of activities with regard to navigational safety, national defense, the safeguarding of human life and the prevention of water pollution. Given this, it should inspect the conditions of the vessels both in the ports and on the waterway itself, to see that the signaling rules are being obeyed, and if they are not, to demand compliance, as well as to inspect the pilotage services (when the pilot, a professional certified by the Brazilian Navy, embarks in a ship to pilot it in difficult areas).

The main ports in the region are under the responsibility of Companhia Docas do Pará (CDP) (Annex I), which, in addition to the marine ports assigned to it, also administers the river ports of Santarém, Vila do Conde, Altamira, Itaituba, Óbidos and Marabá. The CDP is responsible for use and administration of these ports, also collecting fees and registering loading and unloading and their respective volumes and charging for storage and use of land and waterway infrastructure.

In an attempt to make Companhia Docas do Pará a state enterprise, Companhia de Portos e Hidrovias do Pará (CPH) (Pará Port and Waterway Company) (Annex I), a state-run company under private law, connected to the Secretaria de Integração Regional (Secretariat for Regional Integration) of the state of Pará, was created in 2000, for the purpose of assuming the responsibilities of Companhia Docas. However, this effort to make it a state enterprise did not succeed, leaving Companhia de Portos e Hidrovias vacant until its recent restructuring. Its current responsibility is to manage the small-scale ports, as well as the navigable waterways throughout Pará territory, favoring the flow of goods.

In addition to the flow of goods, the Pará region also has a large movement of intermunicipal passengers. This movement is supervised by ARCOM-PA (Annex I), more specifically by the Grupo Técnico Hidroviário (GTH) (Waterway Technical Group) that, in addition to supervising, calculates fees and registers companies and vessels.

To make interventions in the environment, it is necessary to obtain an environmental license, which may require a simple study like a RCA/PCA (Environmental Control Report accompanied by an Environmental Control Plan) or something more complex like an EIA-RIMA (Environmental Impact Studies accompanied by na Environmental Impact Report), depending on the type of enterprise and the intensity of the impacts this may cause. This guidance is given by IBAMA (Annex I) when it affects more than one state, or by the State Environmental Secretariats, when the object to be licensed affects only the territory of a single state.

IBAMA should contact the environmental secretariat of each state so that they can technically declare compliance of the enterprise with their respective plans and norms. Occassional interventions, for example, construction of a quay or a storage terminal, among others, can be licensed at the state level by the agencies responsible for licensing (environmental secretariat), informing IBAMA of the opening and closing of the process and sending it all the documentation related to the licensing.

One of the main obstacles to creation of this waterway system is the plan to construct numerous hydroelectric power plants in its course. Construction of these plants could inhibit navigation on the waterway, either permanently, if locks are not planned, or temporarily, if locks are planned, interrupting navigation in the stretch from the start to the end of the work.

The institution at the federal level that implements and coordinates shared and integrated management of water resources and regulates access to water is the Agencia Nacional de Aguas (ANA) (National Water Agency).

The Comitês de Bacias Hidrográficas (CBHs) (Hydrographic Basin Committees) (Annex I) have a more local focus in managing water use. They are collegiated bodies composed of water users and interested parties; civil society or the government; and federal and state entities active in the region with regard to water resources. According to research, Pará still does not have a basin committee and 5 committees are in the process of being created in Mato Grosso. However, presently only the committees of Ribeirões Sapé and Várzea Grande officially exist.

3.4.5 The Tapajós Waterway System SWOT

Strengths	Weaknesses
• The Teles Pires-Tapajós WS has a strategic location as a connection between Mato Grosso and the Amazon River, being one of the shortest options connecting with marine ports. • The Rivers of the WS (the Tapajós, Juruena, Teles Pires and Arinos) have low sinuosity and medium-low sedimentation levels. • The Tapajós River is navigable from its mouth to Itaituba (close to 280 km.), with good navigation conditions. • There is already inland waterway transport along part of the Tapajós River (the Santarém - Itaituba stretch). • The soybean multimodal transport cost - from the producing regions (MT and GO) to the port of exportation, in general, corresponds to 65% of the cost of direct highway transport. Consequently, waterway transport is quite competitive. • In light of the transport cost for cargos coming from Mato Grosso, the Tapajós River is economically more interesting than the Madeira River. • The Teles Pires River has fewer social and environmental vulnerabilities than the Juruena River and may be the better alternative for reaching the Tapajós River.	• The soil in the region of the Tapajós WS is rocky (very hard granite) along its entire extension. • The Tapajós River does not currently offer adequate conditions for navigation. Upstream of São Luís do Tapajós there are rapids with stone outcroppings and sandbanks. • In the Teles Pires and Juruena Rivers there are many rapids, stone outcroppings and sandbanks that currently impede commercial navigation. These rivers are also considerably narrow for this purpose. • There is a lack of support infrastructure for river navigation (roads, terminals). Even BR-230, which runs parallel to the Tapajós River, is in a precarious state of repair. • AHIMOC faces operational difficulties, imposed by lack of access to financial and human resources (due to an agreement signed between the the DNIT/DAQ and CODOMAR). • Interventions in this region need to consider the significant occurrence of indigenous communities (around the length of the Juruena River, but also around the Tapajós River near Jacareacanga (PA), and along the Teles Pires River between Jacareacanga (PA) and Paranita (MT)), as well as of Integral Protection Conservation Units (in all the area along the Juruena River from Jacareacanga (PA) to Cotriguaçu (MT) and also in the area near the Tapajós and Teles Pires Rivers).

Opportunities	Threats
• Cargo potential in 2031: – Soybeans → 4.4 million tons – Soy meal → 1.7 million tons – Corn → 2.2 million tons – Fertilizers → 0.8 million tons • The Movimento Pró-Logística is interested in developing the waterway system to improve the logistics chain of the region. • Intensified use of the waterway for transport purposes could help reduce illegal mining activities along the rivers of the WS and its banks. • The three hydroelectric power plants that are planned for construction (São Luís do Tapajós, Jatobá and Chacorão) will allow navigation along the Tapajós River if locks are also constructed. • The Five hydroelectric power plants that are planned for construction (Teles Pires, São Manoel, Colider, Sinop and Salto Magessi) will allow navigation along the Teles Pires River if locks are constructed. • The downstream area of the Tapajós River has local tourism under development, which should be taken into consideration if use of the waterway intensifies.	• There are plans to construct dams in the region without the simultaneous construction of locks. • If the construction schedule for the dams is not made compatible with waterway operation, this will result in na obstacle to navigation. • Even with construction of reservoirs, there will be stretches with limited navigation conditions on the Teles Pires River. • Intensification of the use of the waterway may cause greater human occupation of the river banks, a fact that might affect water quality and increase the sedimentation of the river bed, if this does not occur with proper public planning. • The energy sector has several hydroelectric power projects for this region. If both sectors (energy and transport) do not work together, there could be conflicts of interest in terms of water resources use.

3.5 SOUTHERN WATERWAY SYSTEM

3.5.1 Physical system of the river and environmental and social aspects

The Southern Waterway System comprises nine waterways, namely: dos Patos and Mirim Lagoons (including the São Gonçalo Channel), and Caí, Gravataí, Camaquã, Jacuí, Jaguarão, Rolante/Sinos, and Taquarí Rivers; together, they total 1,296 kilometers in length.

The Southern Waterway System is one of the best-structured waterway systems in Brazil, with dams equipped with locks and installed signaling.

The dos Patos Lagoon is currently navigated by commercial vessels with up to 5.1m drafts, allowing for maritime access to Porto Alegre (RS).

Upstream from Porto Alegre (RS), navigation is possible, depending on the convoy type, as far as the municipalities of Cachoeira do Sul, on the Jacuí River, and Estrela (RS) on the Taquari River. However, this stretches have occasional aggradation and rock outcrops, which require intervention.

Gravataí, Rolante/Sinos and Caí Rivers are navigable downstream, where the influence of the Jacuí Delta/Guaíba Lake is relevant and ensures adequate depths. In the most upstream stretches of these rivers, the river bank has small dimensions, high sinuosity rates, aggradation and rapids problems.

The Mirim Lagoon has no waterway structure that allows for commercial navigation, once it has no definite route. Moreover, there are low-depth stretches due to aggradation.

The Gravataí and Jaguarão Rivers are also affected by aggradations and low-depth problems, which prevents access by commercial vessels during the whole year.

The analyses and studies carried out to characterize the physical, social, and environmental conditions of the potential waterways in the Southern Waterway System followed the methodologies introduced in Chapter 1 – item 1.3 – Methodology, of this report.

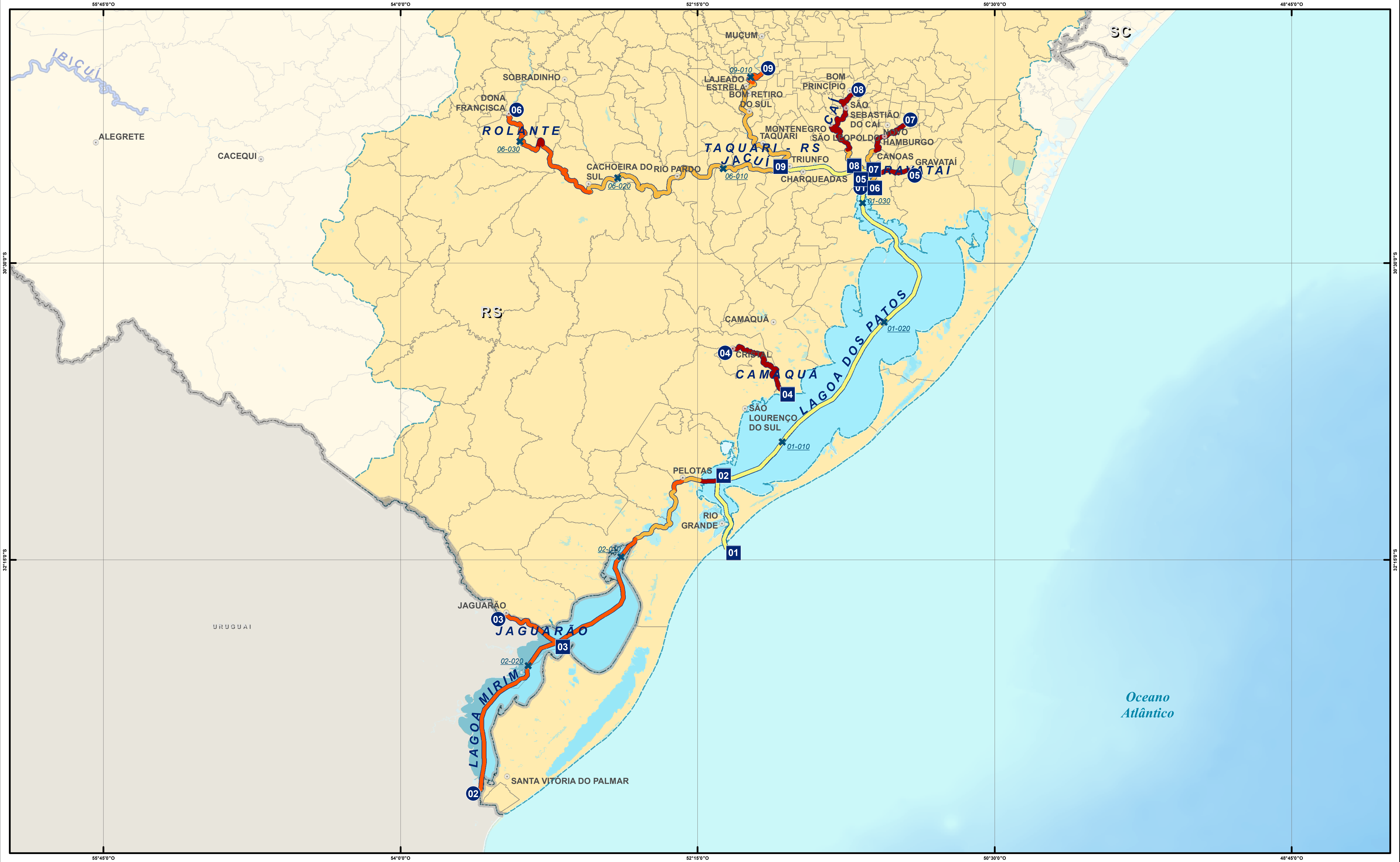
Due to the great volume of information collected and analyzed, this chapter presents the summary of the main results and conclusions for each river under study.

The CD annexed to this report (Step C: Assessment and diagnosis) contains a table in the .xls format, that shows in a more detailed way all the variables and information analyzed for each river and for each section studied.

The Linear Diagrams in this chapter summarize the mentioned table, following the methodology exposed in chapter 1, item 1.3 of this report.

As the result of the final step of the Strategic Waterway Plan (Step F: Preparation of the final strategic plan) a Georeferenced Database is presented, which contains all the existing information in the table of the CD annexed to this report.

The main characteristics regarding the navigability conditions of the waterways of the Southern WS can be verified jointly in the linear diagram presented in sequence.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

X Jusante
X Montante

01 Lagoa dos Patos
02 Lagoa Mirim
03 Rio Jaguarão
04 Rio Camaquã
05 Rio Gravataí
06 Rio Jacuí
07 Rio Rolante
08 Rio Caí
09 Rio Taquari - RS

Bacias do SH do Sul

Trechos de 10 km (xx-yyy)
xx: n° do rio
yyy: n° do trecho
*km = yyy * 10*

Escala de ponderação dos temas
1 - 5 (baixa - alta)
- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 20 40 80 km
SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

Oceano Pacífico
Oceano Atlântico

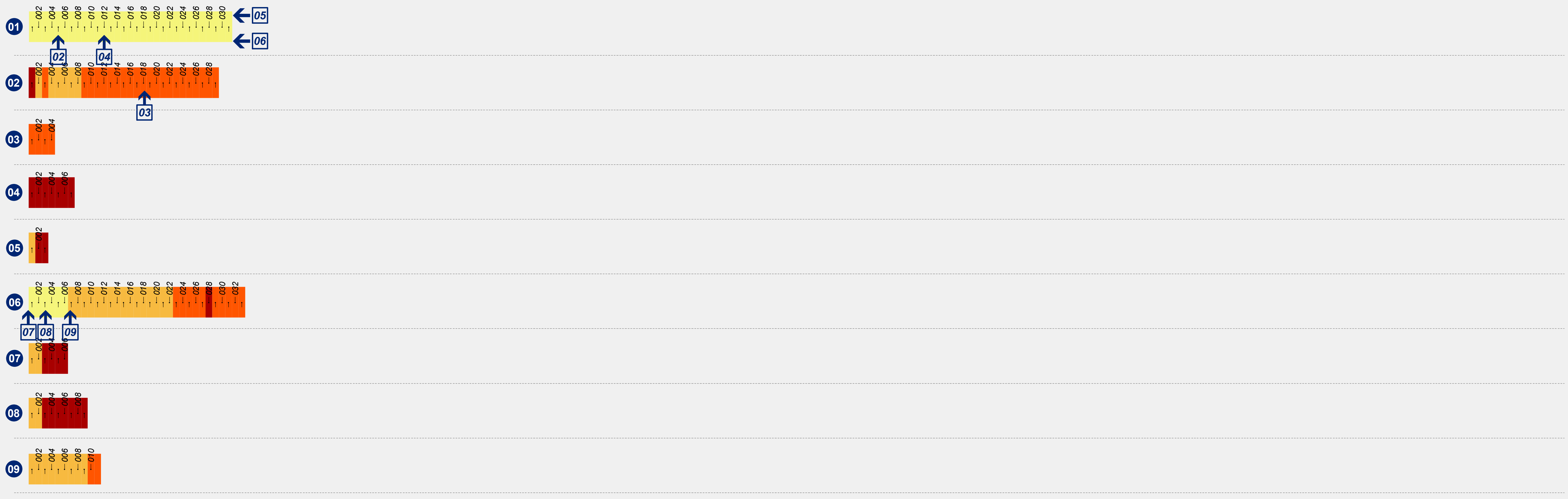
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:2.250.000	SH SUL	MAI/2013



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	*ALTO DE:*	*MÉDIA DE:*	*BAIXA DE:*	
Sinuosidade; ou	*Sinuosidade; ou*	*Sinuosidade; ou*	*Sinuosidade; ou*	*Ausência das ocorrências*
Profundidade mínima; ou	*Profundidade mínima; ou*	*Profundidade mínima; ou*	*Profundidade mínima; ou*	
Empecilhos à navegação (construções); ou	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	
Energia do rio; ou	*Energia do rio; ou*	*Energia do rio; ou*	*Energia do rio; ou*	
Leito do rio; ou	*Leito do rio; ou*	*Leito do rio; ou*	*Leito do rio; ou*	
Assoreamento; ou	*Assoreamento; ou*	*Assoreamento; ou*	*Assoreamento; ou*	
Anteparos naturais; ou	*Anteparos naturais; ou*	*Anteparos naturais; ou*	*Anteparos naturais; ou*	
Largura mínima do rio.	*Largura mínima do rio.*	*Largura mínima do rio.*	*Largura mínima do rio.*	

CONVENÇÕES CARTOGRÁFICAS

- 01 Lagoa dos Patos
- 02 Lagoa Mirim
- 03 Rio Jaguarão
- 04 Rio Camaquã
- 05 Rio Gravataí
- 06 Rio Jacuí
- 07 Rio Rolante
- 08 Rio Caí
- 09 Rio Taquari - RS

x Confluências

Numeração dos trechos

n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

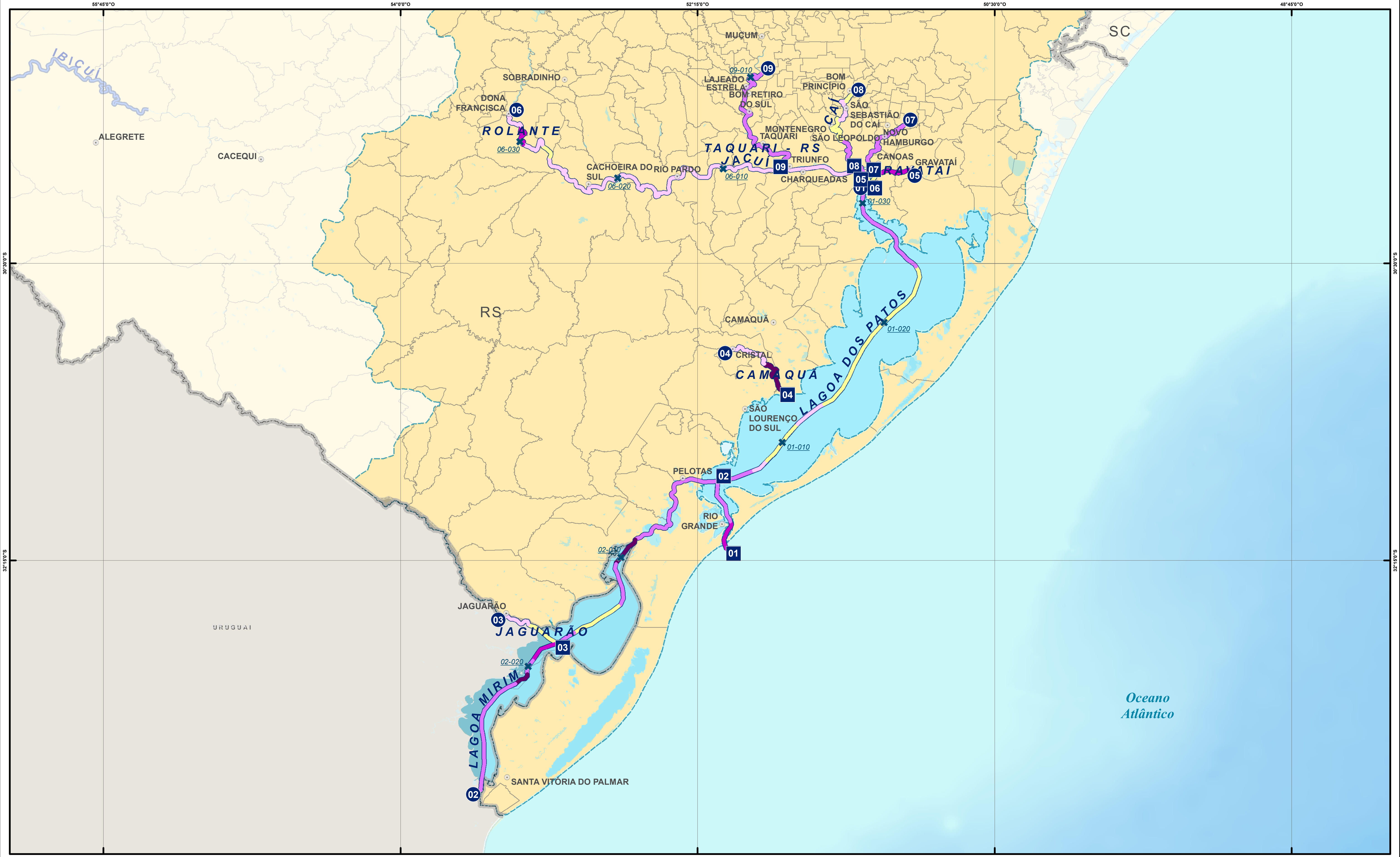
PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH SUL	MAI/2013

This Waterway System is home for about 9 million inhabitants, concentrated especially in urban areas, distributed over 309 municipalities - the most populous of which are Caxias do Sul, Santa Maria, Pelotas and the municipalities in the Metropolitan Region of Porto Alegre, in Rio Grande do Sul.

The main social and environmental characteristics worth considering to foster the integrated planning of possible intervention necessary in the region can be seen together in the linear diagram below.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Lagoa dos Patos
- 02 Lagoa Mirim
- 03 Rio Jaguarão
- 04 Rio Camaquã
- 05 Rio Gravataí
- 06 Rio Jacuí
- 07 Rio Rolante
- 08 Rio Caí
- 09 Rio Taquari - RS

Bacias do SH do Sul

Trechos de 10 km (xx-yyy)
xx: n° do rio
yyy: n° do trecho
*km = yyy * 10*

Escala de ponderação dos temas
1 - 5 (baixa - alta)
- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 20 40 80 km
SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

Oceano Pacífico
Oceano Atlântico

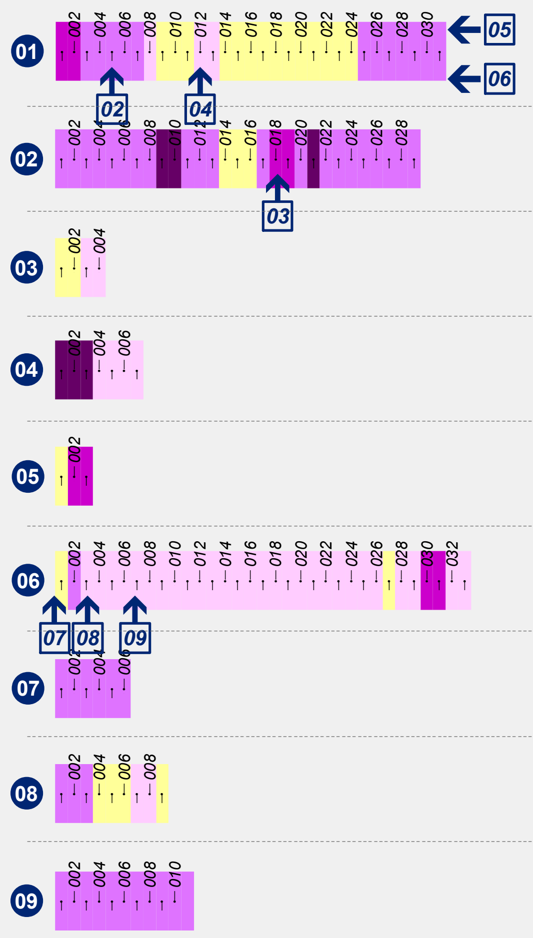
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:2.250.000	SH SUL	MAI/2013



VULNERABILIDADE SOCIOAMBIENTAL

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
UC - proteção integral; ou	*UC - uso sustentável; ou*	*Assentamento INCRA; ou*	*APCB; ou*	*Ausência das ocorrências*
Terra indígena	*Comunidade quilombola*	*Vulnerabilidade ao desmatamento; ou*	*Mineração - Lavra e garimpo*	
		Cavidades naturais		

CONVENÇÕES CARTOGRÁFICAS

- 01 Lagoa dos Patos
- 02 Lagoa Mirim
- 03 Rio Jaguarão
- 04 Rio Camaquã
- 05 Rio Gravataí
- 06 Rio Jacuí
- 07 Rio Rolante
- 08 Rio Caí
- 09 Rio Taquari - RS

X Confluências

Numeração dos trechos

n° < Jusante

n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH SUL	MAI/2013

With the linear diagram, it is possible to see that the waterways formed by the navigable stretches of the Mirim Lagoon and the Camaquã River present most vulnerabilities from the social and environmental standpoints. By the Mirim Lagoon, on stretches 09 and 10 (municipality of Arroio Grande/RS) and on stretch 21 (municipality of Santa Vitória do Palmar/RS), there are Integral Protection Conservation Units. On the Camaquã River, from stretch 01 to 05 (municipality of Cristal/RS), there are Indigenous Lands.

It is noteworthy that on the dos Patos Lagoon waterway, the area of study, considered as a 10 km stretch to each side of the axis of the river, does not include the Lagoon banks, except for the initial stretches (01 through 05). However, through observation of the spacing of the individual variables used to compose the synthetic diagram, it can be seen that the dos Patos Lagoon banks are densely populated and do not have significant occurrences of these variables, except for an Integral Protection Conservation Unit between the municipalities of Tavares and Mostarda, in Rio Grande do Sul, in stretches 15 through 20 of the waterway, about four kilometers far from Lagoon bank.

Below, the main characteristics of the waterways comprising this Waterway System are described.

3.5.1.1 Dos Patos Lagoon Waterway

a) Navigability Diagnosis

Dos Patos Lagoon is a lagoon located in the Brazilian state of Rio Grande do Sul. It is the largest lagoon in Brazil and the second largest in America.

Its drainage area is approximately 10,144 km^2, it is over 300 km long and, on some stretches, its width may be up to 70 km, which justifies the name “Mar de Dentro” (Inland Sea). It is 7 meter-deep (its maximum elevation), in the southwest and northwest direction, parallel to the Atlantic Ocean.

The hydrographic basin that runs off through this channel represents about half of the rivers in Rio Grande do Sul and a small part of Uruguay. Its drainage area is about 162,000 km^2 and its main tributaries, starting from the north, are the Capivari River, the Gravataí and Rolante (also known as dos Sinos) Rivers, the Caí, the Taquarí, and the Jacuí Rivers, united in Guaíba, Camaquã, and Piratini.

In the south, the dos Patos Lagoon connects to the sea through the Canal do Norte in Barra do Rio Grande (RS), where two groynes have been built to improve the transposition conditions in Barra.

At Northwest is located the Guaíba Lake, which is the transition between the dos Patos Lagoon and the Jacuí River Delta, made up of Caí, Gravataí, Jacuí, and the dos Sinos Rivers.

The dos Patos Lagoon is navigable by maritime-size vessels with up to 5.1 meters draft, from Rio Grande (RS), stretch 2, to Porto Alegre (RS), stretch 31, the state capital. To ensure access for larger vessels, minimal depths are maintained by systematic and constant draining at some points. The navigation conditions on the dos Patos Lagoon may become unfavorable due to strong winds when small swell and uncovered spots all across the Lagoon are formed affecting the stability of vessels, especially small and medium vessels.

b) Social and Environmental Vulnerabilities

The Guaíba River Basin has an area of approximately 84,780 km^2. It touches the territories of 255 municipalities between the states of Santa Catarina and Rio Grande do Sul, totaling a population of 7,402,796 inhabitants (IBGE, 2010). The main urban centers are in the state of Rio Grande do Sul, especially the state capital, Porto Alegre, and the municipalities of Caxias do Sul and Pelotas.

Map 23: Dos Patos Lagoon Waterway Location

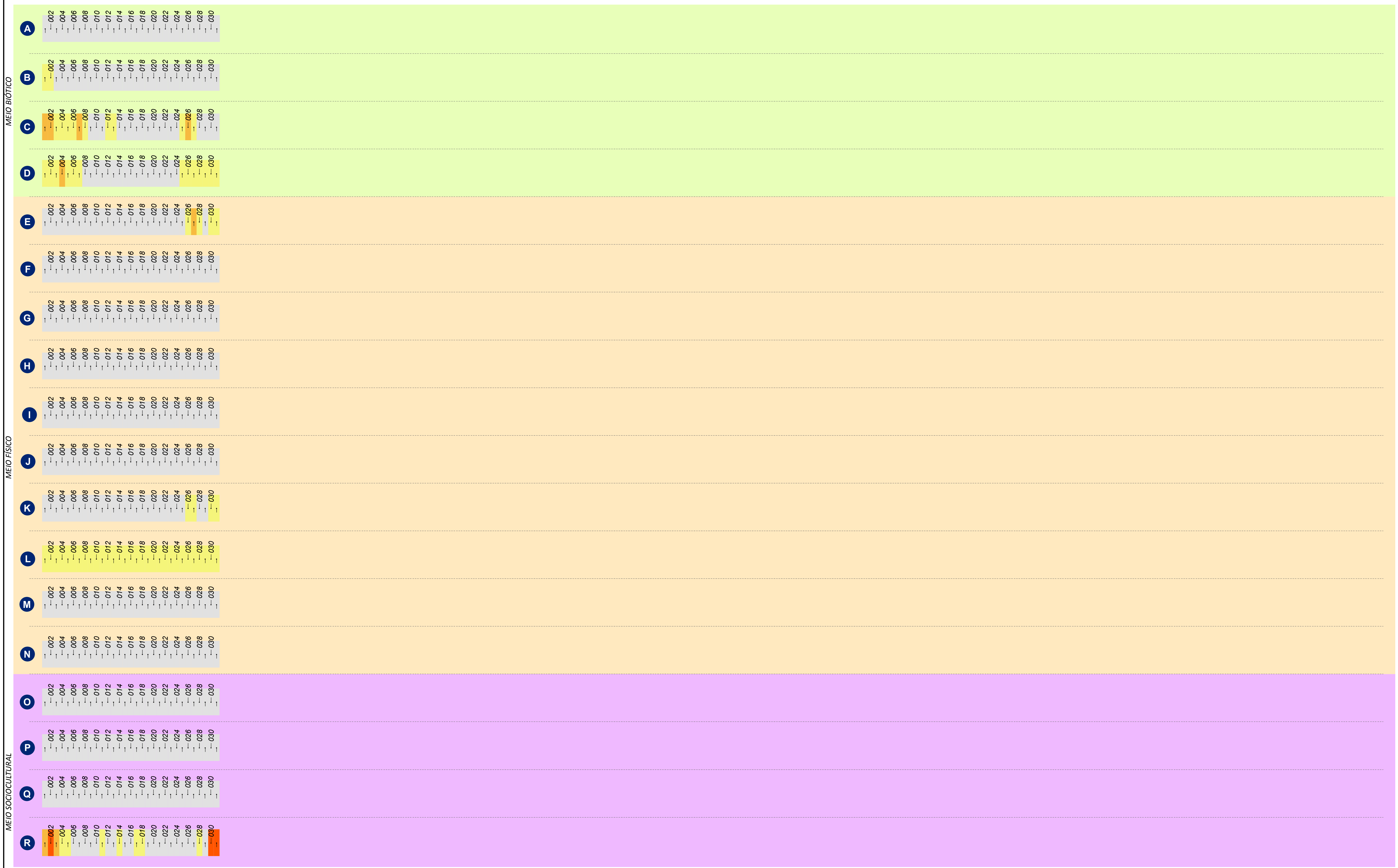
With regard to conservation, the Guaíba River basin has 60% of its area in the Atlantic Forest biome and 40% in the Pampa biome. In its course, there are 829 occurrences of mining, 80 occurrences of natural cavities, 7 Integral Protection Conservation Units, 5 Sustainable Use Conservation Units, 27 Biodiversity Conservation Priority Areas – high and very high priorities, 6 Maroon Territories, 34 INCRA settlements and 6 Indigenous Land areas.

The Rio Grande do Sul Coast Basin has an area of 53,744 km^2; encompassing 52 municipalities in the state of Rio Grande do Sul, totaling 1,567,153 inhabitants (IBGE, 2010). Pelotas and Viamão are among the main urban centers.

With regard to conservation, the basin area is totally inserted in the Pampa biome. There are 137 occurrences of mining, 6 natural cavities, 5 Integral Protection Conservation Units, 3 Sustainable Use Conservation Units, 27 extremely high and very high priority Biodiversity Conservation Priority Areas, 2 Maroon Territories, 156 INCRA settlements, and 3 Indigenous Land areas.

The dos Patos Lagoon waterway is 309 km^2 long, divided into 31 10-km stretches that include 8 municipalities in Rio Grande do Sul, including the state capital Porto Alegre. Together they are home to 2,341,860 inhabitants (IBGE, 2010). The FIRJAN index (2010) is higher for the state capital -0.81. The lowest value is found in the municipality of São José do Norte – 0.60.

On the waterway surroundings, the presence of Integral Protection Conservation Units or Indigenous Lands has not been detected. Noteworthy is the presence of extremely high priority Biodiversity Conservation Priority Areas, however, in the initial stretches, near the Town Hall in Pelotas, where there is already a port.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade mínima
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura mínima do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante
n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante
BA - Baixa
ME - Média
AL - Alta
MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	LAGOA DOS PATOS	MAI/2013

3.5.1.2 Mirim Lagoon Waterway

a) Navigability Diagnosis

The Mirim Lagoon is the second largest lagoon in Brazil. It is about 200 km. Only the dos Patos Lagoon is larger than Mirim, on the borders of Brazil and Uruguay. Its hydrographic basin has an approximate surface of 62,250 km^2, of which 47,310 km^2 are in Brazilian territory and the rest is in Uruguay. The main tributaries of the Mirim Lagoon are Jaguarão River, on the Brazilian side, and Cebollatí and Tacuari Rivers, on the Uruguayan side.

The Mirim Lagoon is connected to the dos Patos Lagoon by the São Gonçalo channel. It is 76 km long.

On the Mirim Lagoon the regime of shared waters with Uruguay prevails, according to the Tratado de Limites (Treaty of Limits), signed in 1909, and the Tratado da Lagoa Mirim (Mirim Lagoon Treaty), signed in 1977.

The region's climate is subtropical, with an average yearly rainfall ranging from 1,200 mm in the south, and up to 1,450 mm in the north, with average monthly temperatures ranging from 25^o C in January to 11^o in July. There is no definite rainy season: the winter months are rainier, while November and December tend to be drier.

The Mirim Lagoon waterway considered in this study consists of the stretch from Barra do São Gonçalo (RS) (stretch 1), near the municipality of Laranjal (RS), to the far south of the Lagoon, near Santa Vitória do Palmar (RS). The total length is about 290 km. The first 80 km belong to the São Gonçalo Channel and the rest belong to the Mirim Lagoon.

São Gonçalo Channel

The São Gonçalo Channel is a 70-km long Waterway that connects the Mirim and the dos Patos Lagoons, in the state of Rio Grande do Sul. Its main tributary is Piratini River (stretch 6). The São Gonçalo Channel is considered a channel rather than a river because its waters do not flow naturally always in the same direction, once the direction of current depends on the water volume in each of the lagoons it connects.

The natural flow along the Lagoon was modified by the Centurião Dam, in the São Gonçalo Channel (stretch 3), built in 1977 to prevent sea waters from intruding into the Mirim Lagoon, thus ensuring the source of potable water for the municipalities of Rio Grande (RS) and Pelotas (RS), as well as preventing damage to the rice plantations around the Mirim Lagoon. The dam also helps in preventing floods. For this reason, the waters flow from the Mirim Lagoon to the dos Patos Lagoon 70% of the time. The flow is inverse only during occasional dry seasons (usually from November through May). The tide influence is up to 1 m.

The Centurião Dam is equipped with a 120-m-long, 17-m-wide, and 5-m-deep lock.

On the stretch between the municipality of Pelotas (RS) and its connection in the dos Patos Lagoon, dredging was performed to allow enough draft to access the port of Pelotas. The average depth is about 5m along the whole Channel.

At the junction of the São Gonçalo Channel to the Mirim Lagoon (stretches 9 through 10) there are signs of aggradation problems, resulting in low depths.

The channel is not fit for large vessels. It is estimated that it can hold up to 2,500-ton cargoes vassels.

There are 3 bridges over the São Gonçalo Channel, in the municipality of Pelotas. Two of them are road bridges (one is inactive) and a railroad bridge (which has a movable span for vessels to pass through. The bridge with the most restrictive dimensions is the railroad bridge, with a span of 39m and clear height of about 20m.

Figure 3.5.1: Bridge over the São Gonçalo Channel. The railroad bridge is in the foreground and the road bridge in the back.

Mirim Lagoon

The Mirim Lagoon is 20km wide in average. Its maximum width is 37km. The average depths are about 1 to 2m in the north - a region known as "Sandradouro" (stretch 9) – where aggradation is more significant. The depths are 4m in the central area and up to 5 or 6m in the south part. However, during the dry seasons, depths may be shallower. Its shore and banks are low and sandy, with minimum depths, marshes and juncus.

The Mirim Lagoon has no well-defined course for navigation, which means there is no safe route. According to the Brazilian Navy, vessels must be careful due to the fact that is has not been charted.

Navigation on the Mirim Lagoon developed until the implementation of BR-471, in the late 1970s, when it started being gradually deactivated.

There are aggradation problems along the Mirim Lagoon. Because no dredging has taken place in the last years, aggradation has been identified causing navigation on the Lagoon to be interrupted. Aggradation problems are found in the north stretch of the Lagoon, near the entrance to the São Gonçalo Channel, resulting in minimal depths of 1m. To be feasible, the waterway needs intervention in this place to re-establish the minimum depth required.

There is no port infrastructure in this locality.

b) Social and Environmental Vulnerabilities

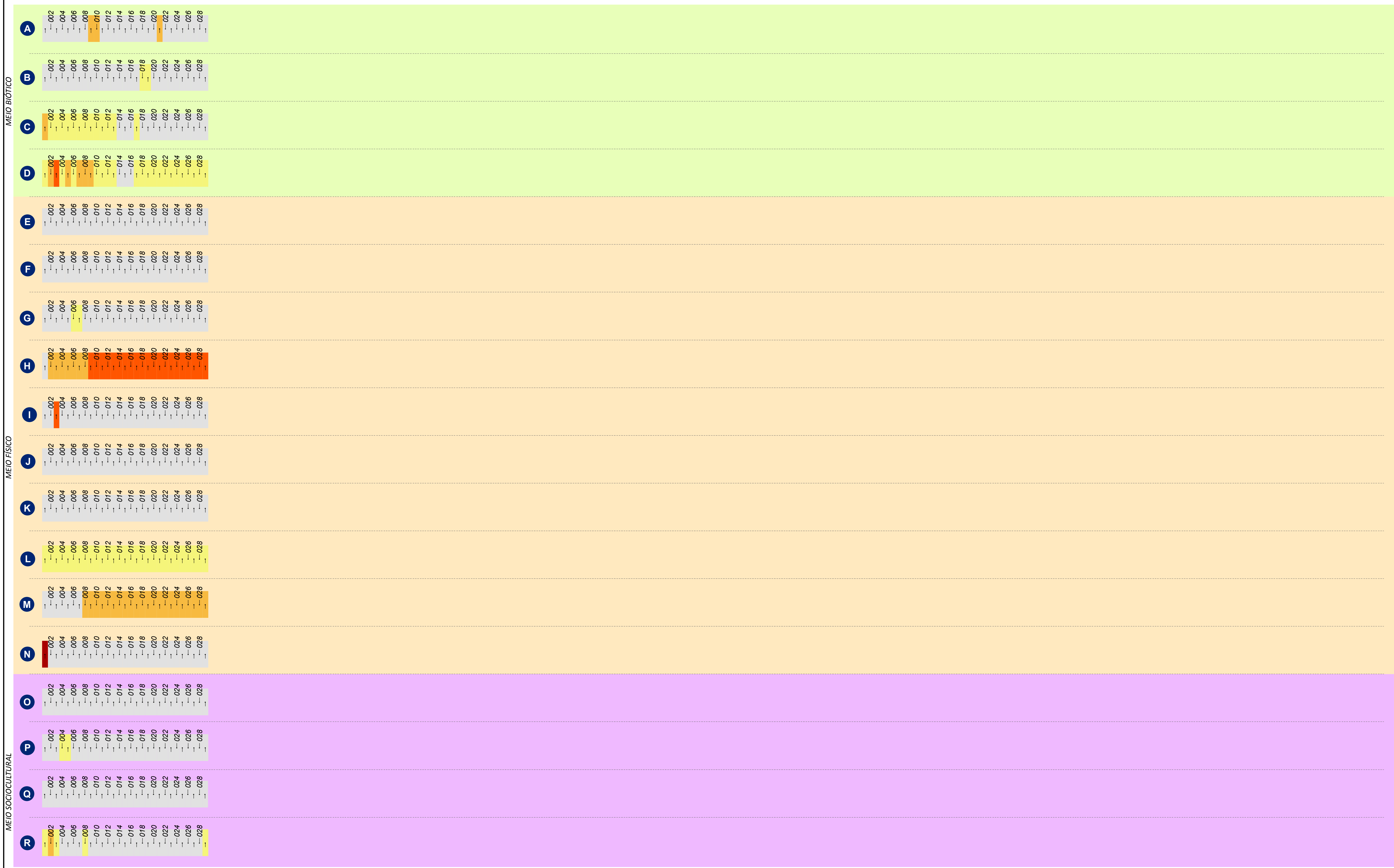
The Mirim Lagoon waterway is 289km long[48]. It is part of Rio Grande do Sul's Coast basin (previously described) and connects to the dos Patos Waterway in the municipality of Pelotas.

Its area of study crosses the territories of seven municipalities in the state of Rio Grande do Sul, totaling 633,109 inhabitants (IBGE, 2010). The municipality of Pelotas has the highest FIRJAN index: 0.78. The municipality of Arroio Grande has the lowest: 0.62. The average is 0.70.

[48] A Lagoa Mirim é um rio internacional, servindo de fronteira do Brasil com Uruguai. Cabe ressaltar que neste estudo consideram-se somente as variáveis socioambientais existentes no entorno da hidrovia em território nacional.

Map 24: Mirim Lagoon Location

Ten percent of the 29 stretches where the waterway was divided into to be analyzed are critical due to the presence of the Integral Protection Conservation Unit – stretch 9 is home to the Matogrande Biological Reservation and stretch 21, to the Taim Ecological Station. Biodiversity Conservation Priority Areas are found next to the Conservation Units.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	LAGOA MIRIM	MAI/2013

3.5.1.3 Camaquã Waterway

a) Navigability Diagnosis

The Camaquã Basin is located in the mid-south of the state of Rio Grande do Sul. Its area is 21,570km^2, which corresponds to 7.6% of the territory of this state. It encompasses total of 26 municipalities. Its springs are located near Lavras do Sul (RS), Bagé (RS), and Dom Pedrito (RS), about 400 m above sea level. About 430km long, its mouth is on the dos Patos Lagoon, between the municipalities of Camaquã (RS) and São Lourenço do Sul (RS).

The Camaquã Waterway analyzed consists on the stretch from its mouth, on dos Patos Lagoon, to the municipality of Cristal (RS), approximately 70km long.

The Camaquã River has minimum widths of about 100m near the mouth and it becomes narrower upstream – as narrow as 30m (stretch 4). Furthermore, the river presents many sandbanks, that, together with the high sinuosity rates verified along the river, make Camaquã a river unfit for commercial navigation.

The river is navigable only for the first 19km downstream, where there is a ferry crossing connecting the two banks of the river.

Figure 3.5.2: Camaquã River (stretch 2) (Comitê de Gerenciamento da Bacia Hidrográfica do Rio Camaquã, 2005)

There are no bridges or other structures that may represent difficulties or obstacles.

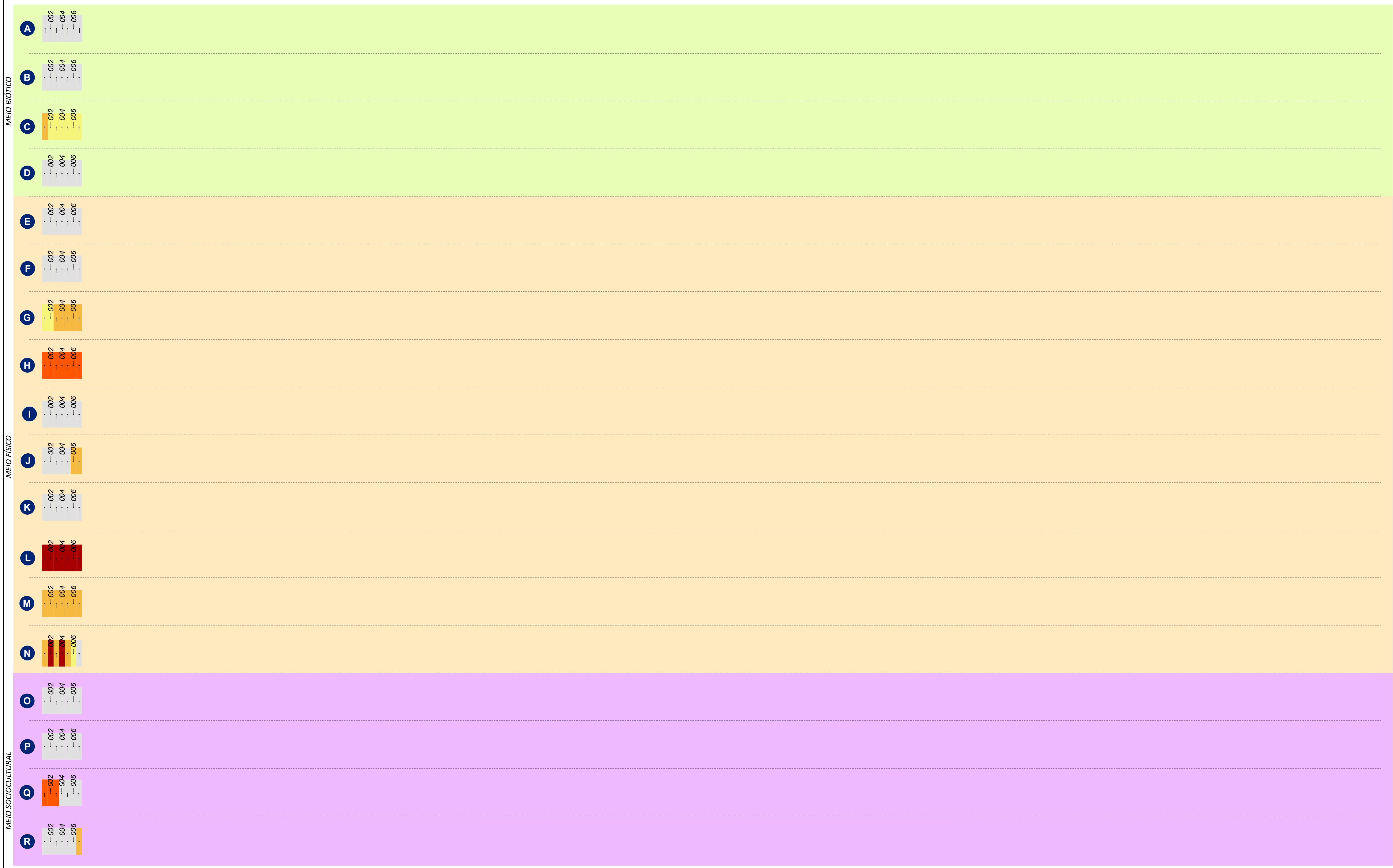
There is not enough data about the depths along the stretch being studied. However, by analyzing the available data, it is estimated that the river has minimum depths of about 1m, in the dry season.

a) Social and Environmental Vulnerabilities

The Camaquã Waterway is 61km long. It is part of Rio Grande do Sul's Coast basin (previously described) and it is connected to the dos Patos Lagoon Waterway in the municipality of Camaquã. The area studied (waterway and surroundings) crosses the territories of Rio Grande do Sul's municipalities of Camaquã, Cristal, and São Lourenço do Sul. Together they have 113,155 inhabitants (IBGE, 2010) and their FIRJAN (2010) index is, respectively, 0.72, 0.59, and 0.69.

Map 25: Camaquã River Location

As for the social and environmental vulnerabilities, 3 of the 7 stretches into which the waterway is divided into hold Indigenous Lands (stretches 01 through 03, an area called Pacheca) in the municipality of Camaquã. Moreover, all the waterway surroundings are within the extreme priority Biodiversity Conservation Priority Area limits, destined to recover the riparian forests.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
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- B Unidade de Conservação - Uso Sustentável
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- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

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DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

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3.5.1.4 Gravataí Waterway

a) Navigability Diagnosis

The Gravataí River hydrographic basin integrates the Guaíba waterway region. It is located in the east of the state of Rio Grande do Sul. Its drainage area is 2,020 km^2, which accounts for 2.4% of the state territory. Its limits are the Coast Basins Hydrographic Region to the east and south, the dos Sinos/Rolante basin to the north, and the Guaíba Lake basin to the west. It includes part of Porto Alegre's (state capital) metropolitan region, encompassing - totally or partially - the municipalities of Porto Alegre (RS), Canoas (RS), Alvorada (RS), Viamão (RS), (RS).

The flood season is not well defined and floods may occur any time of the year. In its downstream stretch, there is current inversion due the influence of the Jacuí Delta/Guaíba Lake. The river's run-off is determined by the flows originating in Banhado Grande and the Demétrio Stream, and by the water level variations in the Guaíba Lake. The average flow in the Gravataí River near the municipality of Gravataí is about $30m^3/s$ (see Appendix VII, item 4.10.2). Gravataí is low and plains lands, of crystalline base and basaltic plateau borders, corresponding respectively to three Morphostructural Domains. The stretch studied is located in a region of alluvial deposits and sedimentary bed, in a low-slope region. The Gravataí Waterway, part of this study, is approximately 30km long and it connects Porto Alegre to the municipality of Gravataí. The main deal of this stretch is in urban areas. The currently navigable stretch is an extension of the Guaíba Lake, stretching for about 20km (stretches 1 and 2), from Porto Alegre through immediately upstream from the BR-116 bridge (stretch 2). The draft permitted is 5.20m. However, due to the lack of periodical dredging, minimum depth is currently inadequate, in some stretches, for commercial navigation. The minimum width in this stretch is about 60m. The BR-116 bridges over the Gravataí River represent an obstacle for navigation, limiting navigation up to this stretch, preventing large commercial vessels from navigating upstream. Upstream from this bridge, the Gravataí River is physically smaller, with widths of about 20m and depths of about 2m, which may be shallower due to the presence of sandbanks along the river. Upon crossing BR 290, the flood area, or floodplains, increase considerably and the river becomes very sinuous.

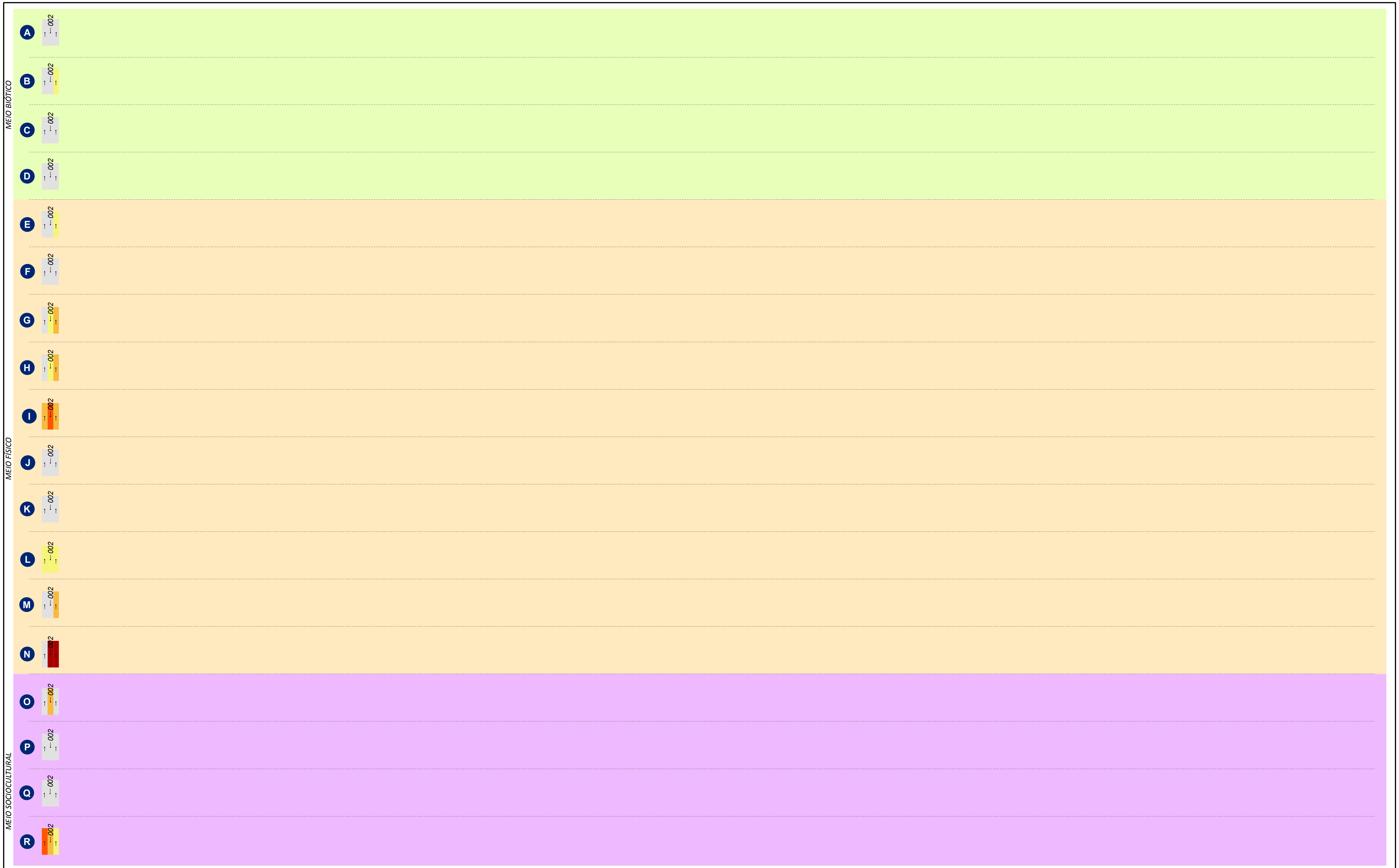
b) Social and Environmental Vulnerabilities

The Gravataí Waterway is 30km long, part of the Guaíba River basin (previously described). The area studied crosses the territories of eight municipalities in the state of Rio Grande do Sul and totals 2,753,885 inhabitants (IBGE, 2010). The highest FIRJAN (2010) index is 0.81 for Porto Alegre and the lowest is 0.68, for the municipality of Viamão.

Map 26: Gravataí Waterway Location

Consórcio ARCADIS logos

The Gravataí Waterway is 30km long. It has been divided into three 10km stretches. In this waterway, there are neither indigenous lands nor integral protection conservation units, but there are 25 mining spots along its stretches. There is also a Sustainable Use Conservation Unit in a Maroon Lands area in the municipality of Gravataí.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
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- D Desmatamento do trecho

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- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
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N W E S

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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3.5.1.5 Jacuí Waterway

a) Navigability Diagnosis

The Jacuí River basin has an area of 71,600 km2, which corresponds to 83.5% of the Guaíba waterway region and ¼ of the area of the state of Rio Grande do Sul. The Jacuí River springs in a plateau region, in the municipalities of Passo Fundo (RS) and Marau (RS). Hydro energetic dams characterize its higher stretch, where the hydroelectric plants of Ernestina, Passo Real, Salto do Jacuí, Itaúba, and Dona Francisca are based. Its mouth is located in the Jacuí River Delta, in a group of channels, islands and swamps from where the Guaíba Lake is formed.

The Jacuí waters flow from the Guaíba Lake through the dos Patos Lagoon. From there, it goes to the Atlantic Ocean.

The main tributaries of the Jacuí River are the Jacuí-mirim, Ivaí, Vacacaí-mirim, Vacacaí, Jacuizinho, Pardo, and Taquari Rivers.

The rainfall is quite homogenously distributed through the months of the year, so there are no well-defined flood periods. Consequently, the Jacuí River, like other navigable Rivers in Rio Grande do Sul, has no distinct periods of navigation during the year. A few days of rain may bring floods that may prevent navigation. On the contrary, in the drier periods, flows may be reduced enough to hinder the movement of vessels. The average flow is about 1,800m3/s, in the São Gerônimo Station (see Appendix VII, item 4.10.1).

The Jacuí Waterway considered in this study covers its mouth, in the Guaíba Lake, in the region of Porto Alegre (RS), until the municipality of Dona Francisca (RS) – 330km in length.

The Jacuí River is presently navigable from its mouth until the municipality of Cachoeira do Sul (RS), on stretch 22. The Jacuí River has three dams equipped with locks for that purpose. Their main objective is to regulate water levels to allow navigation. These are the Amarópolis (stretch 8), Anel de Dom Marco (stretch 16), and Fandango (stretch 22) dams, located, respectively, in the municipalities of General Câmara (RS), Rio Pardo (RS), and Cachoeira do Sul (RS). The figure below shows the schematic layout of these dams.

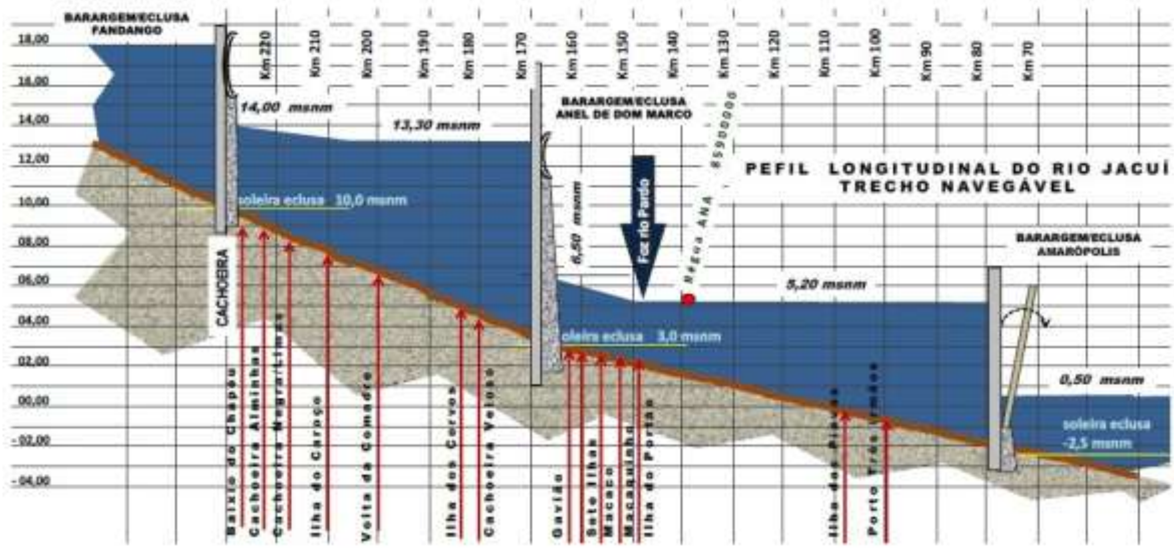


Figure 3.5.3: Jacuí River Profile and operational dams

The river is in a region of lagoon plain deposits, slopes, and sedimentary riverbed.

The waterway studied was divided into the following stretches:

Stretch between the Jacuí Delta and the Amarópolis dam

Navigable stretch with around 70km long, from Jacuí's mouth until 18km upstream of Taquari River's mouth (stretch 7), where the Amarópolis dam is located. On this stretch, the river is wide and sinuosity does not affect navigation conditions. Average slope is low and the existing bridges do not hinder commercial navigation.

On the Jacuí Delta, where the Jacuí waterway originates, there are three navigable channels – Furadinho, das Balsas River and Navegantes. The depth is 6 m, with a average width of 50m. The two first provide access to the Brasken Petrochemical Terminal and the third interconnects the Mauá and the Navegantes Quays.

The Amarópolis dam, concluded in 1974, is located between the municipalities of General Câmara (RS) and Butiá (RS). This has a level difference of 4.6m. It is equipped with locks and its main role is to enable navigation from this point upstream. The lock dimensions are 120m length, 17m width and 3m depth.

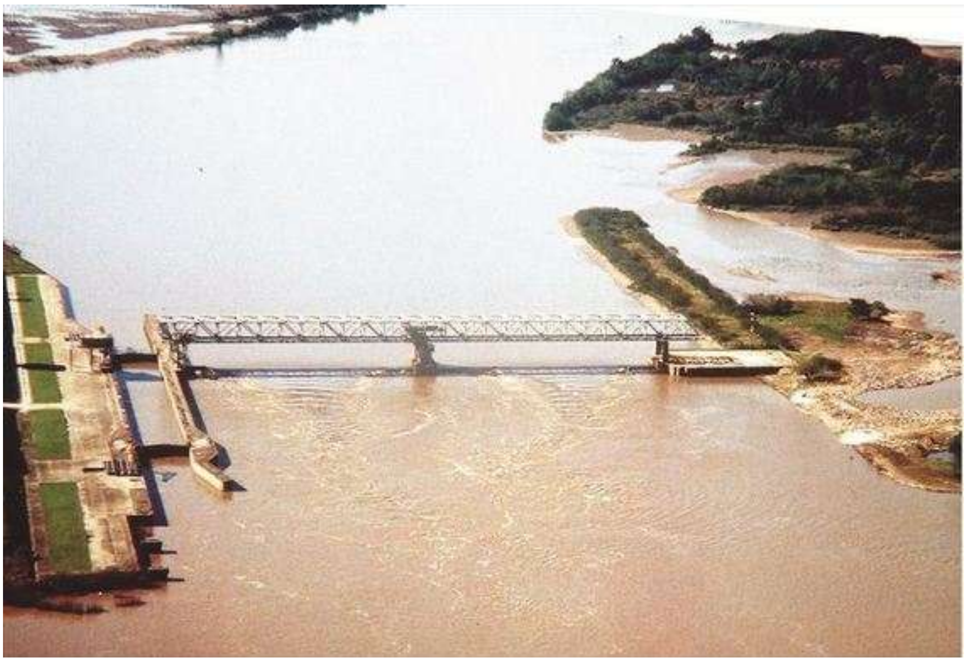


Figure 3.5.4: Amarópolis Dam (Brasília Guaíba, 2013)

This stretch has undergone rock excavations and presents located navigation difficulties, such as aggradation and river islands, which are mapped and signaled. These obstacles may result in restrictions, depending on the convoy type.

The stretch is totally signaled by SPH (Superintendence of Ports and Waterways) and has a constant flow of sand vessels mining upstream from the Amarópolis dam. The removal of sand and gravel along the Jacuí River may interfere in the stability of the banks and at the aggradation levels along the river.

Depths up to the Mexerico Island (7km downstream from the Amarópolis dam) are between 4 and 4.5m. Immediately downstream from the Amarópolis dam a 2.5 draft is permitted depending on the dike flow.

Stretch between Amarópolis dam and the municipality of Cachoeira do Sul (RS)

This stretch is about 150km long and is currently navigable. It relies on the Amarópolis and Anel Dom Marco dams (stretch 16) to maintain the minimum depth necessary for navigation along this stretch. There are stretches, however, of low depth during low flow, when important aggradation conditions arise for navigation.

The Amarópolis and Dom Marco dams create a difference in level of 4.5 and 7.5m, respectively. The locks were built with the same dimensions (120m long, 17m wide, allowing for up to 2.5m drafts) along the Jacuí.

Minimum depths on this stretch are 3m, 90% of the time. However, in spite of the Amarópolis reservoir, the stretch between the Amarópolis and the Dom Marco dams has a number of narrow spots, about 30m, open in basalt, which make navigation difficult. During low-flow conditions the use of smaller drafts is necessary and in high-flow conditions, currents may occur, affecting the control of vessels and their ability to steer.

Figure 3.5.5: Anel de Dom Marco Lock (Hidrovias Interiores-RS, 2012)

This stretch presents aggradation in some stretches making difficult or even preventing navigation, it must undergo periodic dredging and rock excavation.

Today, the river traffic on the stretch is restricted to sand vessels exploiting sediments deposited in the Amarópolis backwater surroundings. Removal and movement of sand on this stretch may result in more erosion on the banks, the formation of new sandbanks and make navigation conditions difficult.

Jacuí River from Cachoeira do Sul through Dona Francisca

In the municipality of Cachoeira do Sul (RS) the Fandango dam (stretch 22) was implemented. This dam, concluded in 1958, was built aiming at enabling the movement of vessels over a waterfall, now flooded. The locks dimensions are smaller than those at the Amarópolis and Dom Marco dams: 85m long, 15m wide and a maximum difference in level of 4.5m.

Figure 3.5.6: Fandango Dam (Visite Cachoeira, 2012)

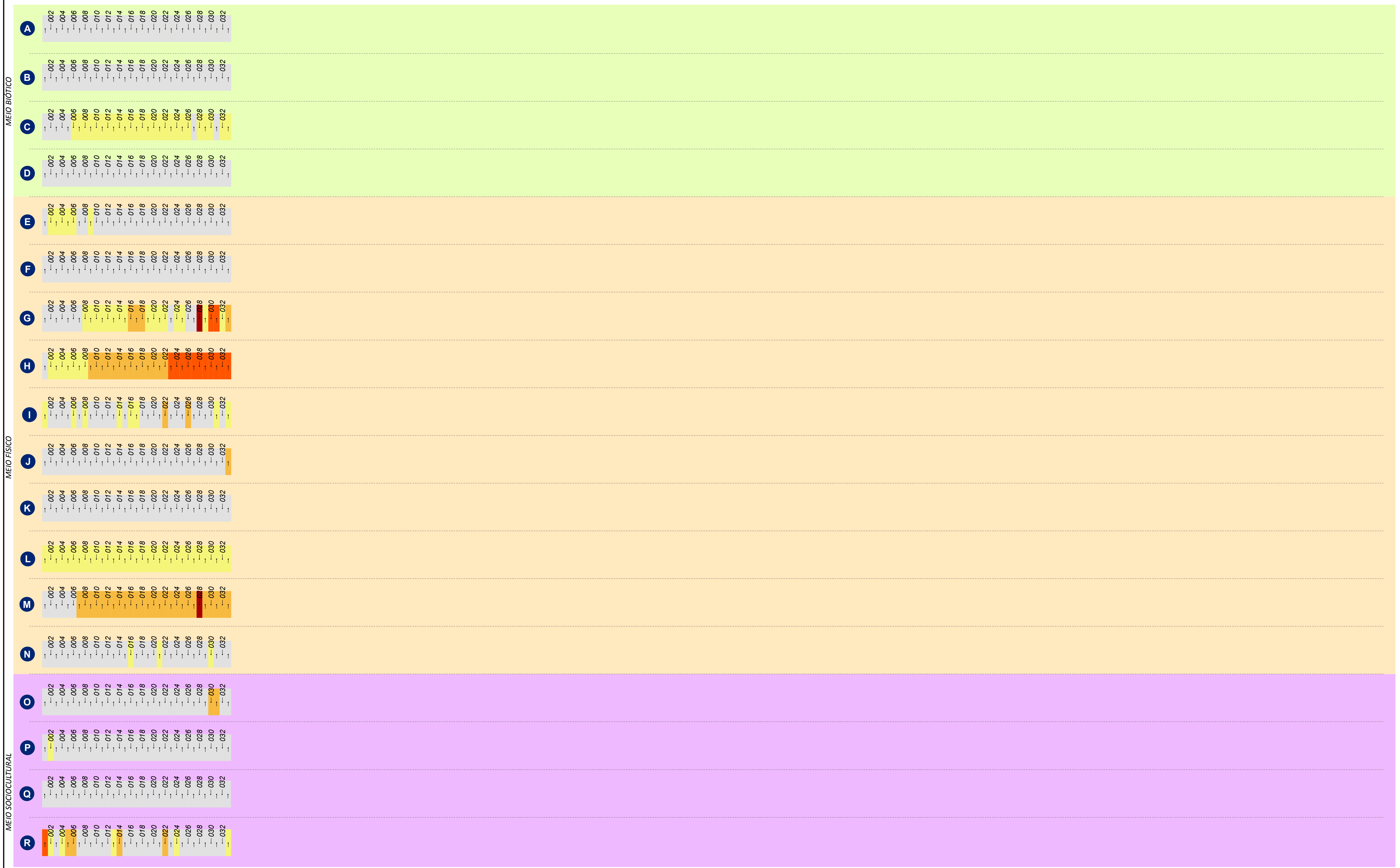
The Fandango Dam reservoir effects is about 30 km long, as far as the Vacacaí River (stretch 26). From this stretch to the municipality of Dona Francisca (RS), the river has minimum depths below 1m, some stretches with a number of sandbanks and some steps, creating funneling spots and sharp bends. Furthermore, the navigation conditions in this stretch depend on the operational regime the Dona Francisca hydroelectric plant, implemented upstream from the municipality of Dona Francisca (RS).

b) Social and Environmental Vulnerabilities

The Jacuí Waterway is 324km long, its area of study crosses the territories of 24 municipalities in the state of Rio Grande do Sul, totaling 1,946,421 inhabitants (IBGE, 2010). Porto Alegre is the most populous city, accounting for 72.40% of this total. As for the FIRJAN index (2010), there is a variation from 0.82 in the municipality of Santa Cruz de Porto and 0.61 in the municipality of Butiá. The average is 0.69.

Map 27: Jacuí Waterway Location

The social and environmental vulnerability of 33 the stretches into which the waterway is divided indicates that there are no critical occurrences related to the variables studied.



CONVENÇÕES CARTOGRÁFICAS

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- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante
BA - Baixa
ME - Média
AL - Alta
MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
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N W E S

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
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3.5.1.6 Jaguarão Waterway

a) Navigability Diagnosis

The Jaguarão River Basin is located in the southwest of the state of Rio Grande do Sul and it borders Uruguay in part of its course. It has a drainage area of 5,780.60km^2. Its spring is located in the Santa Tecla Hill, on the das Tunas Hill or do Arbolito Hill.

The region has a subtropical climate, with average yearly rainfall ranging from 1,200mm in the south to 1,450mm in the north. Average monthly temperature varies between 25^{o}C in January to 11^{o}C in July. There is no definite rainy season in the region: the winter months are rainier, while November and December tend to be drier. The average flow in the Picada da Areia station is about 90m^3/s (see Appendix VII, item 4.10.6)

The regime of shared waters with Uruguay prevails on the Jaguarão River, according to the Treaty of Limits, signed in 1909.

The Jaguarão River is navigable up to the municipality of Jaguarão (RS) and corresponds to the waterway stretch being studied in this Plan. It is about 30km long.

Average depth on this stretch is about 2.5m, during the floods. However, minimum depths may reach 1m on some spots, during the dry season, often due to the existing sandbanks. The level variation of the river is very high during the flood season. According to the Brazilian Navy, it is only possible to navigate on Jaguarão River during the flood season.

Minimum widths are about 200m. The average sinuosity rate is 1.3 on this stretch. The Jaguarão River has many aggradation problems and has occasional fluvial islands, which may represent difficulties and make the route more sinuous than would be expected.

The Jaguarão River has some 1m-tall groynes and spikes, built transversally at the end of the 19th century, aiming to prevent aggradation. Other spikes emerge from the water in the dry periods, but remain invisible, not far from the surface, in the flood season, which impact in additional danger for navigation. There are no periodic dredging campaigns in the river.

Figure 3.5.7: Emerging construction on the Jaguarão River (stretch 1) (Veleiromacanudo, 2012)

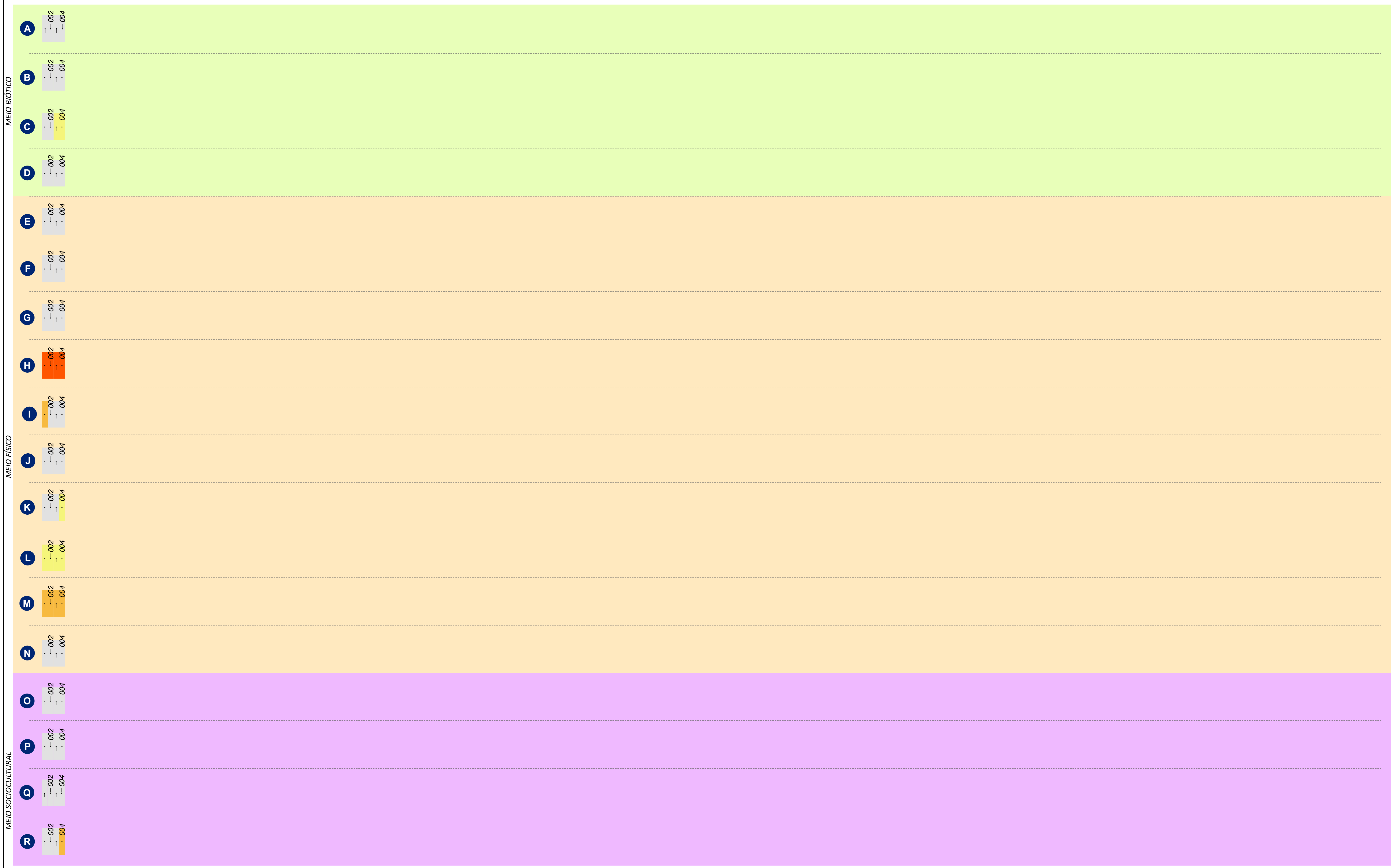
b) Social and Environmental Vulnerabilities

The Jaguarão[49] Waterway is 37km long, located in Rio Grande do Sul's Coast basin (previously described), connects to the Mirim Lagoon waterway in the municipality of Jaguarão, the only one addressed by the area of study in this waterway. The municipality of Jaguarão has a population of 27,931 inhabitants (IBGE, 2010) and the FIRJAN index (2010) is 0.68.

[49] The Jaguarão River is an international river, serving as a border between Brazil and Uruguay. Note that in this study it was considered only the existing social and environmental variables within Brazilian territory.

Map 28: Jaguarão Waterway Location

As for the social and environmental vulnerabilities of the 4 stretches into which the waterway has been divided, they are not very critical in the surroundings.



CONVENÇÕES CARTOGRÁFICAS

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- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
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ESCALA GRÁFICA

0 50 100 200 km

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3.5.1.7 Rolante Waterway

a) Navigability Diagnosis

The Rolante River basin has an area of 3,820km^2. It is one of the rivers former of the Guaíba Lake. The Rolante River, also known as dos Sinos, springs from the hills of the municipality of Caraá, in the north coast of Rio Grande do Sul at levels above 600m and it flows for a 190km course. Its mouth is in the Jacuí Delta, in the municipality of Canoas (RS).

Rainfall is quite evenly distributed through the months of the year, so there are no well-defined flood periods. The average flow in the municipality of São Leopoldo (RS) is about 90m^3/s (see Appendix VII, item 4.10.3).

The Rolante Waterway is about 60km long. It stretches from the Jacuí Delta to the municipality of Campo Bom (RS), near Novo Hamburgo (RS).

The Rolante River has better navigation conditions in the first 20km downstream (stretches 1 and 2), where the river is still directly influenced by the Jacuí/Guaíba Lake Delta, which makes a backwater and results in depths of up to 4m, widths of about 100m and low slopes. Another restrictive factor in the current conditions on this stretch is the inadequate air tie rod of the RFFSA (Anonymous Society Federal Railroad Network) bridges and the BR-386 bridge. On the first the free height on minimal waters is 8.16m, and on maximum waters, 3.72m. On the second, it is 11.02 and 4.69m, respectively.

Figure 3.5.8: RFFSA Bridge over the Rolante/Sinos River (Hidrovias Interiores-RS, 2010)

From this point upstream (stretches 3 through 6), the waterway has a high rate of sharp bends, especially on the area in Sapucaia do Sul (RS). Minimum depths are shallower, reaching between 2.5m and 1m and the navigable channel narrows occasionally. The width is about 20m (stretch 5). The stretch is navigable up to São Leopoldo (RS), during the flood season, by small vessels. In the municipality of São Leopoldo (RS), there are five urban bridges, which may result in difficulties/hindrances for navigation. Upstream from São Leopoldo (RS), slopes are higher compared to the previous stretches, around 50cm/km.

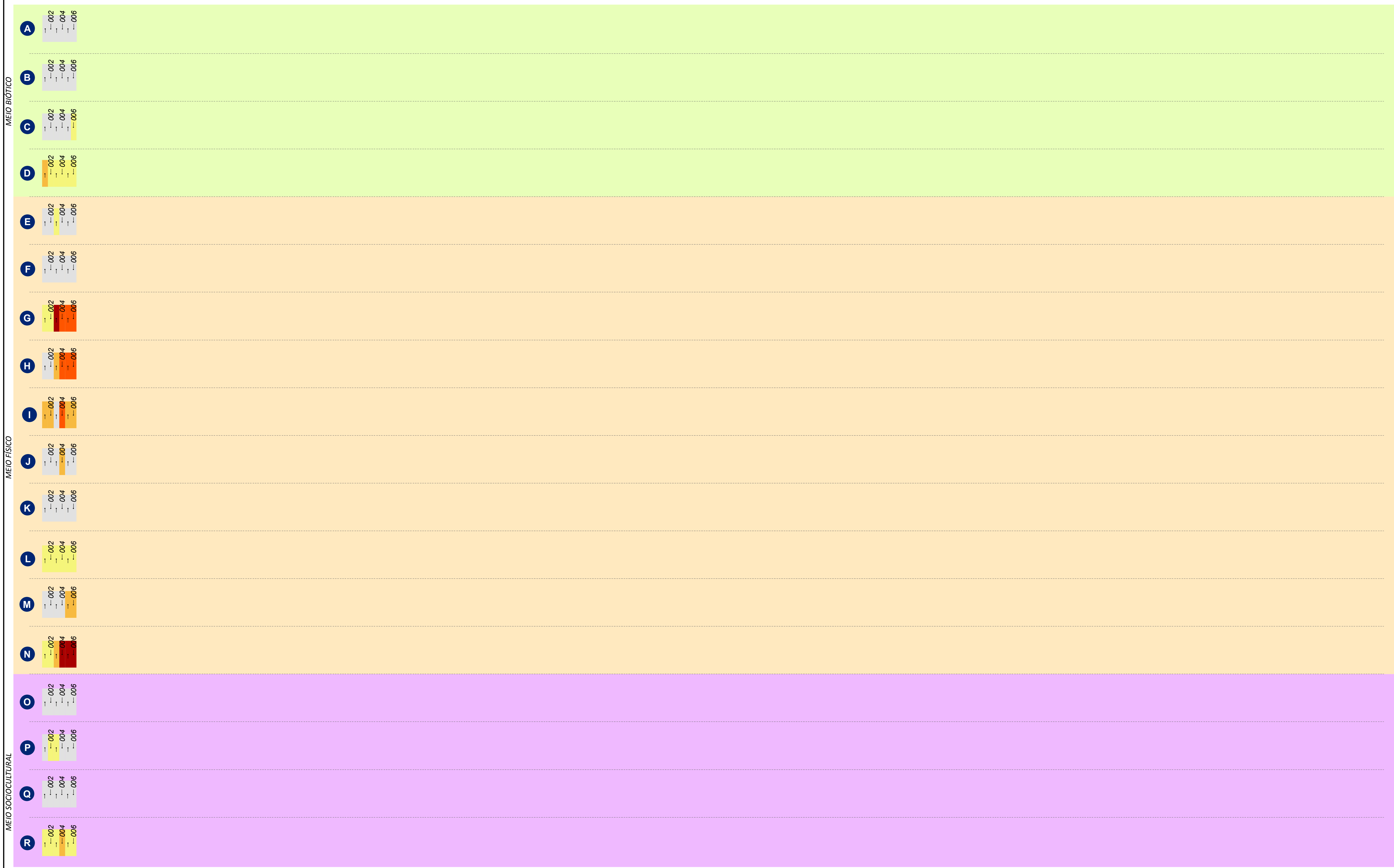
Larger sand vessels (70m long) can be seen navigating on stretch 3, and smaller ones on stretch 4.

b) Social and Environmental Vulnerabilities

The Rolante Waterway is 53km long, located in the Guaíba River basin (previously described). Its area of study crosses the territories of 16 municipalities in the state of Rio Grande do Sul, totaling 2,860,336 inhabitants (IBGE, 2010). Porto Alegre is the most populous city, accounting for 49.27% of the total. The highest FIRJAN index (2010) is 0.81 in Porto Alegre and the lowest, 0.63 in Sapiranga. The average for all these municipalities is 0.74.

Map 29: Rolante River Location

The social and environmental analysis of the six stretches into which the waterway is divided indicates that there are no apparent critical occurrences related to the variables studied.



CONVENÇÕES CARTOGRÁFICAS

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- L Assoreamento
- M Anteparos naturais

SOCIOCULTURAL
- N Largura do rio
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

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REFERÊNCIAS

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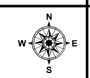
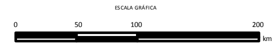
- PNTL, 2010



ESCALA GRÁFICA



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3.5.1.8 Caí Waterway

a) Navigability Diagnosis

The Caí River Basin is 5,027km^2 and accounts for 1.79% of the territory of the state of Rio Grande do Sul. It is located between the Taquari, Low Jacuí and Sinos (or Rolante) river basins. It is part of the Guaíba Lake Hydrographic Region. From the hydrographic standpoint, the Caí Basin is characterized by a main water course (Caí River) and some larger tributaries, such as the Piaí, Forromeco, Pinhal, Cadeia, and Maratá.

The Caí River is 285km long. Its spring is located in a plateau region, about 900m elevation. Its mouth is located in the north of the capital Porto Alegre (RS). The Caí Waterway studied is located between its mouth, in the Jacuí River Delta, and the municipality of Bom Princípio (RS) - about 90km long.

The Caí River basin does not have a defined flood period. However, greater flows occur between the months of June and October. The average flow at the Barca do Caí Station is about 65m^3/s (see Appendix VII, item 4.10.4). The river is on a low land, so its bed is predominantly sedimentary.

Observation has shown that the river is navigable by small draft vessels (up to 1.5m) up to the municipality of São Sebastião do Caí (RS), when the river is still directly influenced by the Jacuí/Guaíba Lake Delta.

The Caí River has high sinuosity rates and narrow stretches, with minimum widths as narrow as 20m. These characteristics are sharper on the upstream stretches of the waterway (stretches 7 through 9). There are rapids, rock outcrops and sandbanks preventing navigation on some stretches.

In the lower course of the Caí River, from its mouth to São Sebastião do Caí (RS) (stretches 1 through 7); the river has low slopes (about 10cm/km), minimum width of about 100m and minimum depth of 1.5m. However, due to natural obstacles, such as sandbanks and rock outcrops, minimum depths may vary locally, between 0.5m and 4m.

The Rio Branco Dam is located on this stretch (6), in the municipality of Capela Santana (RS). This was the first dam built with a lock in Latin America, in 1908, with the objective of making Caí River navigable between Porto Alegre (RS) and São Sebastião do Caí (RS), regulating its water level between stretch 6 and 7. This dam was used at the time to transport goods and passengers. The Dam characteristics are: 43m long, 8.6m wideand 2.6m depth. However, as a result of less navigation, the dam’s small dimensions, and competition with the roads, it lost its function and it is inactive. To reactivate commercial navigation on the Caí River, intervention is necessary at this dam to allow large vessels to pass and to ensure adequate water levels for navigation up to the municipality of São Sebastião do Caí (RS).

The stretch upstream from São Sebastião do Caí (RS) (stretches 7 through 9) does not allow for commercial navigation due to the large number of natural obstacles (sandbanks and stone outcrops), resulting in shallow depths, narrow spots, and slopes of about 50cm/km.

Five bridges cross the Caí River stretch studied. The railroad bridge in the locality of Passo do Caí (RS) is the main limitantion with regard to navigation, with a 9m vertical limit on minimum waters, which means no large commercial vessels may pass. The figure below illustrates this obstacle.

Figure 3.5.9: Railroad bridge over the Caí River (Hidrovias Interiores-RS, 2010)

Because of the curtailment of navigation on the Caí River for convoys, a canal was opened, parallel to its lower course, to reach the Triunfo Petrochemical ("BRASKEN"). It is 7.5km long, 90m wide on the nappe and 50m wide on the sill. The depth is 6.0m. The Santa Clara Terminal is part of the canal. Navigation is restricted for ships as long as 152m, 35m high, and 40m width, due to the Getúlio Vargas bridge on the Jacuí Delta.

Figure 3.5.10: Santa Clara Terminal (Hidrovias Interiores-RS, 2010)

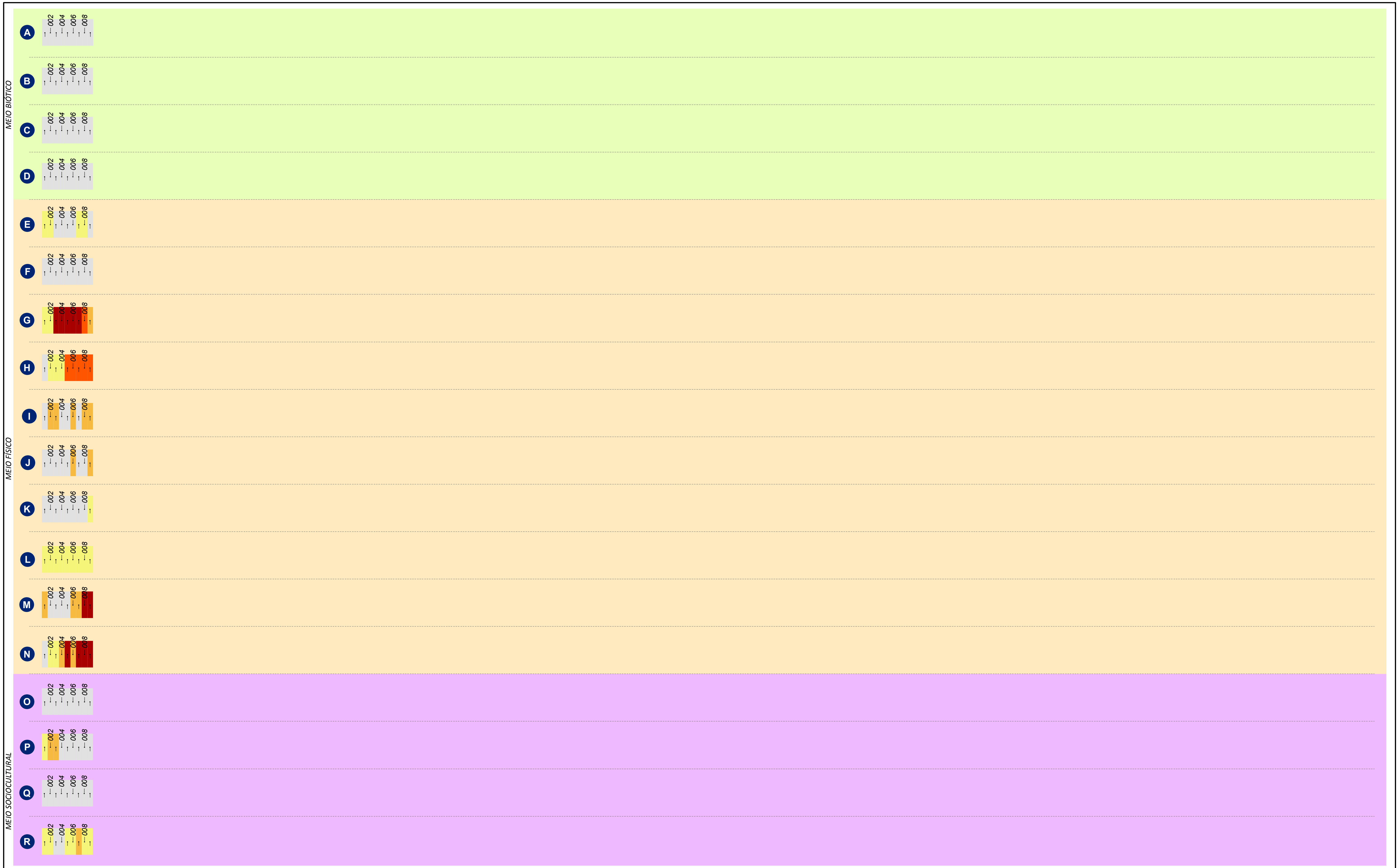
b) Social and Environmental Vulnerabilities

The Caí Waterway is 87km long and is partially on the Guaíba River and on Rio Grande do Sul's coast basins (previously described), connecting to the Jacuí Waterway at its junction with the dos Patos waterway. The limits of the area of study in this waterway cut through the territory of 9 municipalities in the state of Rio Grande do Sul, one of which is Porto Alegre. Together, these municipalities have a population of 1,642,725 inhabitants (IBGE, 2010). The FIRJAN index (2010) is 0.83 for the municipality of Tupandi, next is Porto Alegre with 0.81, and the minimum, 0.64, in the municipality of Capela de Santana.

Map 30: Caí River Location

The Caí Waterway is 87 km long. It has been divided into nine 10km stretches, for the purpose of this study.

As for the social and environmental vulnerability, no critical stretches were found in the waterway's surroundings.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
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3.5.1.9 Taquari Waterway

a) Navigability Diagnosis

The Taquari-Antas Water Basin is located in the northeast region of the state of Rio Grande do Sul. It has an area of 26,492km^2, corresponding to about 37% of the Jacuí basin total area. It comprises 98 municipalities, such as Antônio Prado (RS), Veranópolis (RS), Bento Gonçalves (RS), Cambará do Sul (RS), Carlos Barbosa (RS), Caxias do Sul (RS), Estrela, and Triunfo (RS). The main tributaries are the das Antas, Tainhas, Lageado Grande, Humatã, Carreiro, Guaporé, Forqueta, and Forquetinha Rivers. The Taquari spring is in the Cambará do Sul and Bom Jesus municipalities, at the easternmost Planalto dos Campos Gerais, where it is still known as Rio das Antas. With this name, the river runs for 390km and flows into the Jacuí River, near to the city of Triunfo (RS).

The high rainfall season is between June and October, and the low rainfall season is from December to April. The average flow, in the Encantado Station, is about 450m^3/s (see Appendix VII, item 4.10.5).

The Taquari Waterway studied comprises a length of approx. 110km, from its mouth up to the city of Colinas (RS) (stretch 11). Of the total studied, the navigable waterway stretch is currently 90km, between the mouth and the Lajeado city (RS) (stretch 9), near Porto de Estrela (RS). This stretch has implemented infrastructure (Bom Retiro Dam) and maintenance programs (dredging and rock excavation).

The stretch is in a river plain and alluvial deposits region. The bed is mainly sedimentary, from the mouth through stretch 7, and mixed from this stretch upstream.

The stretch between the mouth (stretch 1) and the city of Bom Retiro do Sul (RS) (stretch 7) has good navigation conditions. The stretch has influence from the Jacuí River, causing minimum depths of 2.5m. The sinuosity reaches rates of 1.6, without, however, making navigation difficult, as the minimum widths are about 100m. There are limitations in this segment (stretches 1 to 7) as per the night flow of loaded vessels, mainly downstream. Its is worth saying that, during the dry season, the stretch downstream of the Bom Retiro Dam (stretch 6) has restrictions to navigation, mainly in the 10km downstream of the dam mentioned, due to the shallow depths and the rocky outcroppings and sandbanks Thus, there are no navigation conditions for vessels with drafts higher than 2.2m on this stretch during the shallow waters.

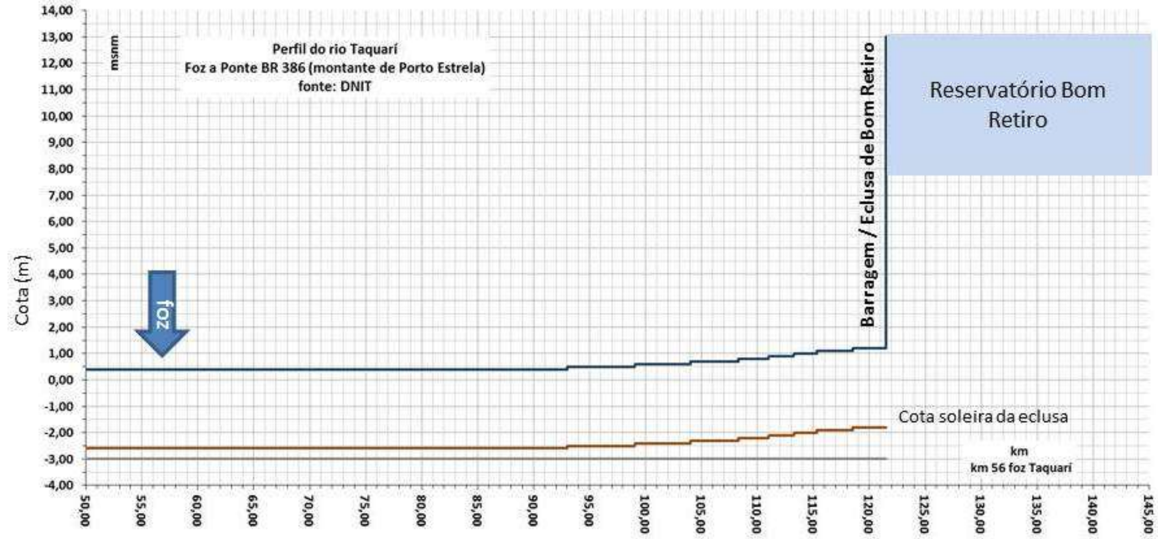


Figure 3.5.11: Taquari River Profile, between the mouth and the Bom Retiro dam

Figure 3.5.12: Stretch downstream from the Bom Retiro Dam (stretch 6) (Zero Hora, 2011)

The Bom Retiro do Sul Dam, the only dam implemented in the Taquari River, is located in the municipality of Bom Retiro do Sul (RS), about 60km from the mouth of the river. This dam is equipped with locks with the same dimensions as those of the dams of Amasópolis and Anel de Dom Marco, in Jacuí River, i.e., length 120m, width 17m, maximum draft 3.2m, and has 11.80m maximum difference in level. The backwater of its reservoir is approx. 30km (stretches 7 to 9), extending navigation to the municipality of Lajeado (RS) (stretch 9), about 10km upstream from the river port of Estrela.

Figure 3.5.13: Bom Retiro Dam (Bom Retiro do Sul Town Hall, 2012)

From Lajeado (RS) upstream (stretches 9 to 11), the Taquari River is navigable only during the flood season and with relevant restrictions. The bed is more sinuous (sinuosity rate 1.8) and with higher slopes (about 30cm/km), with long sandbanks in the middle of the river. In this segment we can see several erosions along the banks.

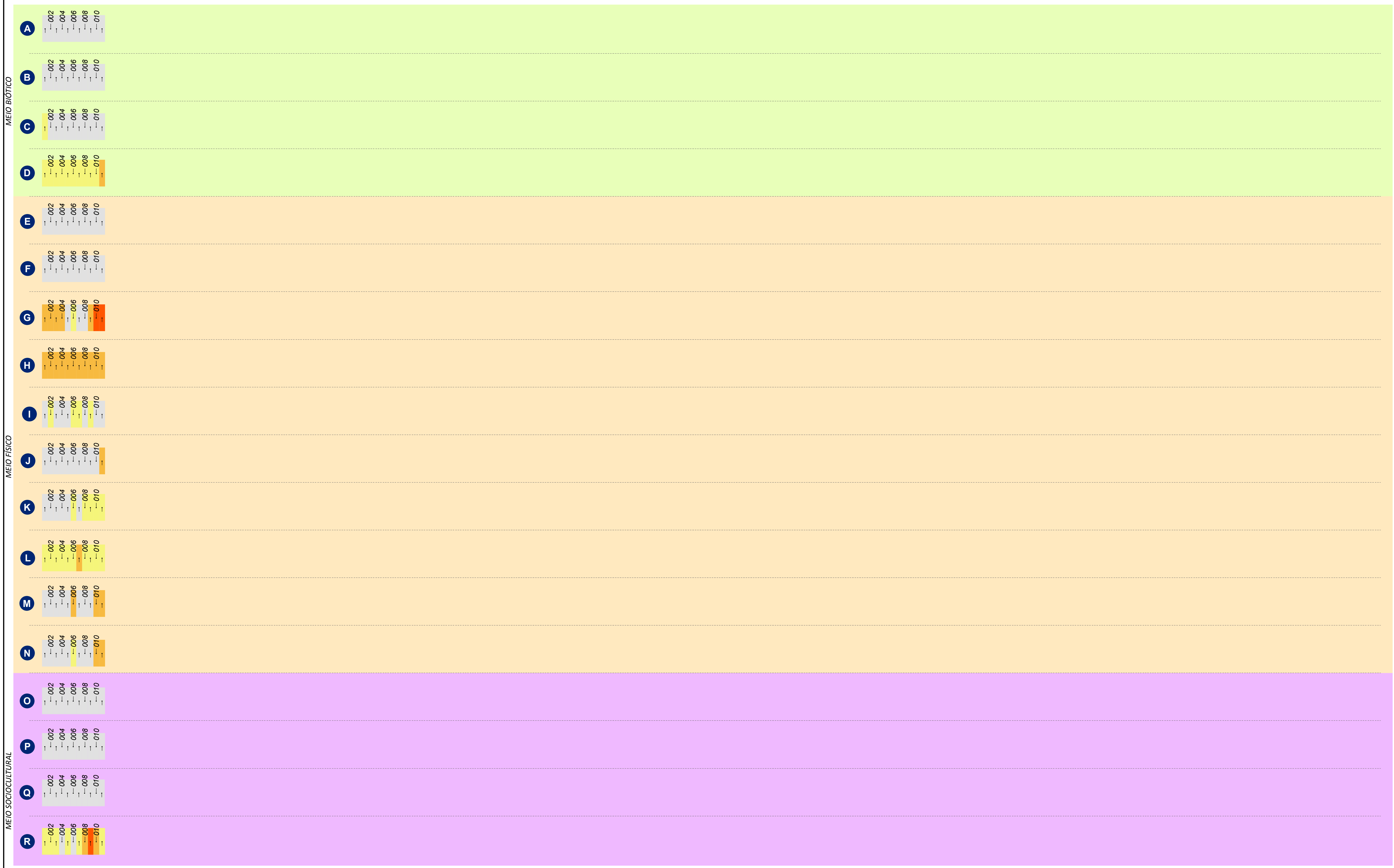
The existing bridges over the Taquari River in the segment under study do not cause more impediments to navigation.

b) Social and environmental vulnerabilities

The Taquari Waterway is 105 kilometers long, connects with the Jacuí River between the municipalities of General Câmara and Triunfo and is inserted in the Guaíba River basin (already described). Its study area crosses the territory of 20 municipalities in the state of Rio Grande do Sul, which total 357,880 inhabitants (IBGE, 2010), and Lajeado is the most populous city, responsible for 19.96% of the total. The municipality of Lajeado has the highest FIRJAN rate (2010) with 0.84 and the municipality of General Câmara has the lowest rate, with 0.63; an average of 0.72.

Map 31: Taquari Waterway Location

As per the social and environmental vulnerabilities, the analysis of the 11 stretches the waterway is divided into does not indicate high criticality in its vicinities.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
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Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

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REFERÊNCIAS

Fontes:
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- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO TAQUARI - RS	MAI/2013

3.5.2 Economic Aspects

3.5.2.1 Current inland waterways transport

Total inland waterway transport in 2011 in the Hidrovia do Sul river basin was about 3.7 million tons. In the following table more information is provided on the types of commodities.

Table 3.5.1: IWT transport by commodity (in 1000 tons)

	Total
Soy	566
Soy Meal	579
Wheat	105
Rice	18
Malt and Barley	5
Fats and Oils	98
Fertilizers	770
Sulfur	45
Salt	21
Wood	294
Cellulose	288
Coal	207
Chemical Products	290
Oil products	397
Ethyl Alcohol	62
Total	**3.746**

The majority of commodities are transported for exports and imports. This includes the agricultural products like soy, wheat and rice. Fertilizers are also very important for IWT. Other relevant commodities are wood, cellulose, chemical products and oil products. Inland waterway transport in Rio Grande do Sul is heavily concentrated on the port of Rio Grande. This port is one of the few ports on the east coast of Brazil with a waterway connection. Only one flow does not have Rio Grande as origin or destination (coal from Charqueadas to Triunfo for the chemical industry). All other flows are connected with the port of Rio Grande.

Concerning passenger transport, some short distance connections exist in Rio Grande do Sul. These transport movements of passengers are cross-river, mostly executed by ferries.

3.5.2.2 Planned developments

The total forecasted growth for the port of Rio Grande up till 2031 is 31 million tons, more than twice the amount in 2010. Four commodity segments are responsible for this growth:

1. Agricultural (including fertilizers) - from 11 million tons in 2010 to 21.5 million tons in 2030
2. Wood and cellulose – from 1.1 million in 2010 to 3.8 in 2030
3. Fuels and chemical products – from 2.1 million tons in 2010 to 8.7 million tons in 2030
4. Containers from 5.6 million tons to 16.4 million tons

The growth of container transport is related to the growth of agriculture (tobacco and food industry) and manufactured products (machine industry, chemical products).

These major growth projections are based on commodity specific forecasts in the catchment area of the Hidrovia do Sul, that are explained in more detail in the background reports concerning commodities and river basins.

3.5.2.3 Future inland waterways transport

The potentially most important commodity groups for inland shipping in the Hidrovia do Sul river basin are:

Agriculture

- Soybean and products of soybean (soy meal, soy oil)
- Other crops: corn, wheat & rice
- Fertilizers

Industrial

- Wood & pulp
- Coal & Fuels
- Chemical products

Other flows

- Containers (meat, tobacco, manufactured products (machines, vehicles))

Soybeans, grains, wood and fertilizers can be considered as bulk products. Meat, tobacco, and manufactured products are very suitable for container transport. In the following table the previous forecasts per commodity are summarized.

Table 3.5.2: Transport projections Hidrovia do Sul (1000 tons)

	2011	2015	2023	2031
Agricultural				
Soy	566	571	665	754
Soy meal	579	590	642	696
Wheat	105	111	126	139
Corn		5	6	8
Rice	18	18	18	18
Fertilizers	770	832	971	1.055
Agri other	103	107	122	135
Industrial				
Wood	294	372	549	770
Pulp	288	946	1.172	1.424
Coal	207	252	372	471
Chemical	290	403	686	1.078
Oil	397	536	910	1.753
Industry other	128	156	230	291
Other				
Container		351	557	775
Total	**3.745**	**5.250**	**7.026**	**9.367**

Beside the commodity flows, passenger transport will also grow, although this is a minimal growth from about 600.000 passengers in 2015 to 629.000 in 2031.

3.5.3 Transport System

3.5.3.1 Transported Cargo

The transported cargo in the Southern waterway system is presented in Chapter 3.5.2. Currently, more than 3.7 million tons of agricultural products are transported, with its majority coming from the states of Rio Grande do Sul and Santa Catarina. The potential increase in the cargo to be transported in 2031 is mainly due to the chemical, timber and pulp sectors. These volumes can be seen in the table below.

Table 3.5.3: Transported and potential cargo for the Southern Waterway system (Source: Antaq Report – Cargo transport in the Brazilian Waterways 2011).

Cargo	2011	2031
Agricultural products		
Soybean	566	754
Soy meal	579	696
Wheat	105	139
Corn		8
Rice	18	18
Fertilizers	770	1.055
Others	103	135
Industrialized		
Timber	294	770
Pulp	288	1.424
Coal	207	471
Chemical products	290	1.078
Oil	397	1.753
Other industrialized products	128	291
Others		
Container		775
Total	**3.745**	**9.367**

3.5.3.2 Infrastructure

This item describes the existing infrastructure in the Southern waterway system which, as said in Chapter 3.5.1, comprises the Caí, Gravataí, Camaquã, Jacuí, Jaguarão, Taquari, Rolante Rivers, dos Patos Lagoon, and Mirim Lagoon. Furthermore, it describes the existing highways and railways.

a) Waterway/river infrastructure

The physical characteristics of the Southern waterway complex, as well as the existing dams, were already mentioned in Chapter 3.5.1. Thus, only the existing ports/terminals and locks will be described.

Ports/Terminals

For the analysis of the Southern Waterway System terminals, the database resulting from the PNIH was utilized, and the information collected during the interviews and from recent reports was added. In this base, 35 terminals are listed, 9 of which do not present information related to the situation and 20 are operative. In the table below, we can see the number of terminals by their situation.

Table 3.5.4: Ports situation for the Southern Waterway system (Source: developed from the PNIH database, 2013).

Situation	Quantity	Percentage
Construction works	2	6%
Inoperative	3	9%
Operative	20	57%
Planned	1	3%
No information	9	26%
Total	**35**	**100%**

The analysis of the current situation was based on the data of the terminals classified as "Operative"; the others were not considered.

The ports were grouped in accordance with their location, some of them were described with more details, due to their importance for the inland waterway transport.

Rio Grande

The municipality of Rio Grande comprises the Port of Rio Grande, the most important port in Rio Grande do Sul for sea and inland water transport, as all routes except one have this port as origin or destination.

Table 3 shows a list of the main ports/terminals in operation in the region, as well as the rivers where they are located and the highway connections.

Table 3.5.5: List of the main operative Ports/Terminals (Source: Developed from the PNIH database, 2013).

Port/Terminal	Type	Location/River	Highway connections	
			Highway	*Railway*
Rio Grande	Organized Port	Rio Grande/Dos Patos Lagoon	BR-293, BR-101	ALL – South system
TUP Yara Brasil Fertilizantes	Private Use Terminal	Rio Grande/Dos Patos Lagoon	BR-293, BR-471	ALL – South system
TUP Bianchini	Private Use Terminal	Rio Grande/Dos Patos Lagoon	BR-293, BR-471	ALL – South system

The port of Rio Grande is administered by SUPRG – Superintendência do Porto de Rio Grande (Rio Grande Port superintendence), the port infrastructure is adapted for the receipt of long course navigation vessels and cabotage. There is no terminal dedicated to inland navigation. The main exported products are agricultural bulks, and the imported, fertilizers. The port of Rio Grande, concerning the moving of containers, competes directly with the ports of Santa Catarina (Itajaí and TUP Portonave), and has been losing market for them, since, according to the Plano Nacional de Logística Portuária (national plan of port logistics), these ports present a lower logistic cost for the moving of containers, due to the highway tolls in the state of Rio Grande do Sul.

The cargo moved in Rio Grande is of diverse nature. In 2011, more than 3.5 million tons were transported by this waterway system, more than 1.1 million from Rio Grande and approx. 2.4 million to that location.

Table 3.5.6: Inland Waterway Transport from Rio Grande, in 1,000 tons (Source: Antaq Report – Transport of cargo in the Brazilian Waterways 2011).

	Porto Alegre	Triunfo	Canoas	Other ports	Total
Fertilizers	752		13	5	770
Fuels	45	68	43	1	157
Wheat	74		24		97
Ethyl alcohol		48			48
Sulfur	45				45
Soy meal				26	26
Salt	21				21
Other commodities	7	10	5	3	24
Total	**944**	**126**	**84**	**36**	**1,190**

Table 3.5.7: Inland Waterway Transport to Rio Grande, in 1,000 tons (Source: Antaq Report – Transport of cargo in the Brazilian Waterways 2011).

	Canoas	Triunfo	Taquarí	Guaíba	Estrela	Rio Grande	Other ports	Total
Soy meal	535				18	26		579
Soybean	553		3		6			561
Wood			291					291
Pulp				287				287
Chemical Products		280						280
Fuels	179	60				1		241
Hydrogenated fat and oil	98							98
Other commodities		14			7	4	34	59
Total	**1.365**	**354**	**294**	**287**	**31**	**31**	**34**	**2,396**

Canoas

All the flows with origin or destination in the town of Canoas have Rio Grande as destination or origin. This is valid for all the routes of the Southern waterway system, except the transport of coal between Charqueadas and Triunfo (191,000 tons in 2011).

Table 3.5.8: Ports/Terminals located in the Canoas region (Source: Developed from the PNIH database, 2013).

Port/Terminal	Type	Location/River	Highway connections	
			Highways	*Railroads*
TUP Oleoplan	Private Use Terminal	Canoas/Rio Gravataí	BR-116, BR-290, BR-386	ALL – South system
TUP Rio dos Sinos	Private Use Terminal	Canoas/Rio Rolante	BR-116, BR-290, BR-386	ALL – South system

The movement in the terminals located in the town of Canoas was already described in the last item, and the summary of this can be seen in the table below.

Table 3.5.9: Moving of cargo in the Ports/Terminals located in the Canoas region (Source: Antaq Report – Transporte de cargas nas Hidrovias Brasileiras 2011).

Commodity	Origin Canoas	Destination Canoas
Fuels	179	43
Oil	98	
Soybean	553	5
Soy meal	535	
Fertilizers		13
Wheat		24
Total	**1,365**	**84**

Others Ports

Besides the ports and terminals located in the municipalities of Rio Grande and Canoas, the following ports are operative in the Southern waterway system.

Table 3.5.10: Other Ports/Terminals in the South waterway system (Source: Developed from the PNIH data base, 2013).

Location	Name	Type	Company
Triunfo	TUP Santa Clara	Private Terminal	Braskem S.A.
Porto Alegre	Porto Alegre	Organized Port	SPH
Guaíba	TUP Aracruz Guaíba (CMPC Pulp)	Private Terminal	CMPC Pulp
Taquari	TUP Moinho Taquariense	Private Terminal	Moinho Taquariense
	TUP Mita	Private Terminal	Mita Ltda.
Estrela	Estrela	Organized Port	CODOMAR

The port of Porto Alegre is administered by SPH – Superintendência de Portos e Hidrovias (ports and highways superintendence), oil products being the most moved, both in imports and exports.

The port of Estrela is a river port administered by CODOMAR, whose main movement is agricultural bulks. Besides, it has a structure for containers. However, the facilities are adapted for agricultural bulks.

Locks

The Southern waterway system comprises a *total* of five locks, whose dimensions and other information are given below.

Table 3.5.11: Characteristics of the locks in the Southern waterway system (Source: Antaq – Brazilian Waterways Report, 2008).

Lock	River	Dimensions (length x width x depth) in meters	Operator
Amarópolis	Jacuí	120 x 17 x 3	AHSUL
Anel de Dom Marco	Jacuí	120 x 17 x 3	AHSUL
Fandango	Jacuí	85 x 15 x 3,5	AHSUL
Bom Retiro	Taquari	120 x 17 x 3,5	AHSUL
Canal de São Gonçalo lock	Canal de São Gonçalo (Mirim Lagoon)	120 x 17 x 5	Agência de Desenvolvimento da Lagoa Mirim – AHSUL

Highways

The main highways which are part of the water system are described below. It is worth noting that, due to the extensive highway system, not all the highways connecting the producing regions to the port of export were mentioned.

BR-290

The BR-290, Rodovia Osvaldo Aranha, is one of the most important highways in Brazil, with an extension of 726km, located in the state of Rio Grande do Sul. It crosses the northern coast of the state westwards, up to the municipality of Uruguaiana, at the border with Argentina.

The stretch between the beginning of the highway, near to BR-101 in the municipality of Osório, up to the state capital, Porto Alegre, is known as Free-way. This stretch has two tolls, one in Gravataí and another in Santo Antônio da Patrulha (this one charged only toward the coast); and presents intensive traffic, with three lanes in each direction. Between the northern zone of Porto Alegre and the municipality of Guaíba, there is one overlap with the BR-116. Going west, the highway goes through Pantano Grande, São Gabriel, Rosário do Sul, Alegrete until Uruguaiana, where the largest dry port of Latin America is located.

The BR-290, complemented by the BR-153, is an alternative system to the Jacuí Waterway. It connects the city of Porto Alegre (RS) to the town of Cachoeira do Sul (RS). It is a single roadway road, with toll, large shoulders and good maintenance of the pavement. In the vicinities of Porto Alegre (RS), BR-290 reaches the BR-116, another important state highway.

BR-287

The BR-287 is a federal highway that crosses the Brazilian state of Rio Grande do Sul. The highway is also known as Rodovia da Integração. It begins in the Porto Alegre region, in the town of Canoas. It is 536.9km long. It crosses the main tobacco region of the country, in the towns of Santa Cruz do Sul and Venâncio Aires, where several cigarette producers and tobacco distributors, such as Universal Leaf Tabacos, Philip Morris, Souza Cruz, Associated Tobacco Company, and Alliance One, among others, are located.

The BR-287 is a single roadway highway, with narrow shoulders and good paving conditions. The highway has two tolls, one in Venâncio Aires with a flow of 4 million vehicles a year, and another in Candelária, with 2.5 million vehicles a year.

BR-116

The BR-116 is the main Brazilian highway, and also the largest totally paved highway in the country. It is a longitudinal highway that begins in the city of Fortaleza, in the state of Ceará, and ends in the town of Jaguarão, in the state of Rio Grande do Sul, on the border with Uruguay. The total length of the highway is approx. 4,385km, going through ten states, connecting towns such as Pelotas, Porto Alegre, Canoas, Caxias do Sul, Lages, Curitiba, São Paulo, Guarulhos, São José dos Campos, Volta Redonda, Rio de Janeiro, Magé, Muriaé, Governador Valadares, Teófilo Otoni, Vitória da Conquista, Feira de Santana, and Fortaleza.

The stretch between Dois Irmãos and Porto Alegre is considered the second busiest in the country. It jJunctions with the RS-239 at km 232, in the municipality of Novo Hamburgo, and the RS-240 at km 245, in the municipality of São Leopoldo. In Porto Alegre, there is a junction with the BR-290 (Free-Way) and the end of the duplication in Eldorado do Sul. In Pelotas, there is the junction with the BR-392, BR-471 and BR-293. The highway ends in Jaguarão, on the Brazil and Uruguay border. In 2013, the works of duplication of the stretch between Guaíba and Pelotas begin, in the state of Rio Grande do Sul, where the stretch between Porto Alegre and Novo Hamburgo was already duplicated.

The BR-116 is parallel to the waterways of the dos Patos Lagoon, Mirim and São Gonçalo channel. Although it connects the capital city to the towns of Camaquã, Pelotas and Jaguarão, the highway is a single roadway highway with bad maintenance conditions of the pavement and narrow shoulders.

BR-392

The BR-392 is an important highway that crosses the center of the state of Rio Grande do Sul. In this highway, a large portion of the raw material produced in the inland of the state is transported. It begins in the municipality of Rio Grande, in the Super Porto, and runs up to Porto Xavier, on the Argentinean border. All along its length, the BR-392 is known by several names. The variations are due to the connection among several municipalities, such as Rio Grande, Pelotas, Cerrito, Morro Redondo, Canguçu, Piratini, Santana da Boa Vista, Caçapava do Sul, São Sepé, and Santa Maria.

The stretch of vital importance in the BR-392 is the one that connects Pelotas to the port of Rio Grande, complementing the connection to the capital city, Porto Alegre, by the BR-116 to the port. This stretch, with a toll, has only one roadway and is in works of duplication.

BR-386

The BR-386 is a Brazilian federal highway that connects Canoas (in the metropolitan region of Porto Alegre, capital city of Rio Grande do Sul) with the municipality of Iraí (in the far northwest of the state], on the Santa Catarina border). The stretch of 66km between Canoas and Tabaí is duplicated. Currently, works of duplication are taking place on a stretch of 34km between Tabaí and Estrela, which shall be ready at the end of 2013. The stretch between Estrela and Lajeado is already duplicated.

This highway connects the towns of Canoas, Nova Santa Rita, Tabaí, Paverama, Taquari, Fazenda Vilanova, Estrela, Lajeado, Marques de Souza, Pouso Novo, São José do Herval, Fontoura Xavier, Soledade, Tio Hugo, Carazinho, Sarandi, Frederico Westphalen, and Iraí.

Its relevance is on the stretch that connects the BR-287 with the city of Porto Alegre (RS), complementing an alternative route to the Jacuí Waterway. In this stretch there are two roadways and traffic conditions are good.

CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais

Barragem existentes
- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes
- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO SUL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:4.000.000	- BRASIL -	JUL/2013

Railroads

The main railroads that are part of the Southern water system are described below.

EF-290

The EF-290 is a transverse railroad that crosses the state of Rio Grande do Sul through the border with Argentina. Its alignment is parallel to the BR-290 and consequently to the Jacuí River. It is operated by América Latina Logística Malha Sul S/A, connects the towns of Porto Alegre, Santa Maria, Cacequi and Uruguaiana up to the Argentina border. The gauge-type is the metric one and the main transported cargoes are soy meal, oil products, alcohol, rice, fertilizer and soybeans.

EF-293

The EF-293 is a transverse railway that crosses the state of Rio Grande do Sul among the towns of São Sebastião, Brasília, Pelotas, and Rio Grande. It is operated by América Latina Logística Malha Sul S/A. The gauge-type is the metric one and the main transported cargoes are soy meal, oil products, alcohol, rice, fertilizer and soybeans. Its most relevant stretch connects Pelotas to the port of Rio Grande.

EF-153

The EF-153 is a railway that crosses the states of Paraná, Santa Catarina, and Rio Grande do Sul up to the connection with the Uruguay border in Santana do Livramento. In Rio Grande do Sul, it crosses the EF-293, having a stretch shared with that railway between the municipalities of Cacequeí (RS) and Santa Maria (RS). It is operated by América Latina Logística Malha Sul S/A. The gauge-type is the metric one and the main transported cargoes are soy meal, oil products, alcohol, rice, fertilizer and soybeans

3.5.3.3 Characteristics of the existing fleet and the operative companies

Currently, according to the Antaq statistical yearbook of 2011, there are only two navigation companies that operate in the Southern waterway system: Navegação Aliança and Laçador Navegação. The former is the most important, with the biggest fleet (12 self-propelled vessels), and the latter, only one vessel. The table below shows the main characteristics of the operative fleet.

Table 3.5.12: Fleet of the main operative company in the Southern Waterway System (Source: Prepared based on the Antaq Statistical Bookyear, 2011)

Navigation Company	Total Statistic Capacity (ton)	Minimum Capacity (ton)	Maximum capacity (ton)	Number of vessels	Maximum LOA (m)	Maximum breadth (m)	Maximum draft (m)	Average age (years)
Navegação Aliança Ltda.	49.706	1,031	5,400	12	110	16	4.69	33,6

3.5.3.4 Management System of River Information

As mentioned in Chapter 3.5.4, the AHSUL and the SPH are responsible for the management of the Southern waterway system and for the system maintenance works, as well as the signaling.

These entities carry out bathymetric surveys and monitoring of the water level in this waterway system. This last one can be verified on the SPH website; there are four measurement stations: Guaíba – Harmonia ruler, Jacuí – Anel de Dom Marco and São Gonçalo ruler – Pelotas port pier ruler, however, only information on Guaíba is on the SPH website.

Moreover, the nautical signaling system is being implemented, especially on the dos Patos Lagoon, to improve the safety of the navigation.

3.5.3.5 Intermodal Competition

Based on the results presented in Chapter 3.5.2, the conclusion is that the potential cargo for the Southern waterway system is that generated by the agricultural bulk exports from Rio Grande do Sul and Santa Catarina. The cargoes that could increase the IWT are those related to the chemical sector, timber and pulp.

For each significant micro-region (those which produce more than 400,000 tons of soybeans per year, or that contain at least one municipality that produces more than 100,000 tons per year), the transport distances for different alternatives were determined. The assumption is that the cargo is loaded at the port of Estrela. Based on these distances, the cost of transport was calculated, using the cost model (see Chapter 1.3.4). The table below shows the costs of transport of the micro-region through Rio Grande, considering two alternatives: mmultimodal and highway only.

Table 3.5.13: Costs of Transport – Southern Waterway System (R$/ton).

Micro-region	Rio Grande	Rio Grande	Multimodal/Highway ratio
	Multimodal	highway	
Cachoeira do Sul	87	92	95%
Palmeira das Missões	103	126	82%
Cruz Alta	100	110	91%
Quatro Irmãos	103	136	76%
Nonoai	109	146	75%
Ijuí	109	117	93%
Passo Fundo	90	123	73%
Tupanciretã	108	106	102%
São Miguel das Missões	120	130	92%
Muitos Capões	98	127	77%
Campos Novos	114	143	80%
Abelardo Luz	129	166	78%

Generally, the multimodal alternative is that of lower cost in relation to the direct highway; in average, the first one represents approx. 84% of the second one's costs. The competitivity of the multimodal alternative could be considered 'reasonable'.

Although the Southern waterway system presents a railway network connected to the port of Rio Grande, there is no direct connection between Porto Alegre and Rio Grande, which implies an additional distance of around 600 kilometers from the productive regions to the port. This distance results in an additional cost of, on average, R$ 50 per ton. Thus, the railway transport presents relatively higher costs.

3.5.4 Governance and institutions

The Southern waterway system, which comprises the waterways of the Jacuí, Taquari, Caí, Rolante, Gravataí, Camaguã, Jaguarão Rivers, Mirim Lagoon and dos Patos Lagoon, and its main intervenient institutions on waterway matters is the AHSUL – Administração Hidroviária do Sul (Annex I) at the federal level and the SPH/RS – Superintendência de Portos e Hidrovias do Rio Grande do Sul (Annex I) at the state level.

Besides these two main intervenient institutions in the Southern Waterway Systems, other governmental agencies are also present, with a specific area of work for each of them. It is worth saying that these attributions reflect the contents in the legal text which defines them, in some cases not depicting their real work. In the table below, it is possible to see in a synthetic way which institutions have similar areas of work. Below, their detailed assignments and interaction form.

Table 3.5.14: Matrix of Formal Attributions of the Southern Waterway System agents

	Port administration	Inspection	Waterway Maintenance*	Licensing process	Regulation
Administrator (AH) – AHSUL	■		■		
Captaincy of the Rio Grande do Sul ports		■			
Super Port of Rio Grande – SUPRG	■				
State superintendence	■		■		
CODOMAR	■				
State and Environment Secretariat				■	
DNIT/DAQ					■
ANTAQ		■			■
IBAMA				■	■
SEP	■				■
Other Agents**				■	

*Execution of dredging, rock excavation, and signaling.

**This block comprises all the agents consulted by IBAMA in the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN, and the Public Ministry)

Source: Arcadis Logos Consortium, 2012

The AHSUL represents the Union and is responsible for the maintenance of the inland navigation on the water courses in the states of Rio Grande do Sul and Santa Catarina, focusing its operation mainly on the Jacuí and Taquari Rivers, as well as on the Mirim Lagoon, all located in the state of Rio Grande do Sul. The AHSUL operates also on the Uruguai River and its tributary, the Ibicuí River. However, this is a less significant route and, according to the SPH, will serve for the installation of energy generation complexes. In the Jacuí and Taquari Rivers, the AHSUL maintains and operates directly four locks – three on the Jacuí River (Amatópolis, Anel de Dom Marco and Fandalgo locks) and one on the Taquari River (Bom Retiro lock). The Waterway Administration conducts topohydrographic surveys necessary to the execution of dredging, for the maintenance of the depths of the project along the navigable channels and executes the beaconage along the stretches maintained in free current. Besides, the AHSUL is also responsible for the Coal Terminal of Charqueada. The Estrela river port is currently directly subordinated to CODOMAR (Annex I), due to the extinction of Portobrás, when several units of the company were transferred to the Companhias Docas (Annex I), by agreements signed with the Ministry of Transport (Annex I). The port of Estrela, specifically, was transferred to CODESP (Annex I), which had the attribution to administer the port, thus transferring employees. By the Convênio de Apoio Técnico e Financeiro para Gestão de Hidrovias e Portos Interiores (agreement for technical and financial support for management of inland waterways and ports) No. 007/2008/DAQ/DNIT, the port was transferred directly to CODEMAR, but maintaining the employees transferred from CODESP.

At the state level, the operation in water port system infrastructure is performed by two superintendences subordinated to the SEINFRA - Secretaria de Infraestrutura e Logística do Rio Grande do Sul (Rio Grande do Sul Infrastructure and logistics secretariat) (Annex I). The SUPRG – Superintendência do Porto de Rio Grande (superintendence of the port of Rio Grande) (Annex I), as indicated by its name, is the Port Authority of the Rio Grande Port, and is responsible for the studies, improvements, operation and maintenance of the referred to port. The SPH - Superintendência de Portos e Hidrovias (port and waterway superintendence) (Annex I), the former DEPRC (state department of ports, rivers and channels), is responsible for the ports of Porto Alegre and Cachoeira do Sul, the access channels to these and to the other state terminals and waterways. The port of Pelotas was linked to the SPH, but a state law incorporated it to the SUPRG, which did not show interest and sent a bill to overturn the incorporation, returning it to SPH.

There is also the ALM – Agência Lagoa da Lagoa Mirim (Mirim Lagoon) linked to the Federal University of Pelotas, which is responsible for the maintenance, operation and administration of the Dam Lock of São Gonçalo, built with the purpose of avoiding the intrusion of salt water in the Mirim Lagoon, guaranteeing the quality of the water and a better use of the natural resources.

All the locks in this system are administered by public agencies, resulting in no fees for its use, the so called lock tariffs. The ALM charges the fees (R$ 30.00) only when it operates out of the pre-determined hours (9, 11, 15 and 17h).

Besides being technically feasible, generated by a good infrastructure and frequent maintenance, the waterways have also to be environmentally feasible. This feasibility is analyzed by the IBAMA - Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (Brazilian institute for the environment and renewable natural resources) (Annex I), because the dos Patos Lagoon has an extremely fragile ecosystem, at the federal level, and by FEPAM – Fundação Estadual de Proteção Ambiental Henrique Roessler (Henrique Roessler state foundation for environmental protection (Annex I), linked to SEMA – Secretaria de Estado do Meio Ambiente do Rio Grande do Sul (Rio Grande do Sul environment state secretariat), at the state level, because the Southern Waterway System is entirely located in the state of Rio Grande do Sul. Those institutions shall communicate with each other for a better analysis of the effects caused by the change in the environment. The IBAMA shall ask FEPAM, besides other institutions that are normally consulted in the licensing processes, to express themselves technically about the compliance of the enterprise with its respective plans and rules, and FEPAM shall inform IBAMA about the licensing process application, as well as send copies of all documents.

Also linked to the SEMA, there are Comitês de Bacias Hidrográficas (water basin committees), collegiate bodies that are part of the Sistema Nacional de Gerenciamento de Recursos Hídricos (national system of water resources management). The committees are composed of representatives of public agencies and entities with interest in the management, supply, control, and protection and use of the water resources, as well as representatives of the municipalities of the corresponding Water Basin, the users of water and representatives of the Civil Society with actions in the water resources area by means of their associative entities.

Their objective, besides the approval of the Plano de Recursos Hídricos da Bacia (basin water resources plan), is to arbitrate conflicts for water use, in first administrative instance, establish mechanisms and suggest the values charged for the use of the water.

The Rio Grande do Sul Ports Captaincy (Annex I) orients about the necessary signaling for the operation of the waterway and inspects whether its rules are being complied with. Its objective is also to guarantee navigation safety, to prevent water pollution, and national defense.

To improve this integration between the state and federal levels, the Ministério dos Transportes (Annex I) intends to create a 'Comitê Gestor da Hidrovia' (waterway management committee), with the participation of federal and state entities responsible for the infrastructure of this waterway, such as DNIT, Antaq, DHN – Diretoria de Hidrografia e Navegação (navigation and hydrography directorate) and DPC – Diretoria de Portos e Costas (coast and port directorate) at the federal level and of SUPRG – Superintendência do Porto de Rio Grande and of SPH – Superintendência de Portos e Hidrovias, at the state level. The users of the waterway would present their demands and complaints to these agencies and the 'Comitê Gestor' would send the necessary measures to the responsible agency and would ask, when the subject goes beyond the attributions of a sole agency, for the participation of other entities. The 'Comitê Gestor da Hidrovia' shall also have, among its attributions, the preparation of a "Gestão Ambiental da Hidrovia" (environmental management of the waterway) program, with the participation of the IBAMA and of the FEPAM.

As a first step for the creation of the Committee, the Convênio de Cooperação Técnica e Financeira was signed in February 2012 by the Secretaria de Infraestrutura do Rio Grande do Sul (SEINFRA/RS) and the SPH/RS (Superintendência de Portos e Hidrovias). The partnership between the agencies is to modernize the South and Uruguai waterways, in their technical aspects of dredging, signaling, beaconage and instrumentation. These actions will be developed jointly by the Administração de Hidrovias do Sul – AHSUL and the SPH/RS.

3.5.5 SWOT Atlantic Waterway System

Strengths	Weaknesses
• The dos Patos Lagoon is suitable for the navigation of sea vessels. • The Jacuí River is navigable, with important restrictions, from Porto Alegre to Cachoeira do Sul. • The Taquari River is navigable from its mouth to Porto Estrela/Lajeado. • The first 20km of the rivers Caí, Sinos/Rolante, and Gravataí are navigable. • There is an active Technical Committee, composed by state and federal authorities, to overcome challenges that influence the navigability of the rivers. • Due to the cooperation among several sectors and collaborators, a system of inland navigation is already operative, with three dams built with locks. • The Southern waterway has some support infrastructure, thus having less necessity of new interventions that could cause environmental and social impacts. • The Rio Grande port is the only sea port that can move the cargo produced in the Rio Grande do Sul region, thus wood and pulp are captive cargoes of this port and, if the Southern waterway system becomes competitive, these cargoes could be captive of this system. • In a general way, the multimodal alternative is that of lower cost in relation to the direct highway; in average, the first one represents approx. 84% of the second one's costs. The competitivity of the multimodal alternative could be considered as 'reasonable'.	• The Mirim Lagoon has sedimentation and shallow depth problems. • The São Gonçalo Channel does not allow the passage of big convoys. • The Jaguarão and Camaquã rivers have many sandbanks and shallow depth. • AHIPAR faces difficulties to operate, imposed by the lack of access to financial and human resources (due to the agreement signed by DNIT/DAQ and CODOMAR). • Lakes in general have peculiar fauna and flora that need to be taken into consideration in the intervention planning phases. More studies are needed related to the dos Patos and Mirim lagoons, to avoid environmental impacts in the region. • Interventions on the Camaquã River should consider the presence of indigenous communities (near to dos Patos Lagoon) and some Áreas de Conservação de Proteção Integral (integral protection conservation units) on Mirim Lagoon.

Opportunities	Threats
• Potential cargo in 2031 – Agriculture → 2.8 million tons – Industry → 6.6 million tons – Containers → 60,000 containers TEU (sea container of 20 feet) • The waterway represents an alternative of transport in the region with lower emission of greenhouse gas .	• The expansion of the North-South railway, connecting the Rio Grande port to São Paulo, could compete for the same cargo of the waterway.

3.6 SISTEMA HIDROVIÁRIO DO PARAGUAI

3.6.1 Physical system of the river and environmental and social aspects

The set of basins that forms the Paraguay Waterway System takes up an area of 328.374m2, inserted within the limits of the Pantanal biome. The state capitals, Cuiabá (MT) and Campo Grande (MS), together with the municipalities of Corumbá (MS), Várzea Grande (MT) and Santo Antonio do Leverger (MT) are the most populous cities of a total of 101 municipalities comprised by the WS

The Paraguay waterway system has very specific physical conditions. The area is swampy and has its own hydrological regime. The Paraguay River has two distinct segments from the navigation viewpoint. From the mouth of the Apa river (stretch 1) to Corumbá (stretch 57), the river is navigable by large commercial convoys, without much trouble; and between Corumbá (MS) and Cáceres (MT) (stretch 121), the river is navigable by small and medium size vessels, presenting difficulties and trouble of more relevance, which is due mainly to river islands, silting and excess of sinuosity.

The analyzed tributaries (Miranda, Taquari, São Lourenço and Cuiabá Rivers) have poor navigability conditions, being the main reasons the small dimensions of the navigable channel and high sedimentation processes, resulting from the increasing erodibility of the soil (verified) in the areas of the basin mouths of these rivers.

The analyses and studies conducted for the characterization of the physical and social-environmental conditions of the potential waterways of the Paraguay Waterway System followed the methodologies presented in Chapter 1 – item 1.3 Methodology, of the report.

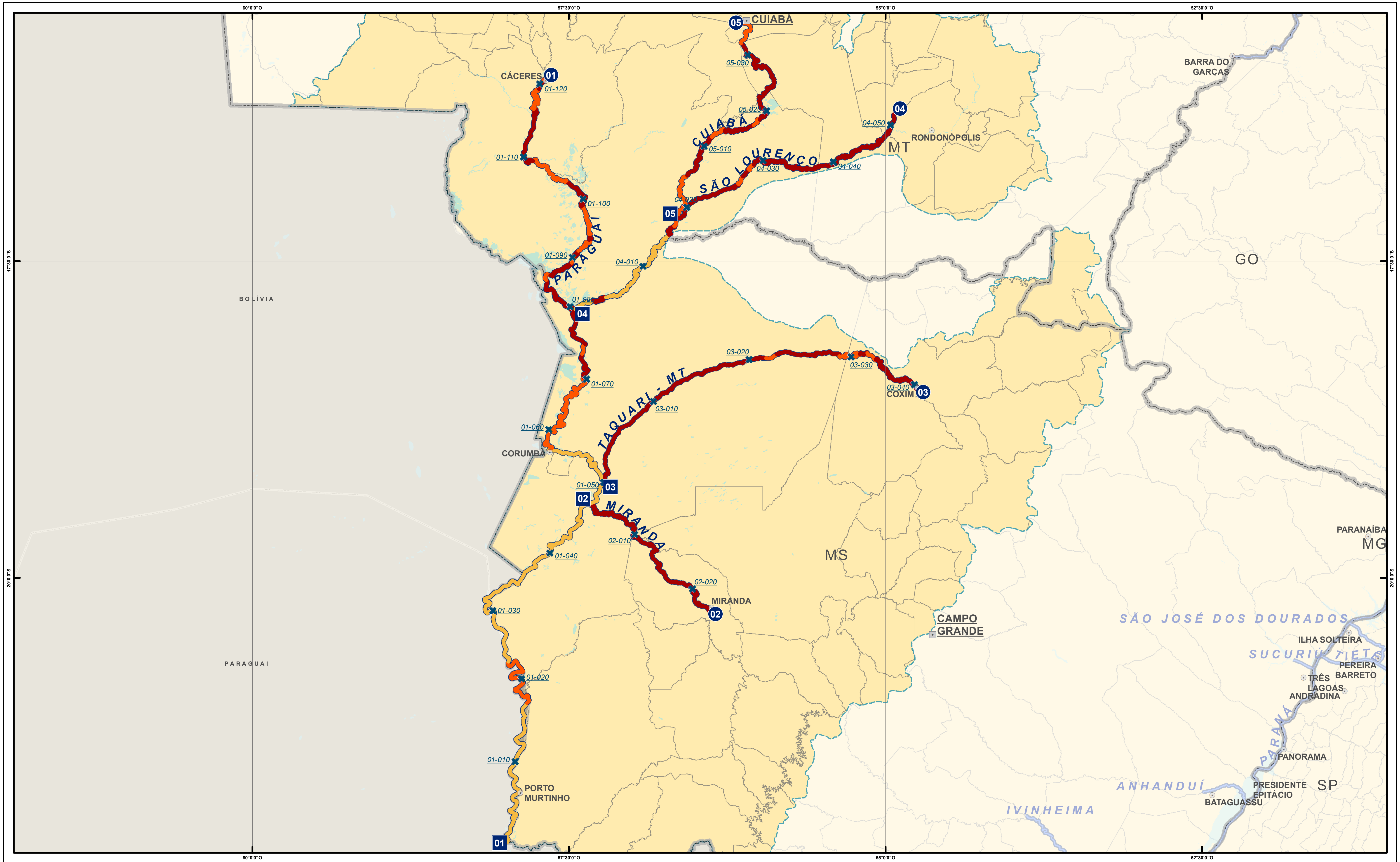
Due to the great volume of information collected and analyzed, this chapter shows the summary of the main results and conclusions for each river under study.

The CD annexed to this report (Step C: Assessment and diagnosis) contains a table in the .xls format, which shows in a more detailed way all the variables and information analyzed for each river and for each stretch under study.

The Linear Diagrams in this chapter summarize the mentioned table; following the methodology exposed in chapter 1, item 1.3 of this report.

As the result of the final step of the Strategic Waterway Plan (Step F: Preparation of the final strategic plan) a Georeferenced Database is presented, which contains all the existing information in the table of the CD attached to this report.

The main characteristics in relation to the navigability conditions of the waterways of the Paraguay WH can be verified jointly in the one-line diagram presented in sequence.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 01 Rio Paraguai
- 02 02 Rio Miranda
- 03 03 Rio Taquari - MT
- 04 04 Rio São Lourenço
- 05 05 Rio Cuiabá

Bacias do SH Paraguai

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 25 50 100 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

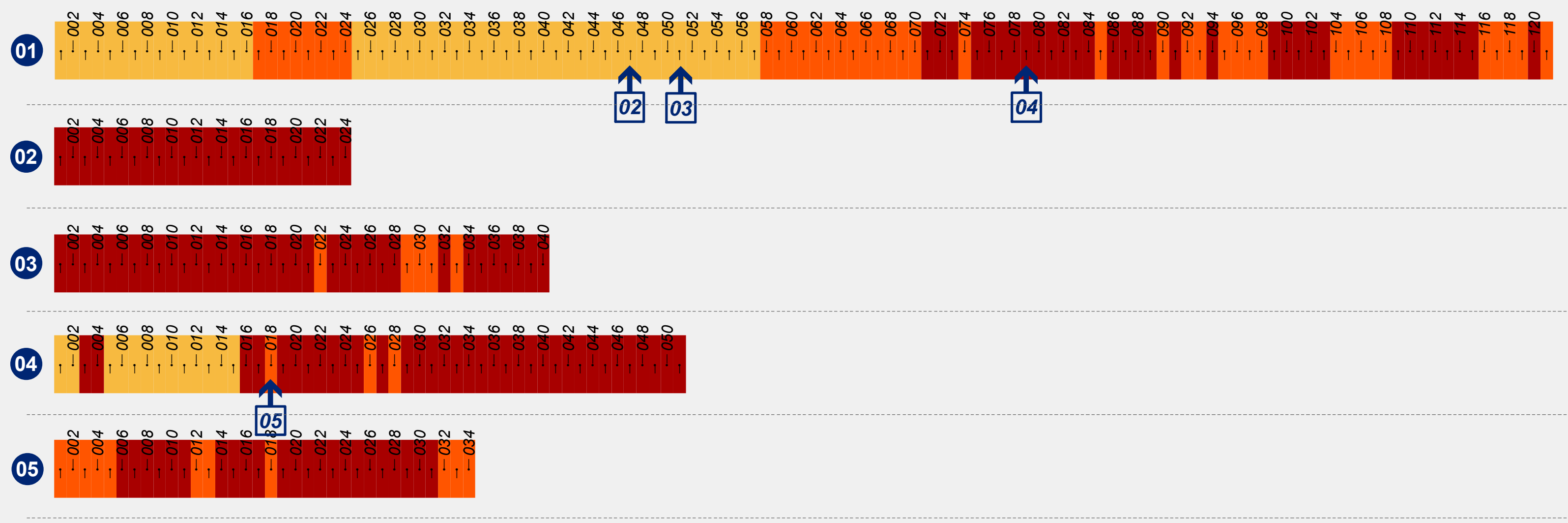
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:3.000.000	SH PARAGUAI	MAI/2013



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	*ALTO DE:*	*MÉDIA DE:*	*BAIXA DE:*	
Sinuosidade; ou	*Sinuosidade; ou*	*Sinuosidade; ou*	*Sinuosidade; ou*	*Ausência das ocorrências*
Profundidade mínima; ou	*Profundidade mínima; ou*	*Profundidade mínima; ou*	*Profundidade mínima; ou*	
Empecilhos à navegação (construções); ou	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	
Energia do rio; ou	*Energia do rio; ou*	*Energia do rio; ou*	*Energia do rio; ou*	
Leito do rio; ou	*Leito do rio; ou*	*Leito do rio; ou*	*Leito do rio; ou*	
Assoreamento; ou	*Assoreamento; ou*	*Assoreamento; ou*	*Assoreamento; ou*	
Anteparos naturais; ou	*Anteparos naturais; ou*	*Anteparos naturais; ou*	*Anteparos naturais; ou*	
Largura mínima do rio.	*Largura mínima do rio.*	*Largura mínima do rio.*	*Largura mínima do rio.*	

CONVENÇÕES CARTOGRÁFICAS

01 Rio Paraguai
02 Rio Miranda
03 Rio Taquari - MT
04 Rio São Lourenço
05 Rio Cuiabá

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

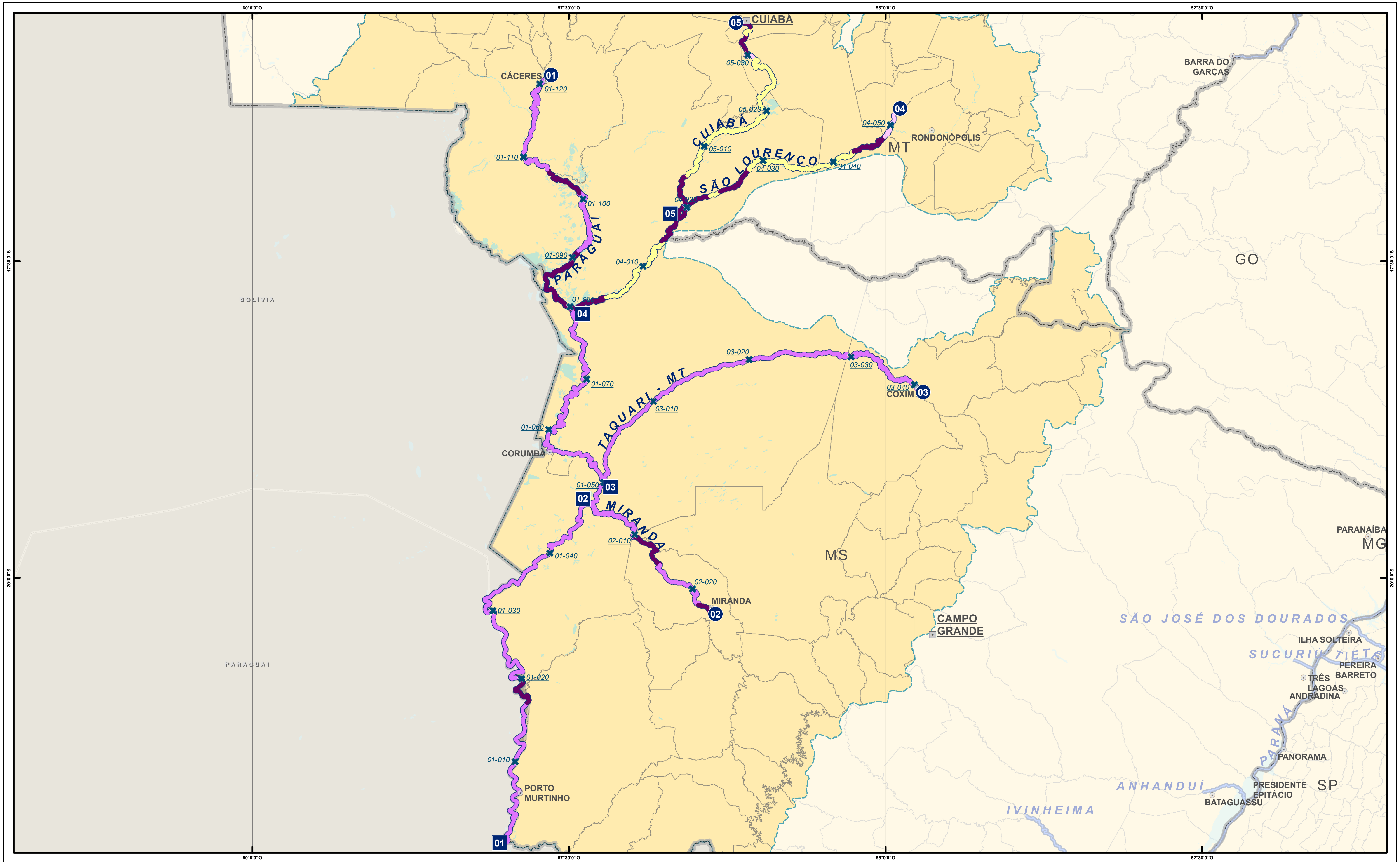
ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH PARAGUAI	MAI/2013

The main social-environmental characteristic which is worth to highlight to foster the integrated planning of occasional necessary interventions in the region where the Paraguay WS is inserted can be verified jointly in the one-line diagram presented in sequence.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Paraguai
- 02 Rio Miranda
- 03 Rio Taquari - MT
- 04 Rio São Lourenço
- 05 Rio Cuiabá

Bacias do SH Paraguai

Trechos de 10 km (xx-yyy)
xx: n° do rio
yyy: n° do trecho
*km = yyy * 10*

Escala de ponderação dos temas
1 - 5 (baixa - alta)
- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 25 50 100 km
SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

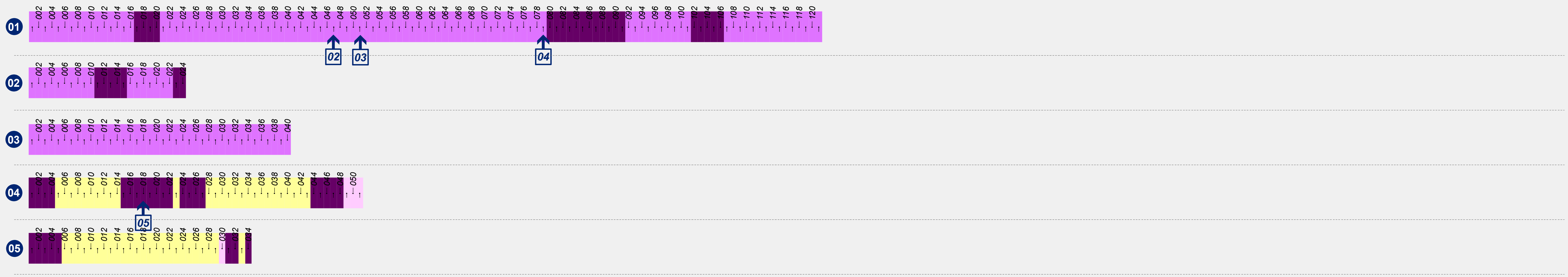
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:3.000.000	SH PARAGUAI	MAI/2013



VULNERABILIDADE SOCIOAMBIENTAL

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
UC - proteção integral; ou	*UC - uso sustentável; ou*	*Assentamento INCRA; ou*	*APCB; ou*	*Ausência das ocorrências*
Terra indígena	*Comunidade quilombola*	*Vulnerabilidade ao desmatamento; ou*	*Mineração - Lavra e garimpo*	
		Cavidades naturais		

CONVENÇÕES CARTOGRÁFICAS

01 Rio Paraguai
02 Rio Miranda
03 Rio Taquari - MT
04 Rio São Lourenço
05 Rio Cuiabá

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionésimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH PARAGUAI	MAI/2013

As can be seen in the presented one-line diagram, with the exception of the Taquary Waterway, all the waterways of this WS have stretches considered as vulnerable to possible interventions, owing to the presence of Indigenous Lands and Integral Protection CUs.

Moreover since these waterways are inserted in the Pantanal Biome the area as a whole is considered more fragile from the conservationist viewpoint. Areas much more sensible are found in the confluence of the Paraguay and São Lourenço Rivers, a region which delimits the municipalities of Cáceres (MT, Poconé (MT) and Corumbá (MS) – where there is an Integral Protection CU which affects the two rivers – as well as in the confluence of the São Lourenço and Cuiabá rivers, between the municipalities of Barão de Melgaço and Poconé (MT) – where there are Integral Protection Conservation Units in Indigenous Land, what makes the two rivers very sensitive in case of future interventions.

The main characteristics of this Waterway System waterways are described below.

3.6.1.1 Paraguay Waterway

a) Navigability Diagnosis

The source of the Paraguay River is in the Serra de Araporé, the Southern hillside of the Serra dos Parecis, in the state of Mato Grosso. The river basin extends over a chapada (plateau in the Brazilian highlands), the Brejal das Sete Lagoas, where the waterway basins of the Prata and Amazônica are separated. The river defines the Brazil-Paraguay border by around 330km (stretches 1 to 33), crosses Paraguay and flows into the Paraná River, in the Paraguay – Argentina border, near to the Paso da Patria city.

Its alignment runs in the general sense of the NE to SW, from the mouths until its discharge at the mouth in Paraná River, with 2.621km of extension. From this total, the river runs in the Brazilian borders in an extension of around 1,693km. With sovereignty shared with Bolivia, there are 48km of extension (stretches 33 to 37) and 332km of shared borders between Brazil and Paraguay (stretches 1 to 32). Its waterway region comprises an area of 1,095,000km^2, being 33% in Brazil and the rest in Argentina, Bolivia and Paraguay.

The Paraguay River behaves in a different way, when compared to the other Brazilian rivers, with respect to the number of flood peaks, reflecting its light gradient (0. 70 to 6.5cm/km) and the presence of Pantanal that cushions and stores the floods. The waterway records of the city of Ladário (MS) (1900 – 2011), where there is also only a peak of flood in the river, show that the hydrologic cycle in this whole period always lasted 12 months, i.e., one upwards period (between December and June), and a recession (between June and December) each year, that can delay or accelerate from 1 to 3 months, depending on the flood levels. This phenomenon is due to the complex combination of several plains, whose lagoons and bays act as flow regulators, accumulating water and cushioning the elevation of the level during the floods and giving water during recession. The medium flow of the Paraguay River, in Porto Murtinho (MS) (stretch 7), is of approx. 2,300m^3/s (see Annex 7, item 4.7.1).

The Paraguay Waterway considered in this study goes from the mouth of the Apa River (stretch 1) to the city of Cáceres (MT) (stretch 121).

The bed of the Paraguay River is constituted of sedimentary and non consolidated material, and with the physical characteristics of the Pantanal region. There are sensitive channel changes and variable depths from year to year. Several stretches have high sinuosity rates, with values higher than 2 (between the stretches 17 to 24 and the stretches 86 to 117). The average declivities are very low, being 2cm/km between the mouth of the Apa river and Corumbá (MS) and 6cm/km between Corumbá (MS) and Cáceres (MT; hence, the runoff velocity is slow all waterway long.

From the mouth of the Amapá River (MS) (stretches 1 to 57), the main restrictions were reduced radii of curvature (stretch 36) and the presence of two bridges (BR-262, stretch 46, and railway bridge Eurico Gaspar Dutra – Passo do Jacaré region – stretch 44), which depending on the width of the convoy, can force to dismember the barges. However, due to the natural conditions of the river (minimum depths of around 3m), the navigation of big convoys is allowed with the occasional systematic dismemberment of the convoy. Besides the referred to restrictions, the stretch considered presents other difficulties, of smaller magnitude, for the navigation, as: low and swampy banks that can lead to the losing of the channels in high waters; vegetation and floating tree trunks which, in the floods, can cause malfunctions to the vessels (mainly to the propulsion system); difficulties to find the navigable channel at night, etc. Due to these and other difficulties, the navigation is interrupted at night in some stretches, in low waters, during 25% of the year (91 days). In this stretch travel convoys with 4x4 formation, comprise barges of 60m long and 12m wide, with 2.6m of draft, with capacity to transport 20,000 to 25,000 tons of cargo per convoy.

Figure 3.6.1: Railroad Bridge Eurico Gaspar Dutra (stretch 44) (Itti, 2011)

In the city of Corumbá (MS) there is a supply water intake whose dimensions of the central spam restrict the passage of vessels between Corumbá and the Puerto Soares city, in Bolivia, through the Tamengo Channel, thus restricting the only access to the sea (Atlantic Ocean) of that country. This intake does not represent, however, an obstacle to the passage of vessels between Corumbá (MS) and Cáceres (MT). The figure below shows that obstacle.

Figure 3.6.2: Water Intake in the city of Corumbá (MS) (stretch 57) (Panoramio, 2013)

In the segment between Cáceres (MT) and Corumbá (MS) (stretches 58 to 121) the alignment is sinuous (the sinuosity rate reaching 2.4) and stretch (stretch 88, minimum width 40m) and the navigation is difficult at some points due to the mobile bed of the river, besides existing some very reduced radii of curvature. In this stretch travel convoys with 2x3 formation, comprise 45m long and 12m wide barges, with 1.50m of draft, with capacity to transport up to 2,400 tons of cargo per convoy. The navigable river channel is 45m wide and has a medium depth of 1.80m during 70% of the year. On the other 30%, the depth is reduced to 1.20m due to sandbank formation, mainly in the stretch of around 150km between Porto Morrinhos (stretch 107) and Cáceres (stretch 121) implying limitations to the navigation and forcing' the convoys to operate with less cargo or, in severe dry seasons, to not navigate, mainly in the mentioned segment. The figure below shows the average behavior of Paraguay river between Porto Morrinhos and Cáceres.

Figure 3.6.3: Paraguay River in Porto Morrinhos (stretch 108) (Panoramio, 2013)

In the place called Guaíba Lake (stretches 83 and 84), in case of west-east winds, we can see waves that reach the sides of the vessels, causing loss of stability and capacity control.

Figure 3.6.4: Part of the sinuous stretch between Porto Morrinho and Cáceres (Google Earth, 2013)

Due to the high sinuosity verified in this stretch, the commercial convoys bump in the river banks causing environmental damages and to avoid it the adopted solution was to put at the convoys bow a little vessel, called "Brasília", for lateral movements, facilitating navigation.

a) Socio-environmental vulnerabilities

The future Paraguay[50] waterway is inserted in the basins of the Cuiabá, Paraguay, Taquari, Negro and Miranda Rivers. The Basin of the Cuiabá River has approx. 44.330km^2, extending through the states of Mato Grosso and Mato Grosso do Sul, covering 20 municipalities, whose total population is 1,175,849 inhabitants (IBGE, 2010).

Of its area, 66% is inserted in the Cerrado Biome and 34% in the Pantanal Biome. It is important to note out of 170 mining works, seven Biodiversity Conservation Priority Areas

[50] O The Paraguay river is an international river, serving as the border of Brazil with Paraguay and, in some stretches, also with Bolivia. It is worth to say that in this study only the existing social-environmental variables were considered in the surrounding of the waterway in national territory.

(APCB's) of extreme or very high priority of action, eight Integral Protection Conservation Units (UCPI), and 48 INCRA settlements can be highlighted.

The Basin of the Taquari River that, as mentioned before, has an area of 59.057km^2, encompasses 19 municipalities in the states of Mato Grosso, Mato Grosso do Sul and Goiás, totaling 489,152 inhabitants (IBGE, 2010). It has 49% of its area in the Cerrado Biome Basin and 51% in the Pantanal Biome. In the basin region there are four Integral Protection Conservation Units (UCPI's), six Biodiversity Conservation Priority Areas (APCB's) of extreme or very high priority of action, 11 INCRA settlements and one Indigenous Land.

The Basin of the Miranda River has an area of 43,937km^2, and its limits intercept 28 municipalities in the state of Mato Grosso do Sul, totaling 1,397,023 inhabitants (IBGE, 2010). It has 83% of its basin inserted in the Cerrado Biome and 17% in the Pantanal Biome. The presence of four Integral Protection Conservation Units, five Sustainable Use Conservation Units, seven Biodiversity Conservation Priority Areas of extreme or very high priority of action, 30 INCRA settlements and, according to FUNAI (2012), 11 Indigenous Lands stand out.

The Negro River Basin has an area of 34,561km^2, comprising six municipalities in the state of Mato Grosso, totaling 61,345 inhabitants (IBGE, 2010). With regard to the conservationist aspects, differently from other basins, the Negro River Basin has its biggest area in the Pantanal Biome, with 80%, and 20% in the Cerrado Biome. It has one Integral Protection Conservation Unit and one of Sustainable Use, four Biodiversity Conservation Priority Areas (APCB's) of extreme or very high priority of action and one area of Maroon Lands.

Finally, the largest basin of the WS is that of the Paraguay River, with an area of 118,748km^2, encompassing 43 municipalities in the states of Mato Grosso and Mato Grosso do Sul, what represents a population of 872,100 inhabitants (IBGE, 2010).

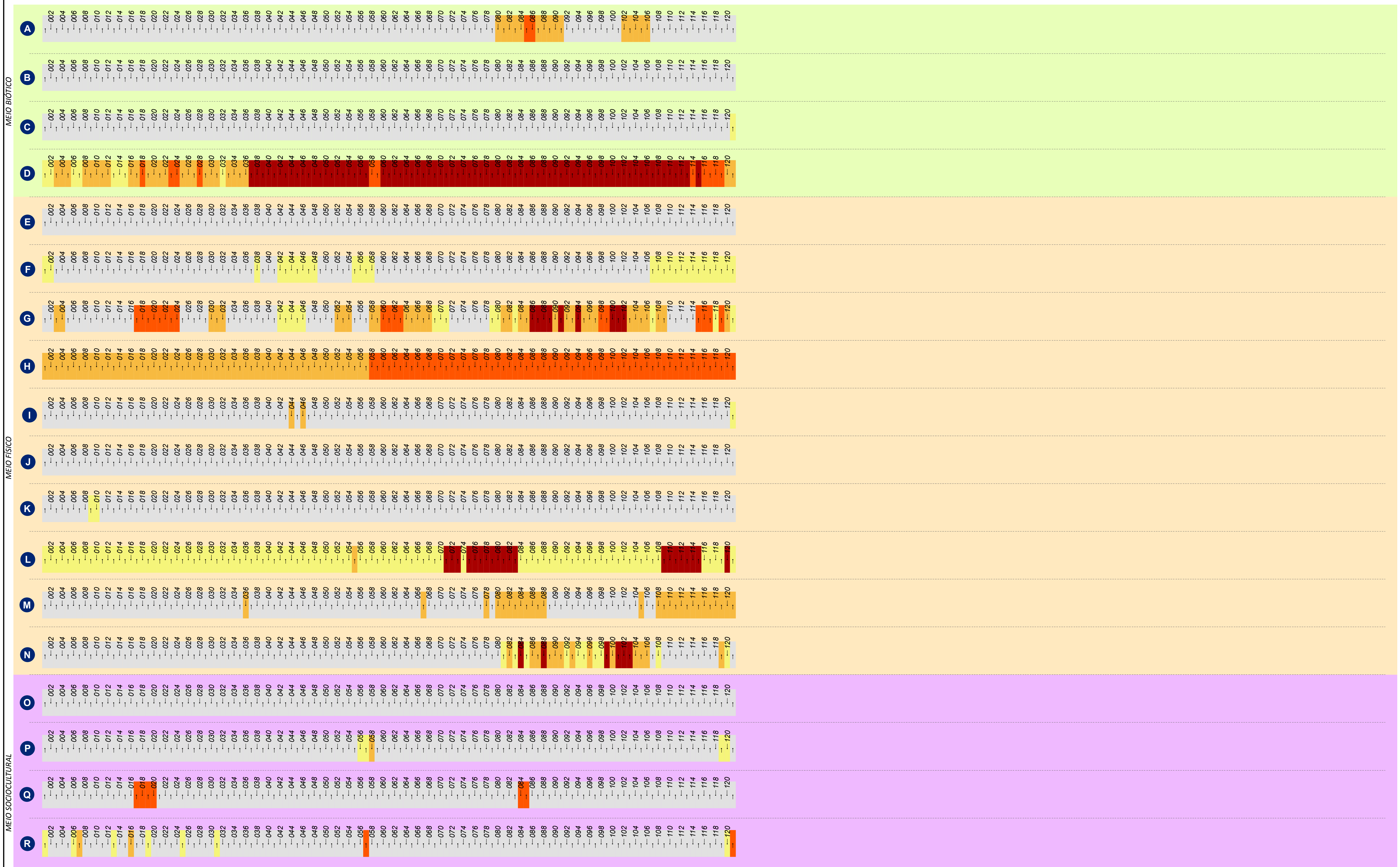
With regard to the conservationist aspects, the Paraguay River Basin has 26% of its area in the Amazon Forest Biome, 34% in the Cerrado Biome and 40% in the Pantanal Biome. It has 45 mining areas, seven Integral Protection Conservation Units (UCPI's), 14 biodiversity Conservation Priority Areas (APCB's) of extreme or very high priority, one Maroon Land, 80 INCRA settlements and 10 Indigenous Lands.

The future waterway of Paraguay River was considered for this study in an extension of 1,200 km, ending at the municipality of Cáceres (MT), where there is a port. The waterway was divided into 121 stretches and these limits cut the territory of six municipalities, Corumbá, Ladário and Porto Murtinho in Mato Grosso do Sul, and Cáceres, Curvelândia and Poconé, in Mato Grosso. These municipalities altogether total a population of 263,279 inhabitants (IBGE, 2010). Cáceres represents the highest FIRJAN Index (2010), of 0.69, while Porto Murtinho represents the smallest.

Map 32: Paraguay Waterway Location

In terms of social-environmental vulnerability, Integral Protection Conservation Units (UCPI's), as the Guirá State Park (Parque Estadual do Guirá) and the Mato Grosso Pantanal National Park (Parque Nacional do Pantanal Matogrossense), are found between stretches 80 to 91 and between stretches 102 to 106, respectively. The Biodiversity conservation Priority Areas (APCB's) are found in the initial stretches near the municipality of Porto Murtinho (MS) and in stretch 121 in Cáceres (MT). In relation to the preservation of the area, between the stretches 37 and 57, comprising the municipality of Corumbá (MS), and also between stretches 60 and 113, the vegetal coverage is very preserved and practically unchanged, what can difficult the access or possible support works to navigation.

All along the waterway there are INCRA settlements in the stretches 56, 57 and 58, in the municipality of Corumbá (MS) and in the stretches 119 and 120 in the Municipality of Cáceres (MT). There are Indigenous Lands in the stretches 17 to 20, the area named Kadiwéu, between the municipalities of Corumbá and Porto Murtinho, and in stretches 84 and 85 the Guató Indigenous Land, in the municipality of Corumbá.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- Ⓐ Unidade de Conservação - Proteção Integral
- Ⓑ Unidade de Conservação - Uso Sustentável
- Ⓒ Áreas Prioritárias para Conservação da Biodiversidade
- Ⓓ Desmatamento do trecho

FÍSICO
- Ⓔ Mineração - Lavra e garimpo
- Ⓕ Espeleologia
- Ⓖ Sinuosidade
- Ⓗ Profundidade
- Ⓘ Empecilhos à navegação (construções)
- Ⓙ Energia do rio
- Ⓚ Leito do rio
- Ⓛ Assoreamento
- Ⓜ Anteparos naturais
- Ⓝ Largura do rio

SOCIOCULTURAL
- Ⓞ Comunidades quilombolas
- Ⓟ Assentamentos INCRA
- Ⓠ Terra indígena
- Ⓡ Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO PARAGUAI	MAI/2013

3.6.1.2 Miranda Waterway

a) Navigability Diagnosis

The Miranda River, tributary of the left bank of the Paraguay, is inserted in the Pantanal region. The river is formed at the encounter of Córrego Fundo with the Roncador River, in the Cerrado region, with an extension of approx. 800km and a drainage area of about 44,740km^2.The rainfall period is February and March, when many fish are attracted for the *piracema* (the fish get to their spawning grounds)In the dry season, the temperature varies a little all over the year and the climate is semi-humid, with moderated water deficiency in the winter. The average temperatures are between 20 and 24^{o}C, and vary according to the seasons of the year, and can reach on average a minimum of 10^{o}C and a maximum of 35^{o}C in the summer. The average flow of the Miranda River is 100m^3/s, in the Tição do Fogo station (see Appendix VII, item 4.7.2).

The Miranda Waterway considered in this analyzis comprises the stretch between its mouth and the Miranda city (MS) (stretch 24), the only city encompassed by the waterway. In this stretch only small size vessel navigation is observed, with a draft smaller than 1m.

The river presents low declivities (variable between 10cm/km and 25cm/km) and high sinuosity along the alignment of the river (with rates that reach 2.5), making the distance to be navigated much longer than the distance in a straight line. Many river arms are verified, abandoned along the meanders. Furthermore, the river is very narrow, with widths varying between 80 and 20m. There are no sufficient data on the minimum depths, however, the estimate is that there are several stretches with minimum depths of around 1, in the dry season and in the stretches more upstream. The figure below shows the behavior of the Miranda River meanders.

Figure 3.6.5: Miranda river meanders (Brasil das Águas, 2007)

The river presents high susceptibility to silting, what can make the navigation conditions worse than expected.

The are 4 bridges crossing the Miranda River, being two of them restrictive to the commercial navigation, due to small dimensions in the bridge spans. They are the highway bridge MT-184, stretch 8, and the railway bridge, stretch 22.

b) Social-environmental vulnerabilities

The Miranda River Basin has an area of 43,937km^2, encompasses 28 municipalities in the state of Mato Grosso do Sul, totaling 1,397,023 inhabitants (IBGE, 2010). The Miranda Waterway is 233km long, divided into 24 stretches of 10km each.

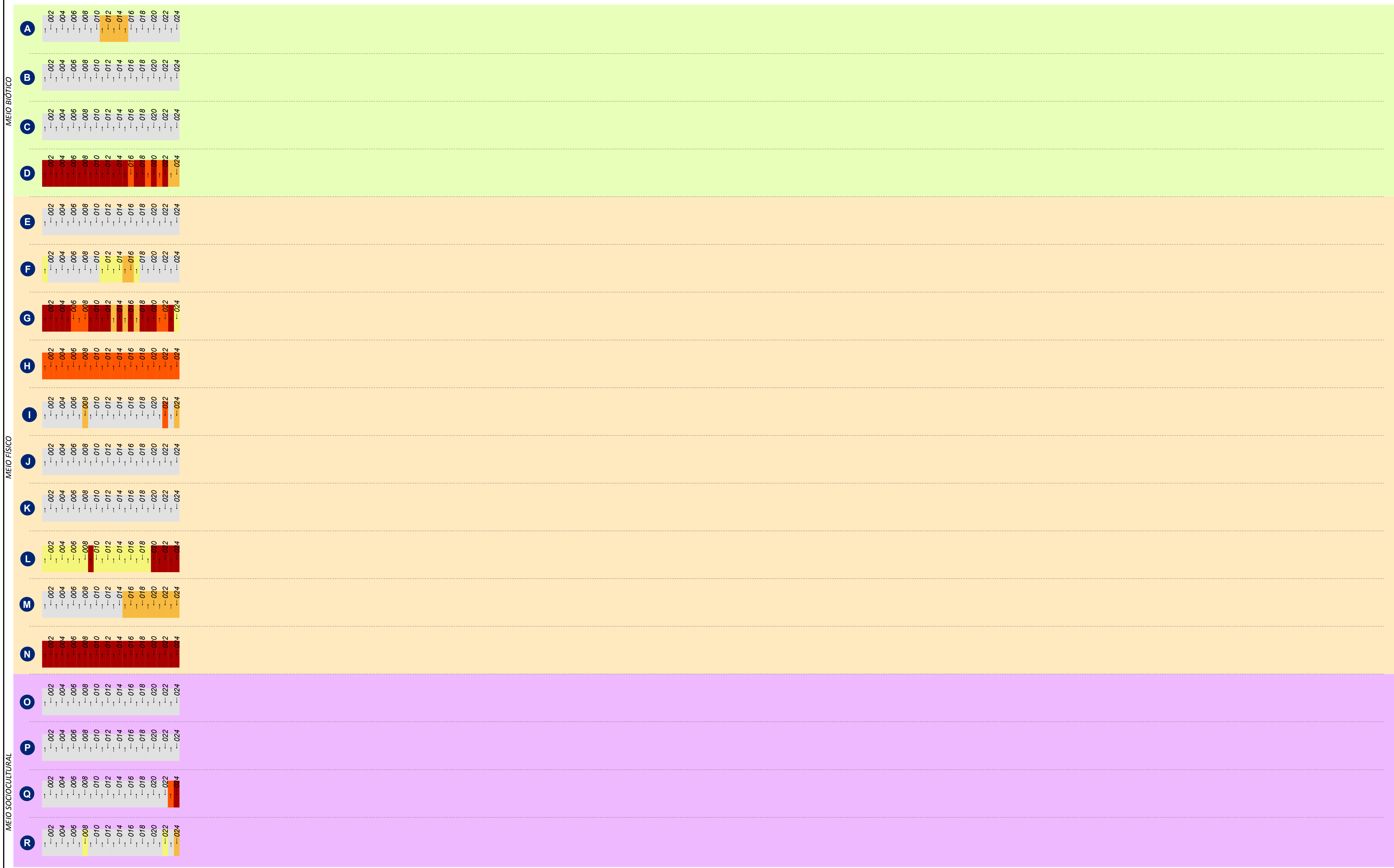
The waterway crosses the municipalities of Aquidauana, Bodoquena, Corumbá and Miranda, with a total population of 182,897 inhabitants. The FIRJAN index (2010) for these municipalities is 0.64 for Corumbá, 0.63 for Aquidauana and Bodoquena and 0.58 for Miranda.

Map 33: Miranda Waterway Location

As per the conservationist aspects, 83% of the basin is inserted in the Cerrado Biome and 17% in the Pantanal. The presence of four Integral Protection Conservation Units (ICMBio, 2012), five Sustainable Use Conservation Units, seven Biodiversity Conservation Priority Areas of extreme or very high priority of action , four Maroon Lands, 30 INCRA settlements and, according to FUNAI (2012), 11 Indigenous Lands.

In terms of social-environmental vulnerability for the surroundings of the waterway, approx. 29% of the stretches are considered vulnerable, with special concentration in the stretches 11 to 15, where there are UCPI (Parque Estadual do Rio Negro) in the municipality of Miranda. In the first stretches of the waterway and in the stretches 23 and 24, there are Indigenous Lands, an area called Cachoeirinha, between the municipalities of Aquidauana and Miranda.

It is worth to mention that between the stretches 01 to 15, in the municipality of Corumbá, and in stretches 17, 20 and 22, in the municipality of Miranda, according to the available data, there is a well preserved vegetal coverage, a characteristic that difficults the access and the execution of works that support the operation of the waterway.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO MIRANDA	MAI/2013

3.6.1.3 Taquary Waterway

a) Navigability Diagnosis

The Taquari River, a tributary of the left bank of Paraguay River, is part of the Pantanal complex. It has an area of 59,057km^2, and his mouth is in one of the Serra do Caipó hillsides, Northwest to the city of Coxim (MS), at the border of the state of Mato Grosso do Sul with Goiás, the High Araguaia region. The river runs around the state of Mato Grosso do Sul and its mouth is near Porto da Mangaba (MS), in the Paraguay River.

As in the entire Pantanal, large volumes of water are concentrated in this basin, generating large swampy areas. This happens due to low declivities, soil waterproofing and type of vegetation.

The flood period is between November and March, however, there are other torrential rainfalls, which change the course of the river in hours. Each year, the change of the water levels causes change in the river bed. The average flow of the Taquari River is around 350m^3/sec in the Porto Rolom station (see Appendix VII, item 4.7.3).

The Taquari River suffers with constant silting, due to the rainfall volumes which erode the river bed and bank, silting the regions more upstream and affecting the stretch of the waterway. Added to that, the more important areas downstream suffer with deforestations, what significantly increase the volume of sediment in the waters of the river, making them muddy and slimy.

The Taquari Waterway under study is the stretch between its mouth and the city of Coxim (MS) (stretch 40), 400km long.

The topography of the basin stretch under study behaves as a homogeneous ramp, so that the tributaries do not converge directly to the Taquari River, but to the depression of the Paraguay River as a whole. In the first 200km upstream of the waterway, the Taquari river is in a muddy place, so as not to allow, in many stretches, to delimit the main channels of the river. Thus, there is no well defined navigation route. The minimum depths are 1.5m and the stretch is subject to the formation of sandbanks.

In the final 200km (stretches 21 to 40), the river has steeper declivities and a better defined chute, with very sinuous stretches (sinuosity rates of up to 2), many sandbanks, river islands and narrow stretches. The minimum depths in this segment reach less than 1m.

There are narrowed stretches along the waterway, with minimum widths in the order of 10m (stretch 8).

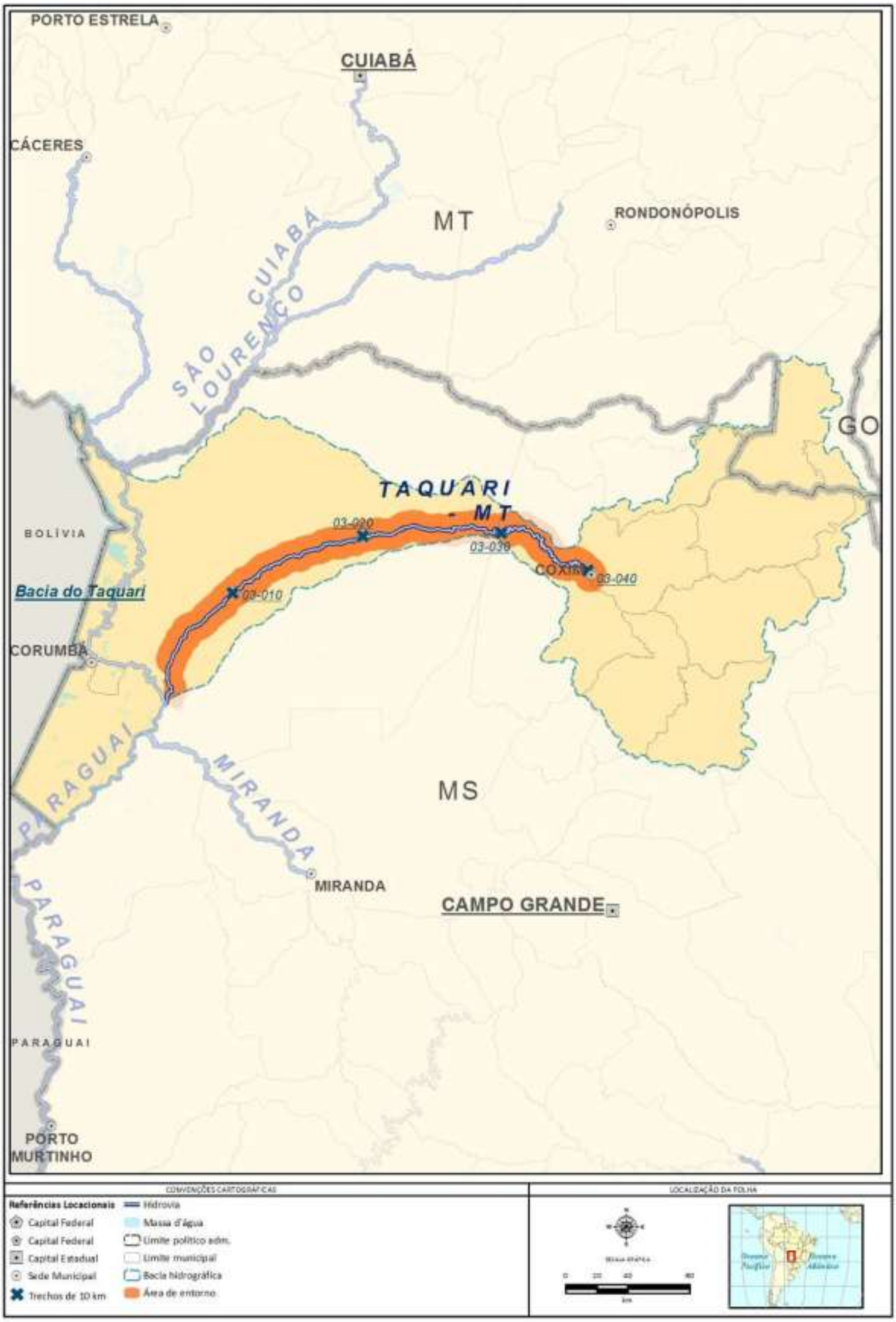
No bridges or other constructions making navigation difficult were identified.

b) Social-environmental vulnerabilities

The Basin of the Taquari River has an area of 59,057km^2, comprises 19 municipalities in the states of Mato Grosso, Mato Grosso do Sul and Goiás, totaling 489,152 inhabitants (IBGE, 2010).

As per the conservationist aspects, 49% of the basin is inserted in the Cerrado Biome and 51% in the Pantanal Biome. In the basin region there are four Integral Protection Conservation (UCPI's), six Biodiversity Conservation Priority Areas (APCB's) of extreme or very high priority, 11 INCRA settlements and one Indigenous Land.

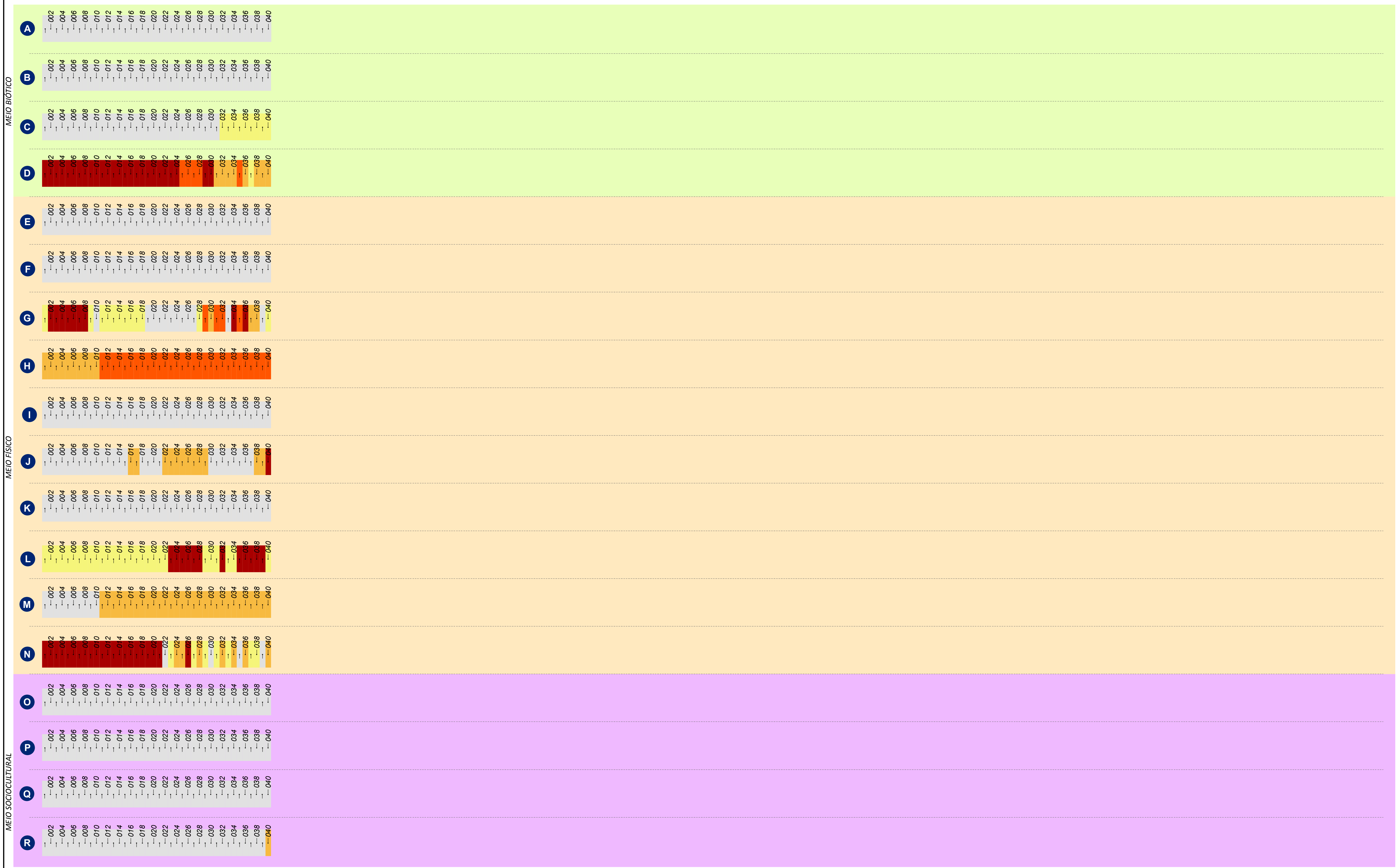
As it was said before, the future waterway of the Taquari River was considered in 400 kilometers of its extension, which were divided into 40 stretches of 10km each. The waterway crosses the municipalities of Mato Grosso do Sul – Corumbá, Coxim, Ladário and Rio Verde de Mato Grosso - which represent altogether a population of 154,752 inhabitants (IBGE, 2010). The FIRJAN (2010) index does not vary much between the municipalities surrounding the waterway, being 0.66 for Coxim and Ladário, 0.64 for Corumbá and 0.62 for Rio Verde do Mato Grosso.



Map 34: Taquari Waterway Location

There are no stretches with high criticality in terms of social-environmental vulnerability in this waterway, however, here are APBC of extreme priority of action in the initial stretches of this waterway, near Corumbá (MS) and in the stretches 32 to 40 between Rio Verde do Mato Grosso and Coxim (MS). It is worth mentioning that, between the stretches 1 to 24, the vegetal coverage is much preserved, and could difficult the access and possible works of support.

The Taquari Waterway does not present too much trouble to the installation of support infrastructure to its operation, since there were no Indigenous Lands in the secondary database used, or UCPI's in its vicinities. Nevertheless, the dense vegetal coverage can demand more attention in the future, mainly in the initial stretches, indicated as of conservationist interest due to the presence of APCB's in the municipality of Ladário up to the stretch 30 of the waterway between Rio Verde do Mato Grosso and Coxim, both in MS.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
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- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

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MA - Muito alta

REFERÊNCIAS

Fontes:
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- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO TAQUARI - MT	MAI/2013

3.6.1.4 São Lourenço Waterway

a) Navigability Diagnosis

The São Lourenço River is one of the main tributaries of the Paraguay River and is inserted in the Pantanal region, almost in its totality in the state of Mato Grosso. Its mouth is in the municipality of Campo Verde (MT), 490m high, passing by the city of Dom Aquino (MT), and its mouth is on the Paraguay River, a very much swampy region. Its hydrographic basin occupies an area of around 44,331km^2, and the main tributaries are the Cuiabá and Piqueri Rivers.

In the São Lourenço River region the tropical climate predominates. The period of drought is three to four months, with rainfalls that vary from 1,200 to 1,700mm per year. The floods period is from December to April. The average flow near the mouth of the Paraguay River is 700m^3/s (see Appendix VII, item 4.7.4).

The waterway of this river considered in this Plan, goes from the stretch between its mouth, on the Paraguay river, and the proximities of the city f Rondonópolis MT) (stretch 51).

The São Lourenço River basin is undergoing an increase in extraction, mining and agribusiness processes, which have caused intensification in the erosive processes along the basin and worsened navigation conditions along the river.

There is no navigation record of commercial convoys in this river. There are medium and small size vessels, mainly related to the tourist fishery, mainly in the first 150km upstream of the São Lourenço river (stretches 1 to 15).

The river presents low declivities and high sinuosity rates all along its alignment (with rates of sinuosity that reach 3), making the distance to be navigated much longer than the distance in a straight line, and difficulting the vessel maneuvering conditions. Many river tributaries are verified, abandoned along the meanders. The river bed is mainly sedimentary, a characteristic of the Mato Grosso Pantanal.

The segment from the mouth of the Taquary River to the mouth of the Cuiabá River (stretches 1 to 18) has better navigability conditions all along the river, with average width of 80m and minimum depths of around 2m, in low waters.

However, the more critical stretches are the upstream stretches (19 to 51), when, besides the high sinuosity, the river is very narrow and presents many sandbanks, caused by the erosion processes in the region. This segment presents bottlenecks in its banks in the intermediate course of the waterway under study, with values lower than 15m. The minimum depths are 1.0m, mainly in the dry season. However, they can be lower in some places due to sandbanks and river islands. The figure below shows the behavior of the São Lourenço River in this upstream stretch.

Figure 3.6.6: Meanders of the Miranda River (Brasil das Águias, 2007) Stretches and Meanders of the São Lourenço River (Olhares, 2011)

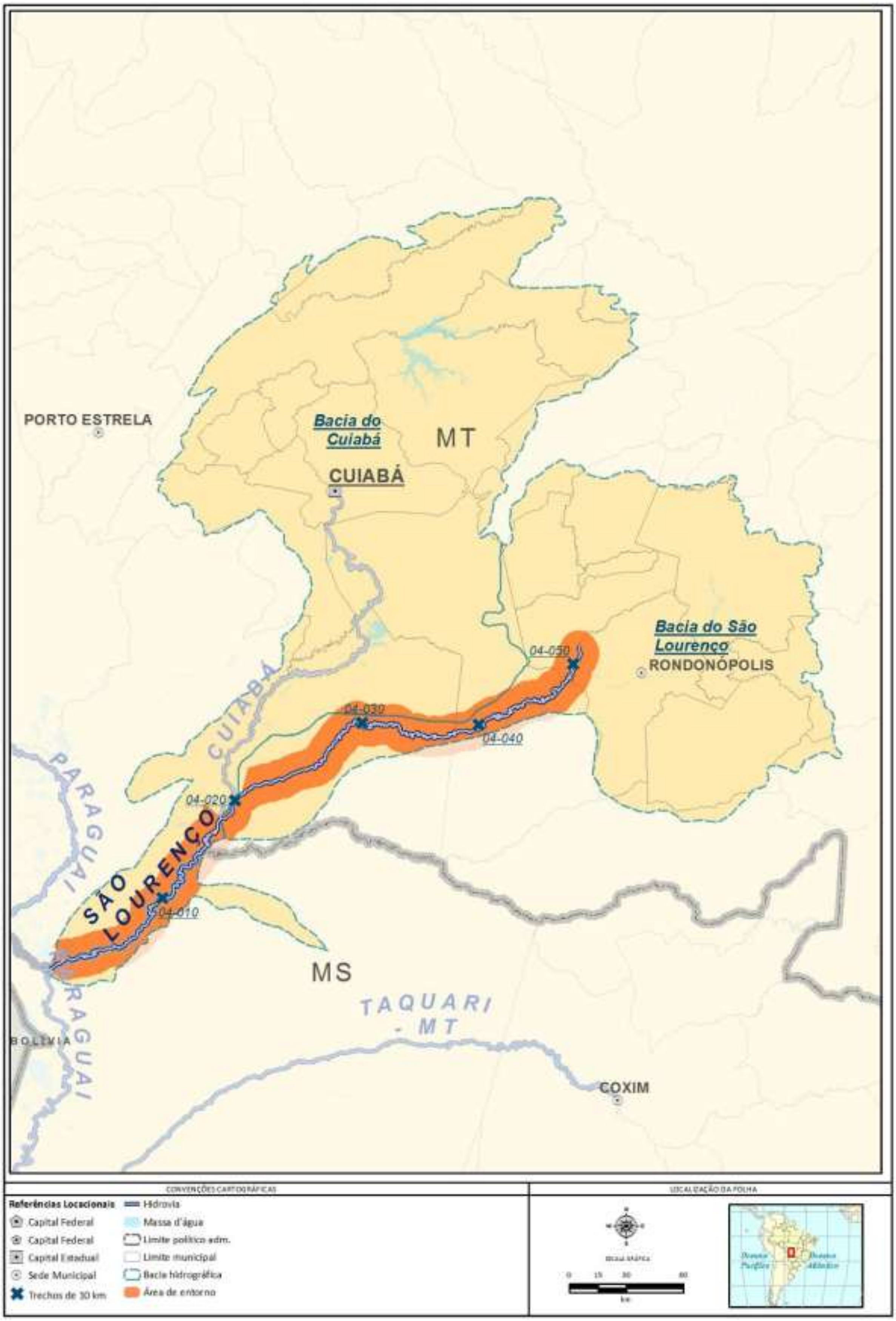
There are no weirs or bridges representing difficulty to navigation on the São Lourenço River.

b) Social-environmental vulnerabilities

The future São Lourenço Waterway is inserted in the river basins of Cuiabá and São Lourenço. The Cuiabá River basin, as already mentioned, has 4,331km^2 extending through the states of Mato Grosso and Mato Grosso do Sul, comprising 20 municipalities, with a total population of 1,175,849 inhabitants (IBGE, 2010). Of its area, 66% are inserted in the Cerrado Biome and 34% in the Pantanal Biome. It is important to note the 170 mining works, seven Biodiversity Conservation Priority Areas (APCB's), eight Integral Protection Conservation Units (UCPI), and 48 INCRA settlements.

The São Lourenço basin has an area of 27,739km^2, encompassing 17 municipalities in the state of Mato Grosso, and these municipalities total 462, 496 inhabitants (IBGE, 2010), with highlight to the municipality of Rondonópolis as the most densely populated.

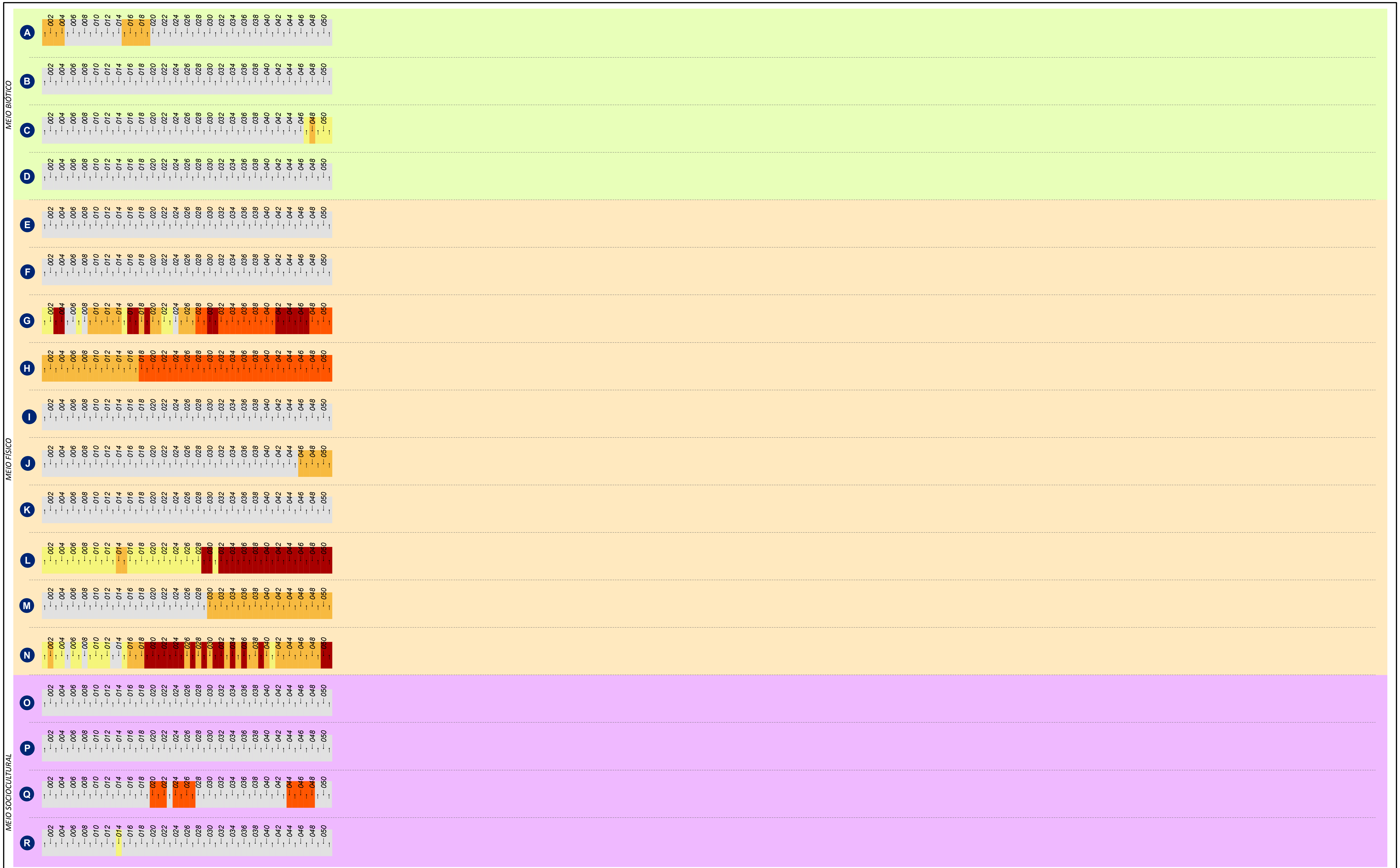
As per the conservationist aspects, the São Lourenço River Basin has 83% of its area in the Cerrado Biome, and 17% in the Pantanal Biome. It has two Integral Protection Conservation Units (UCPI's), five Biodiversity Conservation Priority Areas (APCB's) of extreme or very high priority, 40 INCRA settlements and five areas of Indigenous Lands.



Map 35 : São Lourenço River Location

As already said, the future São Lourenço Waterway goes from the confluence with de Cuiabá River to the vicinities of Rondonópolis (MT, where there is a port. It was considered, for this study purpose, the extension of 508km, divided in 51 stretches of 10km. The waterway passes through the municipalities of Barão de Melgaço, Juscimeira, Rondonópolis and Santo Antônio de Leverger, Poconé and Corumbá, in the state of Mato Grosso, totaling 368,442 inhabitants (IBGE, 2010). The FIRJAN index (2010) reaches 0.77 in Rondonópolis (MT), being Barão de Melgaço (MT) the municipality with the lower rate, 0.52.

In terms of social-environmental vulnerability, near 40% of the surroundings of the waterway presents stretches considered as more vulnerable due the presence of an Integral Conservation Protection Unit (UCPI) between the stretches 01 to 04 (Parque Nacional Mato-grossense) and in the stretches 15 to 19 (Parque Estadual Encontro das Águas) near the municipality of Barão de Melgaço (MT). In addition, there are Indigenous Lands between the stretches 20, 21 and 22 (called Baia do Guató) between the stretches 24 to 27 (called Perigara) – both near to Barão de Melgaço (MT) -, and between the stretches 44 to 48 (called Tereza Cristina) – near the municipality of Santo Antônio de Leverger (MT) -, forming continuous areas of more restrictive environmental protection in the surroundings of the waterway. Thus, there is a spatial continuity between the stretches with UCPI's and Indigenous Lands occurrence all along the waterway surroundings. There are APCB's between the municipalities of Leverger and Rondonópolis (MT), between the stretches 47 and 51.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais

SOCIOCULTURAL
- N Largura do rio
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO SÃO LOURENÇO	MAI/2013

3.6.1.5 Cuiabá Waterway

a) Navigability Diagnosis

The Cuiabá River is one of the main tributaries of the São Lourenço River, which in its turn is a tributary of the Paraguay River, and is inserted in the Pantanal region. Their mouths are in the Serra Azul hillsides, municipality of Rosário Oeste (MT), at the junction of the then called Cuiabá da Larga and Cuiabá Bonito. Its mouth is in the São Lourenço river, in a very muddy place.

In the Cuiabá River basin, the rainiest quarter is January to March, with elevated water levels between December and May. The average flow is about 300m^3/sec (see Appendix VII, item 4.7.5).

The Cuiabá waterway considered in this analyses is the stretch between its mouth, in the São Lourenço River, and the city of Cuiabá (stretch 34), with an extension of about 340 km.

The Cuiabá River is navigable over any period of the year from its mouth up to Porto Cerrado (MT) (stretch 11), about 110km from the mouth, with minimum depths of 1.5m, and due to the silting, only the navigation of small size vessels is allowed.

As well as in the other rivers of the Paraguay basin, the Cuiabá River basin presents high rates of soil erosion, mainly in the headwaters, where agricultural activities and deforestation are more accentuated. This impacts the increase of the sedimentation rates along the Cuiabá (MT) River, impacting navigability conditions. The conditions of the river bed are mainly sedimentary, characteristic of the Pantanal region.

The waterway has low declivities, being the stretches with the biggest declivities those near the city of Cuiabá (MT) (stretches 31 to 34) and is very sinuous (sinuosity rate up to 3), with muddy stretches, mainly in the more downstream stretches (stretches 1 to 20).

Figure 3.6.7: Meandered stretch of the Cuiabá river (Palo, 2010)

The minimum widths along the river are about 80m, however, there are bottlenecks with widths up to 20m (stretch 17). Approx. 150km from the mouth the Cuiabá River dismembers in many tributaries, by about 40km, reducing widths and difficulting navigation.

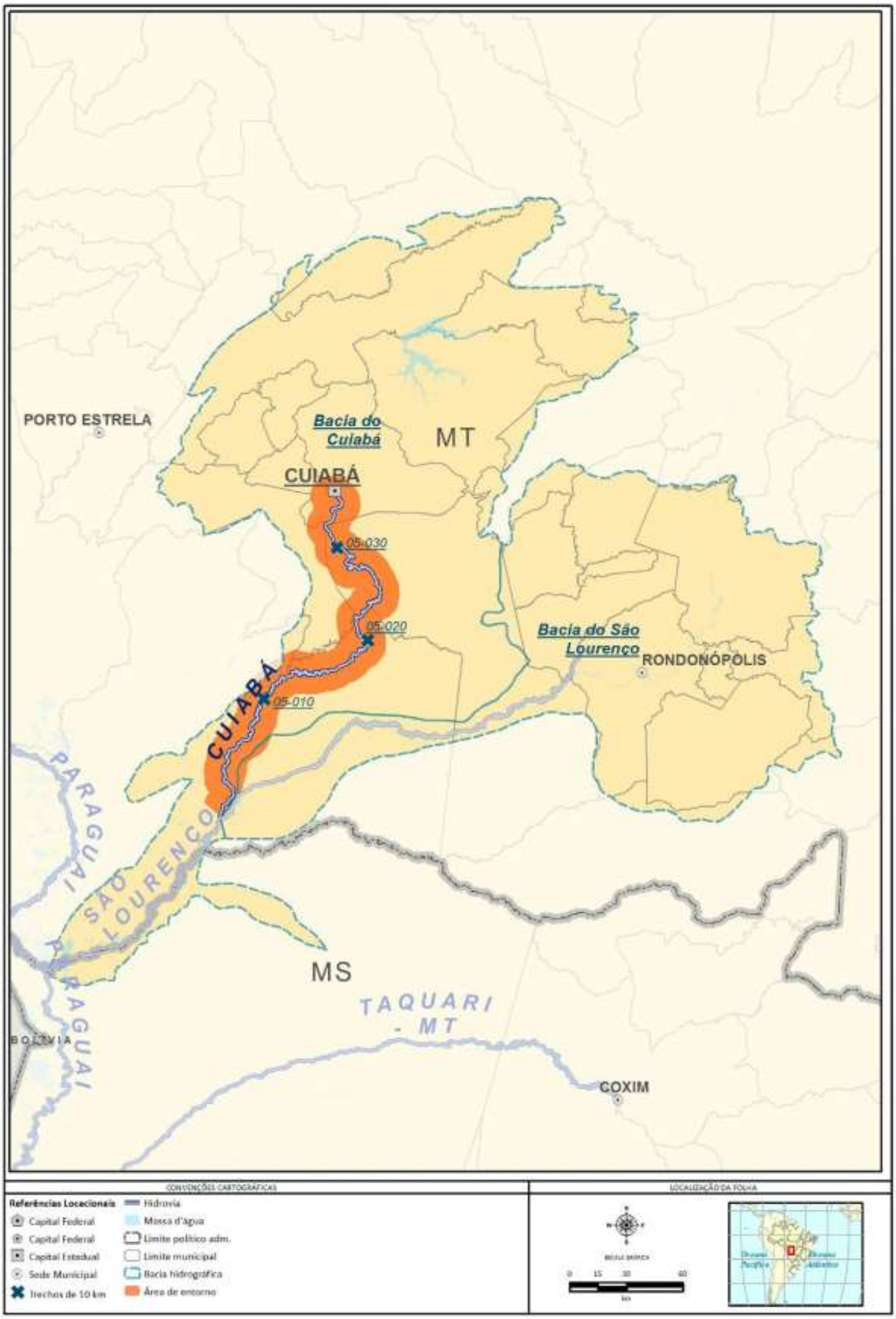
There are minimum depths of about 1.5m between the stretches 1 and 15, and of about 1m in the upstream stretches (stretches 15 to 34), and there could also be more critical stretches owing to the sedimentation process along the river.

In the surroundings of the city of Cuiabá (MT), extreme upstream of the waterway, there are rocky outcroppings and rapids. In this stretch there are also urban bridges (stretches 33 and 34) which have to be verified in relation to its navigation use, once they have small dimensions for commercial vessels.

Figure 3.6.8: Cuiabá River near Cuiabá (MT) (Beltrão, 2007)

b) Social-environmental vulnerabilities

The Cuiabá Waterway is inserted in the Cuiabá River basin, which has an area of 44,331km^2, inserted partially in the Cerrado Biome (66%) and the Pantanal Biome (34%). The basin encompasses the states of Mato Grosso and Mato Grosso do Sul, intercepting the territory of 20 municipalities which, altogether, present a total population of 1,175,849 inhabitants (IBGE, 2010).



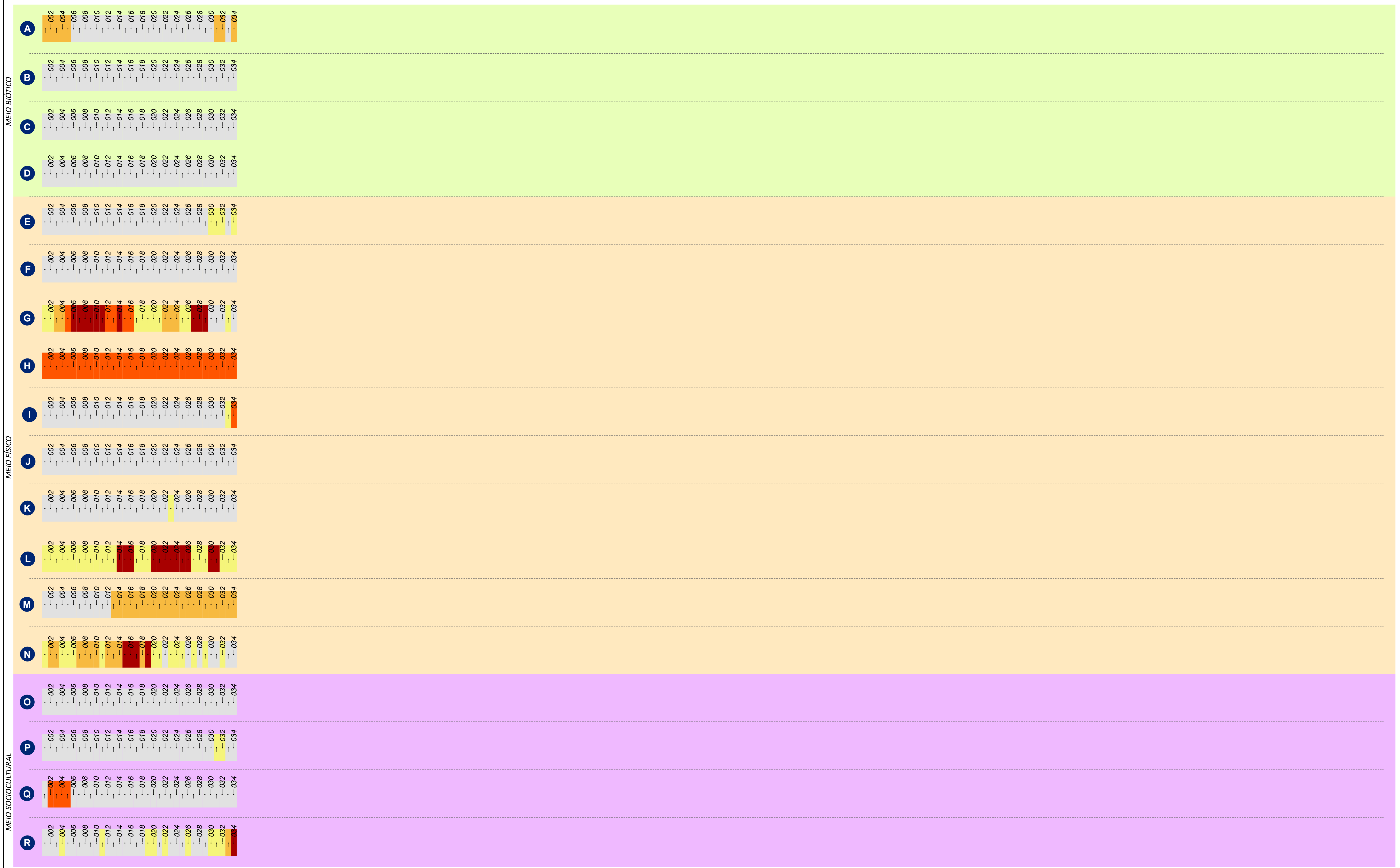
Map 36: Cuiabá Waterway Location

For the purpose of this study the future Cuiabá Waterway was considered in an extension of 338km, divided into 34 stretches of 10km each. This area crosses the territory of six municipalities in Mato Grosso that, jointly, total 873,136 inhabitants (IBGE, 2010), being Cuiabá the more populous city, responsible for 63.11% of the total. The FIRJAN index (2010) considered in these municipalities varies from 0.80 for Cuiabá and 0.52% for Barão de Melgaço, presenting the average of 0.64%. for the municipalities of the surrounding area of the waterway

As per the conservationists aspects, in the basin area there are eight UCPI – Unidades de Conservação de Proteção Integral (integral conservation protection units), three UCUS - Uso Sustentável (sustainable use), besides 170 minings works, seven Áreas Prioritárias para APCB - Conservação da Biodiversidade (priority area for APCB – biodiversity conservation) extremely or very high, and 48 INCRA settlements.

For the area surrounding the waterway, between the stretches 01 to 05, it is important to notice the presence of UC of integral protection, corresponding to the Parque Estadual Encontro das Águas, near the municipality of Poconé, as well as the Terra Indígena Baia do Guató in the stretches 02 to 05, and also in the proximities of this same municipality. There is also a UCPI in the stretch 34, corresponding to the Área de proteção Ambiental (environmental protection area) of the Chapada dos Guimarães.

Other characteristics can be better observed in the one-line diagram below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
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- K Leito do rio
- L Assoreamento
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- N Largura do rio

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Nº dos trechos

nº < Jusante

nº > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

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MA - Muito alta

REFERÊNCIAS

Fontes:
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- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO CUIABÁ	MAI/2013

3.6.2 Economic Aspects

3.6.2.1 Current inland waterways transport

The total inland waterway transport in 2011 on the Rio Paraguay was about 5.4 million tons, mainly consisting of iron ore. The main difference with other river basins in Brazil is that transport over the Rio Paraguay is exclusively border crossing. This makes the Rio Paraguay the most international river in Brazil. The origin of all flows is either Corumbá or Ladário, both in Mato Grosso and about 4 km from each other. The main destination is Argentine. A small part of the transported commodities has Paraguay as a destination. In table 3.6.1 more information on commodities transported by inland waterways is provided.

Table 3.6.1: Transport volume and performance Rio Paraguay (2011)

	Tons (1000)	Tonkm (million)
Iron ore	5.323	3.072,6
Manganese	77	44,3
Sugar	38	21,9
Pig Iron	5	2,7
Total	**5.442**	**3.141,4**

3.6.2.2 Planned developments

For the transport on the Rio Paraguay, the production of the Urucum mine (Corumbá) is important. At the moment the production is about 4.5 million ton per years increasing in 2020 and beyond to 12.5 million tons.

For IWT in general agricultural products are important. Currently no soy or corn is transported over the Paraguay River. A substantial potential for soy and corn transport exists from Mato Grosso. A number of interview partners have stated that a terminal in the vicinity of Cáceres (Mato Grosso) could be an option. The production in the catchment area of Rio Paraguay is expected to increase with about 70% for soy and 30% for corn.

Most of these exports are transported North (Porto Velho -Santarem) or South East (Santos, and Paranagua). The waterway has capacity for expansion of cargo, but improvements in maintenance activities (dredging) are required. The Ministry of Public Works, through an action promoted by Mato Grosso, paralyzed all studies and work to be done on the Paraguay River, not only in Brazil but in all five countries of the River Basin, causing friction in the Intergovernmental Committee of the Waterway. This action was intended to prevent the installation of a port terminal south of Cáceres (Porto Morrinho) and require that any action to be performed on the Paraguay River should be voted on in Congress, since there are indigenous settlements in the region of Ilha de Ínsua, 20 km into the river. Due to this action public investments (PAC) for improvements in the waterway were canceled.

Cargill conducted a study for the feasibility of using the Paraguay waterway in Cáceres (MT) to transport grain via Argentine, but the inability to ensure navigation throughout the year proved to be a major bottleneck, and the company opted for transport by road to Porto Velho (and from there by water to the Northern Ports) and by rail to the Port of Santos.

In the stretch between Cáceres and Corumbá navigation is now limited to tourism. Larger vessels, cargo, cannot currently navigate this stretch of river due to siltation problems. With respect to potential expansion of inland navigation in the region, it was mentioned that the Corumbá region could act as a distribution center for, for example, fertilizer, from Argentina, where there are deposits of potassium.

3.6.2.3 Future inland waterways transport

Current transport on the Rio Paraguay is limited to a restricted number of commodities, mainly ores and sugar. Transport of iron ore is expected to further increase, following increased production. The growth of sugar transport is modest and almost negligible compared to ores.

Table 3.6.2: Transport forecasts Rio Paraguay (in 1000 tons)

	2011	2015	2023	2031
Iron ore	5.323	7.569	10.699	14.660
Manganese ore	77	89	121	163
Sugar	38	44	51	60
Total	**5.438**	**7.702**	**10.871**	**14.883**

Potentially a number of *additional commodities* could be transported over the Paraguay River. The most promising commodities are soy, soy meal and corn. Cáceres region has a catchment area covering a radius of 500 km, corresponding to a production of approximately 12 million tons currently. Only if the stretch between Cáceres and Corumba is improved (dredged), and the connections between the production regions in Mato Grosso and the terminal near Cáceres are optimized, a substantial part of soy and / or corn could be transport by Rio Paraguay.

Furthermore return cargo (e.g. fertilizers) in principle would be interesting for Rio Paraguay, as this could be done rather cheap because the convoys have to go back to Corumbá anyway.

As a result of current state and national policies however we do not foresee transport of these potential additional commodities.

3.6.3 Transport System

3.6.3.1 Transported Cargo

Based on the results presented in Chapter 3.6.2, the conclusion is that the potential cargo for the Paraguay waterway system is predominantly of iron ore from the Corumbá region. The cargo is loaded in Corumbá and transported to the Nueva Palmira port (Uruguay).

This cargo can be considered as captive. Both the roadway and the railway do not compete with the waterway, because there are no connections along the Pantanal.

3.6.3.2 Infrastructure

This item describes the existing infrastructure in the Paraguay waterway system, which, as mentioned in Chapter 3.6.1, encompasses the Cuiabá, Miranda, Paraguay, Taquari and São Lourenço Rivers.

a) Waterway/river infrastructure

The physical characteristics of the Paraguay waterway complex were already mentioned in Chapter 3.6.1. Thus, only the existing ports/terminals, the federal railroads and the highways relevant for the region will be described.

Ports/Terminals

For the analysis of the Paraguay Waterway System terminals the database resulting from the PNIH was utilized, and the information collected during the interviews and from recent reports was added. In this base 20 terminals are listed , 10 of which do not present information related to the situation and 5 are in operation. In the table below we can see the number of terminals by their situation.

Table 3.6.3: Port Situation of the Paraguay Waterway System (Source: Developed from the PNIH, 2013 database).

Situation	Quantity	Percentage
Demolished	1	5%
Inoperative	1	5%
Operative	5	25%
Planned	3	15%
No information	10	50%
Total	**20**	**1**

The analysis of the current situation was made based on the data of the terminals classified as "Operative"; the others were not considered.

Table 2 shows a list of the ports/terminals in operation in the region, as well as the rivers they are localized in and the highway connections.

Table 3.6.4: List of the Operative Ports/Terminals.

Port/Terminal	Type	Location	Highway connections
TUP Gregório Curvo	Mixed Private Use Terminal	Paraguay River	BR-262
TUP Porto Murtinho	Mixed Private Use Terminal	Paraguay River	BR-267
TUP Porto Sobramil	Mixed Private Use Terminal	Paraguay River	BR-262
TUP Granel Química	Mixed Private Use Terminal	Paraguay River	BR-262

The Vale has the TUP Porto Gregório Curvo, in the municipality of Porto Esperança, and leases the ports of Sobramil (Corumbá) and Granel Química (Ladário). The main products moved in these terminals are, respectively: iron ore; iron and manganese ore; iron ore, grain and liquids.

Highways

The highway considered, belonging to Paraguay waterway system, are presented below. It is worth noting that in this region there is no competition with the other modes, due to the type of the cargo to be transported.

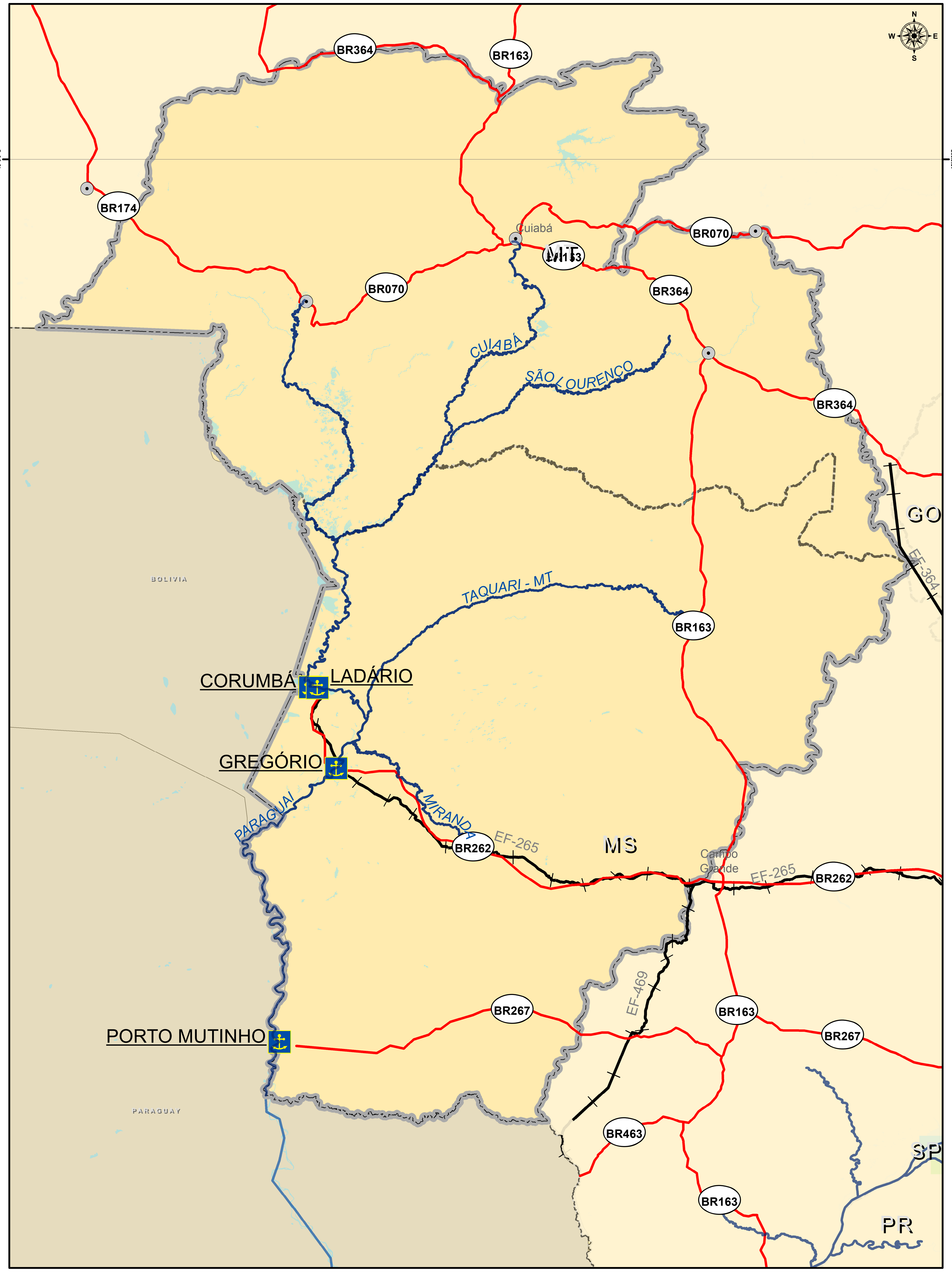
BR-163

The stretch of the BR-163 from Cuiabá (MT) to Guaíra (MS) is a feasible alternative to the transport of cargo, mainly agricultural bulk. This stretch encompasses the localities of Cuiabá (MT), Jaciara (MT), Rondonópolis (MT), Sonora (MS), Coxim (MS), Rio Verde (MS), São Gabriel do Oeste (MS), Bandeirantes (MS), Jaraguari (MS), Campo Grande (MS), Nova Alvorada do Sul (MS), Rio Brilhante (MS), Dourados (MS), Naviraí (MS), Mundo Novo (MS) and Guaíra (PR). The pavement is well conserved, presenting few defects, mainly in the stretch belonging to the state of Mato Grosso do Sul.

BR-262

The BR-262 is a Brazilian transverse highway that connects the states of Espírito Santo, Minas Gerais, São Paulo and Mato Grosso do Sul. Its course begins in Vitória, in state of Espírito Santo and goes through important cities, such as Belo Horizonte (MG), Araxá (MG), Uberaba (MG), Três Lagoas (MS) and Campo Grande (MS) and ends near the border with Bolivia, in Corumbá, state of Mato Grosso do Sul.

The BR-262 presents a stretch perpendicular to the Paraguay River, which connects the cities of Corumbá (MS) and Ladário (MS) to Campo Grande (MS). It is composed of a single lane, with the pavement in excellent conditions of conservation and large road shoulder on both sides of the stretch at issue. It has also adequate signaling and low traffic volume. It also connects the highways BR-163 and BR-419. It is one of the main highways that go into the Pantanal.



CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais

Barragem existentes

- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes

- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 20 40 80 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO PARAGUAI

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:3.000.000	- BRASIL -	JUL/2013

Railroads

The railroads that are part of the Paraguay waterway system were selected based on the geographic localization and on the potentiality of competition or complementarity of the modes.

EF-265

The EF-265 is a transverse railroad that connects the states of São Paulo (Santos, Mairinque, Bauru) and Mato Grosso do Sul up to the border with Bolivia, passing by Ladário Terminal in Mato Grosso do Sul. Its design is parallel to BR-262 and consequently to the Miranda River, crossing the Paraná River in the city of Três Lagoas (MS).

The EF-265, called Ferrovia Novoeste S.A., in operation since 07/01/1995 and connects the cities of Corumbá (MS) and Ladário (MS) to the state of São Paulo, passing by Campo Grande (MS). The gauge-type is the metric one and the main cargo transported are oil products, iron and manganese ores, soybean, steelmaking products and soy meal. It is operated by América Latina Logística Malha Oeste S.A.

EF-469

The EF-469 is characterized as a connection railroad, going from Indobrasil, located near the city of Campo Grande (MS), to Ponta Porã (MS). Its alignment é parallel to the Paraguay River in the most downstream stretch and consequently to the highways BR-419 and BR-163.

As well as the EF-265, the EF-469 also is part of the Ferrovia Novoeste S.A. The gauge-type is the metric one and the main cargo transported are oil products, iron and manganese ores, soybean, steelmaking products and soy meal. It is operated by América Latina Logística Malha Oeste S.A.

3.6.3.3 Characteristics of the existing fleet and the operative companies

The information elated to the navigation companies operating in this waterway system were obtained by interviews and the Antaq database.

Table 3.6.5: Navigation Companies – Paraguay Waterway System (Source: Prepared as from the Anuário Estatístico da Antaq (statistic yearbook of Antaq).

Navigation Company	Third PartiesTransport	Quantity of Vessels	Statistical Capacity (ton)	Quantity of Pushers	Average age (years)
Naveriver Navegação Fluvial Ltda.	Yes	29	53.370	3	29,9
Serviço de Navegação da Bacia do Prata (SNPB)	Yes	33	43.230	14	25,2
VALE[51]	No	166	308.800	8	N/D

The Naveriver Navegação uses convoys of up to 16 vessels, 48m wide, 300m long (considering a push boat 60 m long, which is the highest power) and 3.5m of draft, as presented in the figure below. The SNPB uses convoys of 9 vessels, 33m wide, 225m long and 2.8m of draft.

Figure 3.6.9: Convoy 4 x 4, used by Naveriver Navegação.

Vale obtained authorization for the navigation of convoys with 20 barges and one pusher. If we consider the barges of the Mississippi type, the transport capacity is equal to 32,000 tons, and the Jumbo type, 50,000 tons, however, it was not possible to obtain further information regarding the convoys, like formation and length.

The convoys, when passing through tight meanders, use a bow vessel to help with the maneuvers.

The pushboats fleet as well as its characteristics was idenfitied for this system and can be found in the table below.

[51] Information obtained from interviews

Table 3.6.6: Information of Shipping Companies and their fleet of tugs - Paraguay Waterway System (Source: Compiled from the Anuário Estatístico da ANTAQ, 2011).

Company	Average Power	Number of pushboats	Average age (years)
Naveriver Navegação Fluvial LTDA	1964	39	12,9
Serviço de Navegação da Bacia do Prata (SNPB)	355	49	10,1
VALE	4638	8	N/D

3.6.3.4 Management System of River Information

The Paraguay waterway system in the Brazilian territory is managed by AHIPAR, however, due to its conditions of a waterway with international reach, other agencies also exercise different functions. This characteristic can be found in Chapter 3.6.4.

In the national territory, the river is signaled and can be divided into two stretches:

- Cáceres – Corumbá/Ladário; The AHIPAR is responsible for the signaling and beaconage of the stretch;
- Corumbá/Ladário – Mouth of the Apa River: The Serviço the Sinalização Náutica do Oeste (western nautical signaling service) is responsible for the signaling and beaconage of the stretch.

Even though this navigation security system exists, during the interviews a deficiency was identified in the dredging and the signaling activities and the nautical charts, which are not updated. It was also said that due to the conditions of these charts, navigation é made based on the experience of the crew.

3.6.3.5 Intermodal Competition

As already said, the potential cargo for this waterway system is iron ore from the Corumbá region, which is a captive cargo. Owing to the lack of competition with the waterway mode in the region, the analysis of intermodal competition was not made.

3.6.4 Governance and institutions

The AHIPAR – Administração Hidroviária do Paraguai (Paraguay waterway administration) is responsible, in the national territory, for the operation and maintenance of the Paraguay waterway system that crosses the states of Mato Grosso and Mato Grosso do Sul. The AHIPAR, currently linked to CODOMAR (Annex I) via the Convênio de Apoio Técnico e Financeiro para Gestão das Hidrovias e Portos Interiores (covenant for the technical and financial support for the management of inland waterways and ports) No. 007/2008/DAQ/DNIT, was earlier a branch of Portobrás, however, with its extinction in the decade of 1990 was linked to CODESP (Annex I), transferring its public-sector employees to its payroll, to which they are linked to date.

Besides Brazil, the waterway goes through four more countries: Bolivia, Paraguay, Argentina and Uruguay, being an international waterway. Due to that, a Comitê Intergovernamental da Hidrovia – CIH (intergovernmental waterway committee) (Annex I) was created, which would later establish a Comissão de Coordenação Técnica –CCT (technical coordination commission), an advisory agency formed by environmental engineers and specialists responsible for making effective the safety and reliability of Waterway programs.

According to its bylaws, the CHI is a permanent agency of the Sistema do Tratado da Bacia do Prata (treaty of the Prata basin system) in charge of promoting, coordinating and following-up the multinational integrated development programs of the Prata Basin, with the technical and financial support of international agencies and executing the decisions approved by the Ministérios das Relações Exteriores (foreign affairs ministries) of the involved countries (Annex I).

In practice, the Committee could not take many of its actions, because, although a homogenous legislation was created for the waterway, each country internalized only the part of it was interested in, thus resulting in different laws for the countries com posing the Paraguay-Paraná waterway system, generating higher navigation costs. As a CIH financial instrument, a Fundo de Desenvolvimento para a Bacia do Prata – FONPLATA (development fund for the Prata basin) (Annex I) was created for the purpose of financing the conduction of the study, projects, programs and works to foster the sustainable development and the physical integration of the Prata Basin and its area of influence.

Besides this Committee for the Prata Basin there is also the IIRSA – Iniciativa para a Integração da Infrastruture Regional Sul-Americana (initiative for the integration of the regional infrastructure in South America) (Annex I), responsible, as its own name says, for the entire South America, performing integration plans and projects of transport , energy and communications infrastructure. For the Paraguay-Paraná Waterway, five work fronts were created, each one responsible for an area of study:

- Group 1 – Paraguay River, in the Assunção to Corumbá stretch – this group has as strategic function to improve the social and economic integration of the Paraguay, Brazil and Bolivia regions which are part of the basin, strengthen and foster the integration of the productive chain of the surroundings.

- Group 2 – Tietê – Paraná – its objective is to strengthen the social-economic dynamics of the area of influence and improve the integration of the productive with the consumption zones in the Tietê and Paraná basin.
- Group 3 – Paraguay – Paraná, Assunção Rivers – Paraná Delta – it has as strategic function to strengthen and foster the integration of the productive chains in the areas of influence and improve the efficiency of the productive sector of the region and the quality of life of the population in the influence area of the group.
- Group 4 – Paraná, Itaipú - Confluence – its objective is to establish the social-economic dynamics of the influence area of the group, improve the integration of the productive with the consumption zones in the Tietê and Paraná basins.
- Group 5 – Uruguay River – shall strengthen the social-economic dynamics of the influence area of the group.

Besides these specific objectives all the groups have the strategic function of establishing an efficient regional system of the river and port activities in order to allow the way out to the Atlantic.

At the end of the study, each group presented its improvement projects trying to reach its objectives; in total, this study resulted in 95 projects for 2010, estimated in about 6.7 billion dollars (IIRSA, 2010). Some of these projects were already part of the IIRSA plans and, in 2005, the technical group, with the assistance of the CCT, came together to start the first infrastructure projects for this stretch.

However, the Paraguay-Paraná Waterway crosses the High Paraguay basin, which drains the called "planície pantaneira" (Pantanal plain) one of the most important humid areas in the Globe, giving it a high environmental importance, highlighting it by the singularity of the ecosystems within it and by the indissociable interactions of these with the regional dynamics of the water resources. Due to this singularity and fragility the environment became the main obstacle for the feasibility of the waterway.

There were several tries to expand the navigation capacity of the Paraguay River basin, which crosses the Pantanal Matogrossense. The first one was in the 1980's, when the Ministério dos Transportes (Transport Ministry) (Annex I) proposed the construction of a channel in the Pantanal; the project emerged from Mercosul negotiations and, since its beginning, was appointed as an important outflow channel for the agricultural production of the region, in special soybean to the international market. Already at the beginning of the 1990's, the project of this waterway was taken up again with the name of "Projeto Internave", as it would be performed by a company with the same name. This project lasted up to 1998, when the Brazilian government announced its abandonment and adopted the strategy of constructing the waterway by parts, with small works in different regions without apparent connection among them.

The last phase began with new studies conducted by the Comitê Intergovernamental da Hidrovia, added to the governmental decision of integrating the "Projeto Hidrovia" (waterway project) to the IIRSA. The South-American initiative anticipated the beginning of the works in the Pantanal for 2005 but, for this to happen, it was necessary that the Ministério dos Transportes would have presented in January of the same year the Estudo de Impacto Ambiental and the Relatório de Impacto do Meio Ambiente (environmental impact study and the environment impact Report) (EIA-RIMA), what did not occur.

The destiny of the waterway is still in question. In 2010 the initiatives of the Paraná-Paraguay waterway project were taken again, in meetings promoted by the Ministério dos Transportes.

One of the first meetings to discuss about the matter was in June 2010, through the seminar "A Hidrovia do rio Paraguai: o desenvolvimento regional e o PAC2 (the Paraguay Waterway: the regional development and the PAC 2), held in the city of Corumbá. The seminar was held to identify the main cargo flows; to measure the economic gains generated by the waterway use and establish goals for the future of the transport modal.

The IBAMA is the Brazilian agency responsible for the licensing of the enterprises and the activities performed in the Paraguay Waterway, whose direct environmental impacts surpass the territorial limits of the country or of more than one state. It is also responsible for requesting and orienting more complete studies, as is the case of the EIA-RIMA.

In the case of this specific waterway it was also determined that the IBAMA be the responsible agency for the Licenciamento Ambiental de Transportes de Produtos Perigosos (dangerous product transport environmental licensing) destined to guarantee the current security and navigability levels, in the form of the Resolution 237/97 of the CONAMA. The bathymetry, signaling and beaconage activities for the safety of the navigation, are not subject to the environmental licensing.

Since 1998, the AHIPAR has already an IBAMA operation and maintenance license, to execute the dredging of the stretches from Cáceres till the Taiamã island, adding the points of the Independência and Lagoa Gaíva islands. This license is being renewed annually to maintain the navigability of this stretch.

In the environmental licensing realized by IBAMA, the state and municipality agencies of the environment, more specifically the IMASUL – Instituto de Meio Ambiente do Mato Grosso do Sul (institute of the environment of Mato Grosso do Sul) (annex I), SEMA – Secretaria de Estado de Meio Ambiente do Mato Grosso (state secretariat of the environment of Mato Grosso) (Annex I) and IMAP – Instituto do Meio Ambiente Pantanal (Annex I), have to speak up technically with relation to the conformity of the enterprise to their respective plans and standards.

Within each of the Secretarias Estaduais de Meio Ambiente there is a specific agency responsible for water resources; in Mato Grosso, this agency is named CEHIDRO – Conselho Estadual de Recursos Hídricos (state council of water resources) (Annex I) and has as objective to discuss the water resources in the state, as well as execute its Plano Estadual de Recursos Hídricos (state plan of water resources) to optimize its utilization and avoid the emergence of future conflicts among water users. To execute the Plano Hídrico, the Council gets together with the Comitês de Bacias Hidrográficas (water basins committees) (Annex I) assessing the investment intentions and analyzing whether the multiple use of the waters is maintained.

In Mato Grosso do Sul, though, the responsible agency is the Conselho Estadual de Recursos Hídricos – CERH/MS (state council of water resources) (Annex I) which also consults its basin committees on the use of water resources.

The convoys obey the criteria defined by the Brazilian Navy (Annex I) and by the Ministry of Transports (Annex I), following technical engineering parameters for the protection of the waterway, safety and environment. The Capitania Fluvial do Pantanal (Pantanal river captaincy) (Annex I) checks whether the criteria are being followed, not only those referring to vessels, but also whether the passage under the bridges and other infrastructure works restrictions are being complied with, often decreasing the number of vessels that can cross these interventions at the same time, compelling the dismemberment of the convoys. The Captaincy is also responsible for what concerns the signaling of the waterway, informing AHIPAR about the inconsistencies to be solved.

The Ministério Publico Federal (federal public ministry) has been closely following the Paraguay waterway system, once it received an injunction stopping any study or work all along the Paraguay River. The objective of this action was to prevent the installation of the terminal in Porto Morrinho, in the city of Cáceres, a vital work to deviate the cargo in the more sinuous stretches of the river and also oblige to be voted in the National Congress all and any action to be executed in the Paraguay River, owing to the presence of the indigenous lands in the Ínsua island, 20km inside of the river, among others.

Despite that injunction, and according to the Secretaria de Gestão de Programas de Transportes (secretariat of transportation program management) linked to the Ministério dos Transportes, the Federal Government intends to invest approx. R$ 126 million in the Paraguay Waterway, called Corredor Hidroviário do Paraguai (Paraguay waterway corridor). R$ 82 million of them will go to the infrastructure of the river bed and R$ 44 million to the port infrastructure. The resources are estimated for the period 2011 to 2014, within the Programa de Aceleração do Crescimento (growth acceleration program), the so called PAC2.

As described, the Paraguay waterway system has several agents, national and international, involved with the implementation and maintenance of this navigable waterway, as well as in the ports present in its route. By the figure below, it is possible to see in a simplified way, the main institutions within the national and regional scope, as well as part of its formal assignments. It is worth saying that these attributions reflect the content anticipated in the legal text which defines them, in some cases not depicting its real work.

Table 3.6.7: Matrix of the Formal Attribution of the Paraguay River Agents

	Port administration	Inspection	Water way Maintenance*	Licensing process	Regulation
Waterway Administration (WA) - AHIPAR	■		■		
Port Captaincy of Pantanal		■			
Environment Secretariats				■	
DNIT/DAQ			■		■
ANTAQ		■			■
IBAMA				■	■
Other Agents**				■	

*Execution of dredging, rock excavation, signaling.
**This block encompasses all the agents consulted by IBAMA in the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN, Public Ministry)
Source Consórcio Arcadis Logos, 2012

In the specific case of this waterway, it is important to stress again the environmental side and the weight of the “Other Agents”, more specifically the Ministério Público, in the viabilization of this project.

As it was said in the Tietê-Paraná Waterway and in the Uruguay Waterway, the transposition of the UHE Itaipu would link the Paraná River to the Prata River, in Argentina, which originates from the union of the Paraguay River with the Uruguay River, thus generating the Mercosul Waterway, which will have 7000 navigable km, bringing together four MERCOSUL countries (Brazil, Argentina, Paraguay and Uruguay), with the capacity to move 80% of the economy of the region, generating a huge economy in the costs of transports and hence a higher competitivity of the products.

3.6.5 SWOT Paraguay Waterway System

Strengths	Weaknesses
• The inland waterway transport, in this WS, is in activity between Corumbá and Puerto de Nueva Palmira. There, the transport is made mainly by large convoys. • The AHIPAR has environmental license from IBAMA to execute some maintenance activities between Cáceres and Corumbá. • The waterway transport by the Paraguay River presents relatively lower transport costs, when compared with the other transport modes. • Low declivity and the absence of rapids are some of the characteristics of the Paraguay River. • Currently, the main transported products in this WS are iron ore and manganese. • The highway and railway modes do not compete with the waterway for the transport of iron ore, because there are no roads or connections.	• AHIPAR faces difficulties to actuate, imposed by the lack of access to financial and human resources (due to the agreement signed between DNIT/DAQ and CODOMAR). • In the Paraguay river, there is a significant occurrence of protected areas (indigenous communities and Integral Conservation Protection Units), in the rivers: Paraguay, São Lourenço, Cuiabá and Miranda. • Between Porto Murtinho and Corumbá, the convoys have to divide so they can pass under bridges and sinuous stretches. • The stretch between Carumbá and Cáceres is very sinuous and with small depth during the dry season. • The Miranda, Taquari, São Lourenço and Cuiabá Rivers have high sinuosity, shallow depth, narrow beds and stretches with many sandbanks. These rivers, however, are not too relevant from the cargo flow point of view.

Opportunities	Threats
• Pantanal being an important area of environmental preservation, the intensification of this river utilization diminishes the necessity of building roads that, in turn, have higher impact on the environment. • IIRSA operates in the region planning investments to foster more integration among the countries. • The volume of the higher flow of cargo (iron ore) will triplicate until 2031. The growth forecast of the iron ore and manganese transport is of about 14.9 million of tons. • There is the opportunity for the increase of the waterway transport of soybean and corn from Mato Grosso, if the navigation conditions between Cáceres and Corumbá are improved.	• The intensification of the waterway use can trigger an increase of man occupation in the river banks, which could affect the quality of the water. • The Pantanal region is very important from the environmental point of view and any intervention that eventually has to be made in the region tends to confront a higher complexity in the licensing process. The Ministério Público prohibited the licensing of any construction or work in the waterway. • As Paraguay is potentially an international WS, bilateral/plural agreements (Brazil-Paraguay-Bolivia) have to be negotiated to avoid, among others, the illegal cargo transport through the WS.

3.7 SISTEMA HIDROVIÁRIO DO TIETÊ - PARANÁ

3.7.1 Physical system of the river and social and environmental aspects

The Tietê-Paraná Waterway System is composed of 14 waterways distributed through the hydrographic basins of the Grande, Paraná, Paranaíba, Paranapanema and Tietê Rivers, occupying an area of 812,011 km², and extending through the states of Minas Gerais and São Paulo (Southeast region), Paraná (South region), Mato Grosso and Goiás (Center-West region).

Altogether, they amount to 1,650 km of currently operating waterways, passing through 286 municipalities that represent 26,290,703 inhabitants (IBGE, 2010). Among these municipalities it is worth highlighting the following towns: São Paulo (SP), Campinas (SP), Guarulhos (SP), Londrina (PR) and Foz do Iguaçu (PR), Três Lagoas (MS) and Araguari (MG), as the main urban centers.

The Tietê-Paraná Waterway is today one of the major operating waterways, with the following river stretches in operation: the Paraná River, between São Simão and Itaipu; the São José dos Dourados River, in the first 40 downstream km; the Pereira Barreto Channel; the Tietê River between its mouth and the town of Anhembi (SP); the Piracicaba River from its mouth to the bridge on SP-181. This waterway has operating beaconage and signaling systems.

The physical navigation conditions are, however, inadequate on the Tietê River, upstream from Salto, and the Piracicaba River, upstream from the town of Piracicaba, due mainly to countless natural obstacles and the small size of the channel.

The Paranapanema and Paranaíba Rivers have a number of implemented dams, all without locks and with differences in level of about 40 m. The Amambaí, Anhanduí, Ivaí, and Ivinhema Rivers have small size channels and navigation potential only for small vessels.

The analyses and studies conducted for characterization of the physical and social-environmental conditions of the potential waterways of the Tietê-Paraná Waterway System obeyed the methodologies presented in this report's Chapter 1 – item 1.3 – Methodology.

Due to the large volume of collected and analyzed information, this chapter presents a summary of the main results and conclusions obtained for each river studied.

In the CD contained in the annex to this report (Step C: Assessment and Diagnosis, a table is presented in the xls format containing, in a more detailed manner, all the variable and information analyzed for each river and stretch studied.

The Linear diagrams contained in this chapter synthesize the mentioned table following the methodology presented in Chapter 1, item 1.3 of this report.

As a product of the final step of the Waterway Strategic Plan (Step F: Preparation of the Final Strategic Plan), a geo-referenced database is presented containing all the information existing in the table of the CD attached to this report.

The main characteristics as to physical navigability conditions of the waterways composing the Tietê-Paraná River WS can be checked together with the one-line diagram presented below.

CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Paraná
- 02 Rio Amambaí
- 03 Rio Ivaí
- 04 Rio Ivinheima
- 05 Rio Paranapanema
- 06 Rio Tibagi
- 07 Rio Anhanduí
- 08 Rio Sucuriú
- 09 Rio Tietê
- 10 Rio Piracicaba
- 11 11 Rio São José Dos Dourados
- 12 Rio Grande - MG
- 13 Rio Paranaíba

Bacias do SH Paraná

Trechos de 10 km (xx-yyy)
xx: n° do rio
yyy: n° do trecho
*km = yyy * 10*

Escala de ponderação dos temas
1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 25 50 100 km
SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

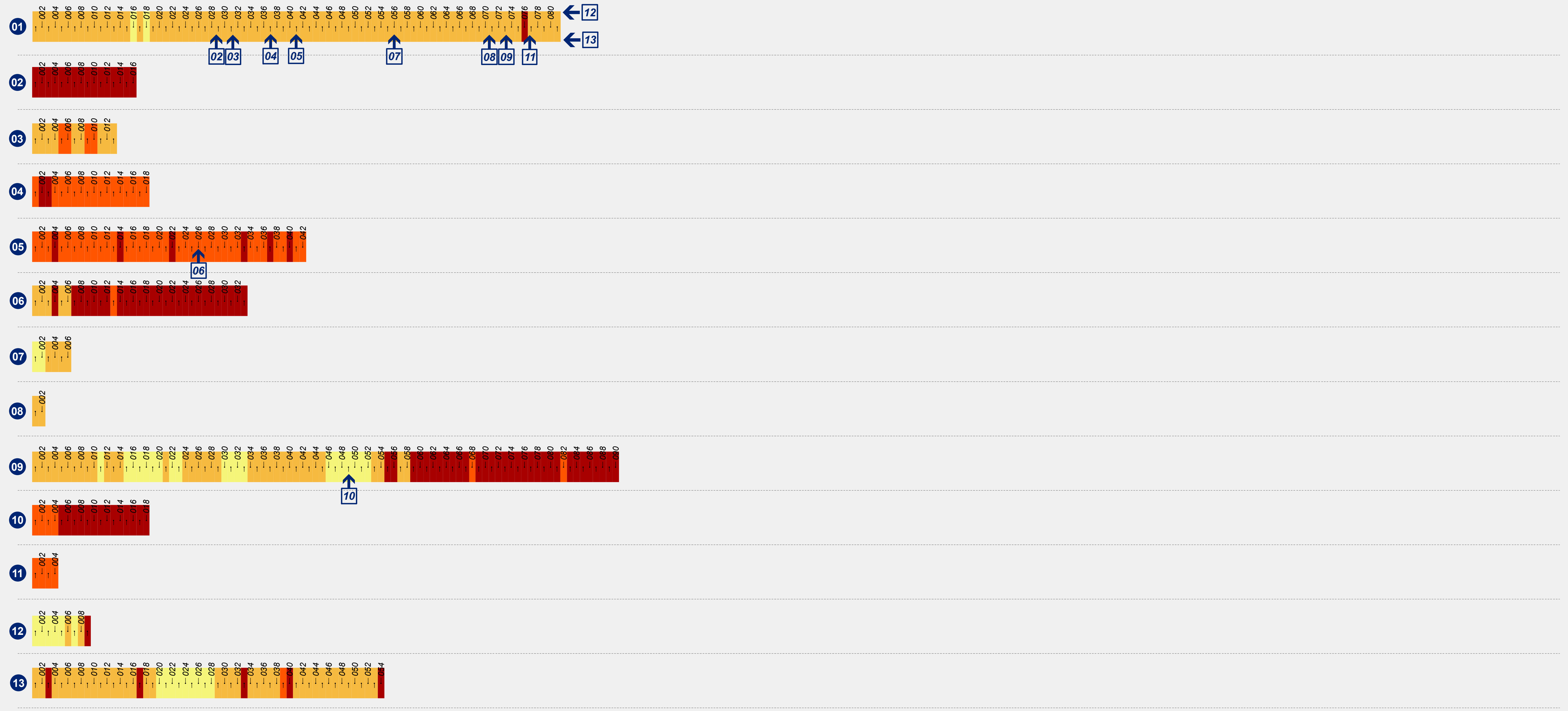
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:3.500.000	SH PARANÁ	MAI/2013



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	*ALTO DE:*	*MÉDIA DE:*	*BAIXA DE:*	
Sinuosidade; ou	*Sinuosidade; ou*	*Sinuosidade; ou*	*Sinuosidade; ou*	*Ausência das ocorrências*
Profundidade mínima; ou	*Profundidade mínima; ou*	*Profundidade mínima; ou*	*Profundidade mínima; ou*	
Empecilhos à navegação (construções); ou	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	
Energia do rio; ou	*Energia do rio; ou*	*Energia do rio; ou*	*Energia do rio; ou*	
Leito do rio; ou	*Leito do rio; ou*	*Leito do rio; ou*	*Leito do rio; ou*	
Assoreamento; ou	*Assoreamento; ou*	*Assoreamento; ou*	*Assoreamento; ou*	
Anteparos naturais; ou	*Anteparos naturais; ou*	*Anteparos naturais; ou*	*Anteparos naturais; ou*	
Largura mínima do rio.	*Largura mínima do rio.*	*Largura mínima do rio.*	*Largura mínima do rio.*	

CONVENÇÕES CARTOGRÁFICAS

- 01 Rio Paraná
- 02 Rio Amambaí
- 03 Rio Ivaí
- 04 Rio Ivinheima
- 05 Rio Paranapanema
- 06 Rio Tibagi
- 07 Rio Anhanduí
- 08 Rio Sucuriú
- 09 Rio Tietê
- 10 Rio Piracicaba
- 11 Rio São José Dos Dourados
- 12 Rio Grande - MG
- 13 Rio Paranaíba

X Confluências

Numeração dos trechos

n° < Jusante

n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH PARANÁ	MAI/2013

All the main social-environmental characteristics worth highlighting in order to foster integrated planning of occasional interventions needed in the region where the Tietê-Paraná River WS is found can be checked as a whole in the one-line diagram presented as follows.

CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Paraná
- 02 Rio Amambaí
- 03 Rio Ivaí
- 04 Rio Ivinheima
- 05 Rio Paranapanema
- 06 Rio Tibagi
- 07 Rio Anhanduí
- 08 Rio Sucuriú
- 09 Rio Tietê
- 10 Rio Piracicaba
- 11 Rio São José Dos Dourados
- 12 Rio Grande - MG
- 13 Rio Paranaíba

- Bacias do SH Paraná

Trechos de 10 km (xx-yyy)
- *xx: n° do rio*
- *yyy: n° do trecho*

*km = yyy * 10*

Escala de ponderação dos temas
1 - 5 (baixa - alta)
- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 25 50 100 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:3.500.000	SH PARANÁ	MAI/2013

VULNERABILIDADE SOCIOAMBIENTAL

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
UC - proteção integral; ou	*UC - uso sustentável; ou*	*Assentamento INCRA; ou*	*APCB; ou*	*Ausência das ocorrências*
Terra indígena	*Comunidade quilombola*	*Vulnerabilidade ao desmatamento; ou*	*Mineração - Lavra e garimpo*	
		Cavidades naturais		

CONVENÇÕES CARTOGRÁFICAS

- 01 Rio Paraná
- 02 Rio Amambaí
- 03 Rio Ivaí
- 04 Rio Ivinheima
- 05 Rio Paranapanema
- 06 Rio Tibagi
- 07 Rio Anhanduí
- 08 Rio Sucuriú
- 09 Rio Tietê
- 10 Rio Piracicaba
- 11 Rio São José Dos Dourados
- 12 Rio Grande - MG
- 13 Rio Paranaíba

X Confluências

Numeração dos trechos

n° < Jusante

n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA 0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH PARANÁ	MAI/2013

By observing the one-line diagram and the location map, it can be seen that for this waterway system the most vulnerable areas are located in the surroundings of the Paraná River, especially between the municipalities of Guaíra (PR) and Rosana (SP), and the surroundings of its tributaries in the region – the Ivinheima, Amambaí, Paranapanema, and Tabagi Rivers. This is a region with Integral Protection Conservation Units on the left bank (in Mato Grosso do Sul) surrounded by Sustainable Use Conservation Units, which take place on both banks in this same region. Should it be necessary to implement new infrastructure to support river transport in this region, the licensing process may be more complex.

It is to be emphasized that in spite of the occurrence of vulnerable areas around the Tietê River – particularly the presence of Integral Protection and Sustainable Use Conservation Units in the São Paulo metropolitan region and at the confluence of the Piracicaba River in the vicinity of the municipality of Anhembi – it is necessary to consider that they are densely populated regions where there is already some structure supporting navigation.

3.7.1.1 The Paraná Waterway

a) Navigability Diagnosis

The Paraná basin is 879.860 km² in size and is divided between the states of São Paulo, Paraná, Mato Grosso do Sul, Minas Gerais, Goiás and Santa Catarina and the Federal District. The rainfall rates, on average, range between 1,200 and 1,800 mm per year. In the more western region the temperature increases and rainfall decreases, with the average close to 1,300 mm.

The Paraná River originates between the states of São Paulo, Minas Gerais and Mato Grosso do Sul, at the confluence of the Grande and Paranaíba Rivers.

The major tributaries of the Paraná River are:

the Iguaçu River, the Amambaí River (stretch 29[Eu usei 'Stretch']), the Ivaí River(stretch 31), the Paranapanema River (stretch 41), the Pardo River (stretch 56), the Verde River (stretch 65), the Sucuruí River (stretch 71), the Tietê River (stretch 73), the São José dos Dourados River (stretch 76) and the Grande and Paranaíba Rivers (stretch 81). The Paraná River runs approximately at the central axis of the Paraná Basin, a wide sedimentary basin. Downstream from Foz do Iguaçu (PR), the river changes direction and becomes the natural limit between Argentina and Paraguay. At the confluence of the Paraguai River, it enters entirely Argentinian land and starts running southwards, discharging into the delta of the Paraná and, consequently into the Prata River. Its total length to the mouth of the Prata River, in the city of Buenos Aires, is about 4,880 km, being 1,950 the PK of Itaipú.

The flood period takes place between December and May. The average flow at the Guaíra station and the Ilha Solteira hydroelectric power plant is about 9,500 m³/sec and 6,000 m³/sec, respectively (see Appendix VII, Item 4.8.1).

The Paraná Waterway includes the stretch from the Brazil-Argentina-Paraguay triple border to the confluence of the Grande and Paranaíba Rivers.

The river bed is prevailingly rocky from the Itaipu hydroelectric power plant to the town of Guaíra and sedimentary from this town upstream.

The waterway today has four hydroelectric facilities (UHE): Itaipu UHE (stretch 3), Porto Primavera UHE or Eng. Sergio Motta UHE (stretch 44), UHE Jupiá (stretch 71) and UHE Ilha Solteira (stretch 76), with total power of over 20 GW.

From downstream to upstream, the Paraná Waterway starts at the triple border, goes through the Itaipu hydroelectric power plant (UHE) dam, which has no locks, and meets the Tietê River mouth after crossing the Porto Primavera and Jupiá UHEs, which have locks. At this point, in order to bypass the Ilha Solteira UHE dam, which has no locks, the waterway goes on through the Tietê River, crosses the Três Irmãos UHE and then goes through the Pereira Barreto Channel, connecting it to the São José dos Dourados River, where navigation returns to the Paraná River, thus arriving both at the Grande River, up to the Água Vermelha UHE, and the Paranaíba River, at the São Simão UHE.

Along the waterway there are works and interferences to be transposed, among which are road stuctures (bridges), hydraulic works (UHEs), power transmission lines, the Brazil-Bolivia gas pipeline and submersed optical fiber cables. The most critical crossing among these interferences is the passage under the Francisco de Sá railway bridge, that interconnects the towns of Andradina (PR) and Três Lagoas (MS), with a free navigation span of 7 m.

The Paraná waterway can be subdivided into the following stretches:

- A segment between the Itaipu UHE dam (stretch 3) through the access channel to the Ayrton Senna highway bridge (stretch 20), downstream from the Guaíra Channel. This stretch is navigated under a lacustrine regime with large widths and depths between 10 and 180 m and 170 km long.

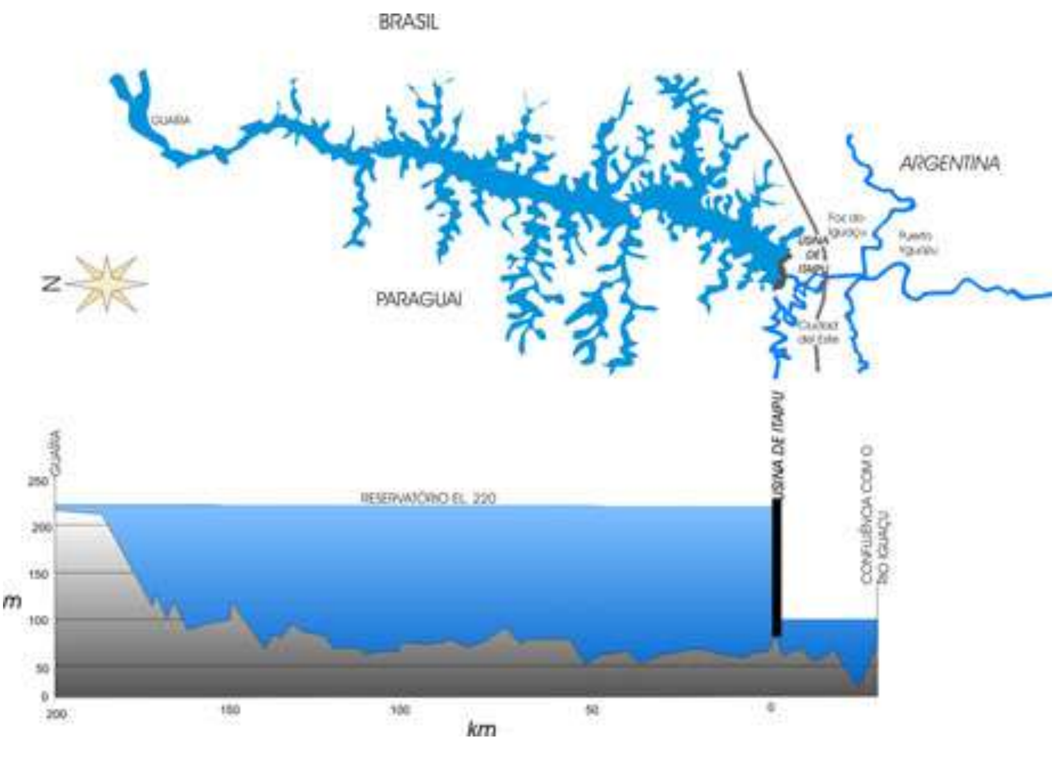


Figure 3.7.1: Profile of the Itaipu UHE reservoir. (Itaipu Binacional, 2013)

It is worth mentioning that the Itaipu UHE does not have any lock system, making navigation to Foz do Iguaçu and, consequently, to Argentina and the Atlantic Ocean impossible.

- Segment of the Guairá navigation channel, under the Ayrton Senna Highway Bridge (stretch 20), to the Porto Primavera UHE (stretch 44). This stretch, 245 km long, is navigated under a free current regime in a permanent environmental preservation area. Being the most critical stretch of the waterway and the object of detailed studies at the greatest restriction points, its current status allows only traffic of limited draft compositions.

  The main restrictions in this stretch take place in the Guaíra Channel and in the Porto Camargo region (PR) (stretch 30). The first case consists of a 2.5 m deep and 80 m wide channel excavated in rock, referred to the level corresponding to the absolute elevation of 220.2 m when the Guaíra (PR) limnimetric rule (stretch 20) is at the relative elevation of 1.7 m, thus enabling the navigation of vessels with a draft of up to 2.0 m.

  As a function of its location, in the Porto Camargo (PR) region the channel is subject to the formation of sand deposits coming from the Amambaí River, creating unfavorable navigation conditions in terms of depths and sinuosity along its course. AHRANA started to use the navigation channel on a route through the eastern channel of the Jacaré Island, thus defining the adequate positioning of nautical signaling and resulting in safe natural conditions for free navigation in the eastern channel. River level monitoring through observation of the limnimetric ruler of Porto Caiuá allows better use of the hydraulic conditions. On this ruler, when the level measures 1.7 m, it refers to the absolute elevation of 228.6 m, which corresponds to a 2.5 m depth in the river, allowing navigation with a draft of up to 2.0 m.

Figure 3.7.2: Formation of shores in the Porto Camargo region. (Panoramio, 2013)

The Porto Primavera UHE lock, as well as those of the Jupiá UHE, is 210 m long and 17 m wide, with a water level up to 4m, allowing the passage of 2x1 convoys, one at a time.

Figure 3.7.3: Porto Primavera lock. (Panoramio, 2013)

The current bridges in the segment (Ayrton Senna bridge and BR-487) allow the passage of 2x2 commercial convoys.

Figure 3.7.4: BR-487 bridge on the Paraná River (stretch 30). (Agência de Notícia do Estado do Paraná, 2013)

The next segment consists of the long stretch from the Porto Primavera UHE reservoir (stretches 44 through 70) to the Jupiá UHE dam and Francisco de Sá railway bridge (stretch 70). In this stretch the Paraná River has good navigation conditions due to a route relocation of approximately 270 km, with depths ranging from 3.5 to 20.0 m. The main difficulty lies in the Francisco de Sá railway bridge (stretch 70), whose dimensions may force the need to dismember convoys.

Figure 3.7.5 - Francisco de Sá railway bridge (stretch 70). (Férias, 2013)

The segment between the Jupiá UHE and the Ilha Solteira UHE dam has good conditions, with depths sufficient for commercial navigation.

However, due to the lack of a lock system at the Ilha Solteira UHE, navigation on stretches upstream from this UHE is made by using a diversion through the Tietê River, passing through the Três Irmãos UHE (equipped with locks), the Pereira Barreto Channel and the São José dos Dourados River (on a stretch flooded by the Ilha Solteira reservoir). The entire circuit is about 120 km long and navigation [in it] is made without great difficulty. The lock system of the Três Irmãos UHE is 12 m wide and 144 m long.

The final stretch between the exit of the São José dos Dourados River and the confluence of the Grande and Paranaíba Rivers has good navigation conditions. It has good lacustrine conditions, minimum depths of 5.0 m and large widths.

Navigation goes from this stretch mainly through the Paranaíba River, up to the São Simão UHE dam.

The waterway has adequate beaconage and signaling all along its course.

Figure 3.7.6: Signaling buoy on the Paraná River. (Appendix VIII – Navegação, 2013)

b) Social-environmental Vulnerabilities

The Paraná Waterway runs through the Paraná River basin, the Paranapanema River basin and the Tietê River basin.

The area of the Paraná River basin is 235,237 km² and it is inserted in the Cerrado (48%) and Atlantic Forest (52%) biomes. 234 municipalities in the states of São Paulo, Paraná, Mato Grosso do Sul and Goiás are part of it. In this area live 5,902,404 inhabitants, with Campo Grande (MS), Maringá (PR), Cascavel (PR), Foz do Iguaçu (PR) and Dourados (MS) being the most populated municipalities in the basin (IBGE, 2010). According to the FIRJAN index, Maringá (PR), Campo Grande (MS) and Chapadão do Céu (GO) are the municipalities having the highest development indices within the basin, i.e., 0.86. On the other hand, the municipalities of Coronel Sapucaia (MS) and Japorã (MS) are those with the lowest development index, i.e., 0.48. The average development index in the basin is 0.70 (FIRJAN, 2010).

Ten Integral Protection Conservation Units (UCPIs) were identified within the Paraná River basin, as well as five Sustainable Use Conservation Units (UCUS), 35 Biodiversity Conservation Priority Areas (APCBs) of extreme or very high action priority, 38 Indigenous Lands, one Maroon Land and 150 INCRA settlements.

The area of the Paranapanema River basin is 106,563 km², covering the territory of 246 municipalities in the states of Mato Grosso do Sul, Paraná and São Paulo. These 246 municipalities, together, represent a population of 6,230,299 inhabitants (IBGE, 6.230.299). The most populous of them are Botucatu and Presidente Prudente in São Paulo and Londrina and Maringá in Paraná.

With regard to conservationist aspects, the Paranapanema basin is inserted in the Cerrado (24%) and the Atlantic Forest (76%) biomes, and along the basin there are 892 areas of mining works, 20 Integral Protection Conservation Units (UCPIs), 9 Sustainable Use Conservation Units (UCUS), 41 Biodiversity Conservation Priority Areas (APCB) of extreme or very high priority, 167 INCRA settlements and 8 Indigenous Lands.

The area of the Tietê River basin is 104,141 km², covering 362 municipalities in the states of Mato Grosso do Sul, São Paulo and Minas Gerais that represent together a population of 33,923,598 inhabitants (IBGE, 2010); being the most populous, it was considered in this plan. Among the most populous municipalities are São Paulo, Campinas, São Bernardo do Campo and Sorocaba, in the state of São Paulo, and Três Lagoas in Mato Grosso do Sul.

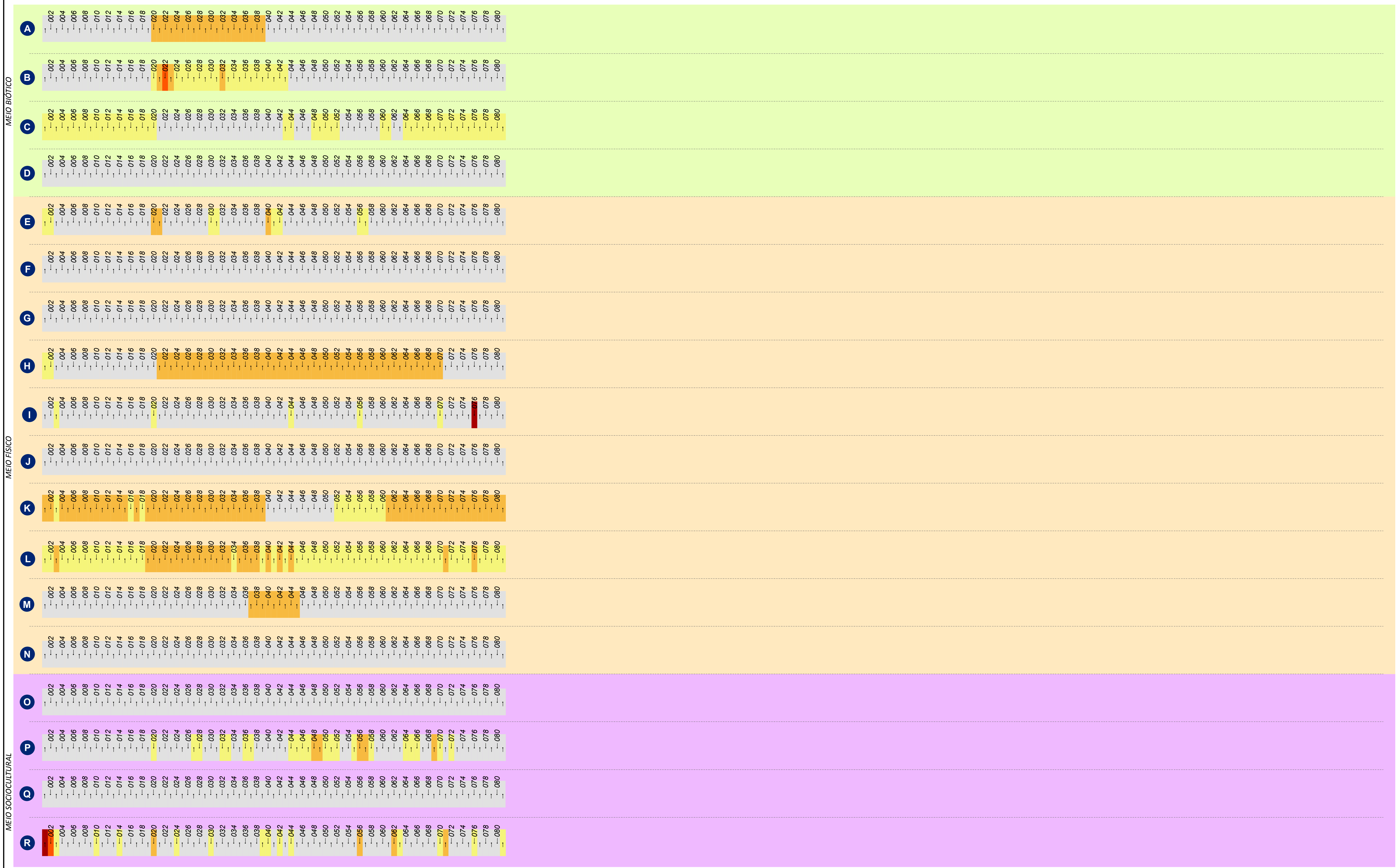
With regard to conservationist aspects, 215 of the areas are inserted in the Cerrado biome and 79% in the Atlantic Forest biome, and there are 1,650 areas of mining works, 27 Integral Protection Conservation Units (UCPIs), 29 Sustainable Use Conservation Units (UCUS), 38 Biodiversity Conservation Priority Areas (APCB) of extreme or very high action priority, 4 Maroon Lands, 76 INCRA settlements and 6 Indigenous Lands.

Specifically, the future Paraná Waterway was divided, for the purposes of this analysis, into 81 10 km-long stretches. The waterway crosses 47 municipalities in the states of São Paulo, Paraná and Mato Grosso do Sul; altogether, the municipalities total 1,021,728 inhabitants (IBGE, 2010), with Três Lagoas (MS) and Foz do Iguaçu (PR) standing out. The FIRJAN (2010) index ranges from 0.81 at Foz do Iguaçu (PR) to 0.62 at Santa Rita do Pardo (MS), the average being 0.71.

Map 37: Paraná Waterway location

It can be seen that of the 81 stretches into which the waterway was divided, 25% have greater vulnerability, due mainly to the existence of Integral Protection Conservation Units in the area of the Parque Nacional do Iguaçu in the municipality of Foz do Iguaçu (PR) and in stretches 20 through 39, in the Parque Nacional Ilha Grande, in the municipalities of Alto Paraíso, Altônia, Guaíra, Icaraíma and São João do Patrocínio, on the Paraná side, and Eldorado, Itaquiraí, Mundo Novo and Naviraí, in Mato Grosso do Sul. This region is also surrounded by Sustainable Use Conservation Units.

Other areas of conservationist interest and/or of potential useage conflict are found in the vicinity of the waterway, such as APCBs in stretches 1 to 20 (between Foz do Iguaçu/PR and Guaíra/PR), 43 to 52 (between Rosana/SP and Bataguassu/MS) and 60 to 81 (between Panorama/SP and Santa Fé do Sul/SP). Indigenous or maroon lands were not identified in the vicinity of the river, but there are INCRA settlements along the waterway.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO PARANÁ	MAI/2013

3.7.1.2 *The Amambaí Waterway*

a) Navigability Diagnosis

The Amambaí River is one of the right bank tributaries of the Paraná River. Its spring is located on the Brazil-Paraguay border and cuts through the south of the state of Mato Grosso do Sul over 400 km until it reaches one of the Paraná River arms near Porto Camargo (PR). The main cities covered by the waterway are Naviraí (MS) and Juti (MS).

The basin suffers the influence of the tropical and subtropical climates, with an average temperature of 22°C. Annual rainfall ranges from 1,750 to 2,000 mm, and is concentrate from October to April. The average flow of the Amambaí River is around 140 m³/second at the Naviraí station (see Appendix VII, Item 4.8.8).

The Amambaí Waterway addressed in this analysis consists of the stretch from its mouth, on the Paraná River, to the vicinity of the city of Juti (MS), about 160 km long.

The Amambaí River basin has the characteristics of river plains and alluvial deposits, with a predominant sedimentary river bed in the first 50 downstream km of the river (stretches 1 through 5), close to the mouth on the Paraná River; and is located in a region of the Central Plateau from this point upstream, with a rocky river bed in stretches 13 to 16.

The river has high sinuosity rates along its entire alignment (values between 1.2 and 1.9) and the minimum widths do not vary significantly along the river, being on the order of 30 m. These characteristics make navigability conditions for commercial convoys difficult along the whole stretch of the river under study.

Figure 3.7.7: Sinuous stretch of the Amambaí River (stretch 2). (Panoramio, 2013)

The Amambaí River transports a large quantity of sediments, which it tends to deposit in the more downstream stretches of the waterway, where declivity is on the order of 6 cm/km. The sediments carried by the Amambaí River end up impairing navigability conditions in the Paraná River near Porto Camargo (PR). In the Amambaí River, sandbanks are deposited on the river bottom and may cause low depths, on the order of 1 m.

The river has low declivities, on the order of 6 cm/km, from its mouth to 60 km upstream (stretches 1 to 6). From this point until the vicinity of the city of Naviraí (MS) (stretch 10), the declivities are on the order of 19 cm/km, and from this place/spot upstream the river has a number of rapids and small falls, with an average declivity on the order of 40 cm/km (stretches 11 through 16). These low falls and rapids cannot be transposed/passed, from the navigation point of view.

There are no barriers today in the Amambaí River in the stretch considered in this study. However, implementation of a PCH in the most upstream stretch of the waterway (stretch 15) is anticipated to take advantage of the current differences in level for hydroelectric power generation. The construction of this PCH (small power plant), should it be equipped with locks, will enable navigation in non-navigable stretches of the waterway.

Figure 3.7.8: Pirapó Falls in the Amambaí River (stretch 15). (ConeSul, 2012)

Figure 3.7.9: Guanabara Falls in the Amambaí River (stretch 15). (Panoramio, 2013)

Five bridges were identified: BR 487, BR 163, MS 298 and two new vicinal bridges, without further information. These two bridges may be obstacles to navigation and even prevent the navigation of commercial convoys.

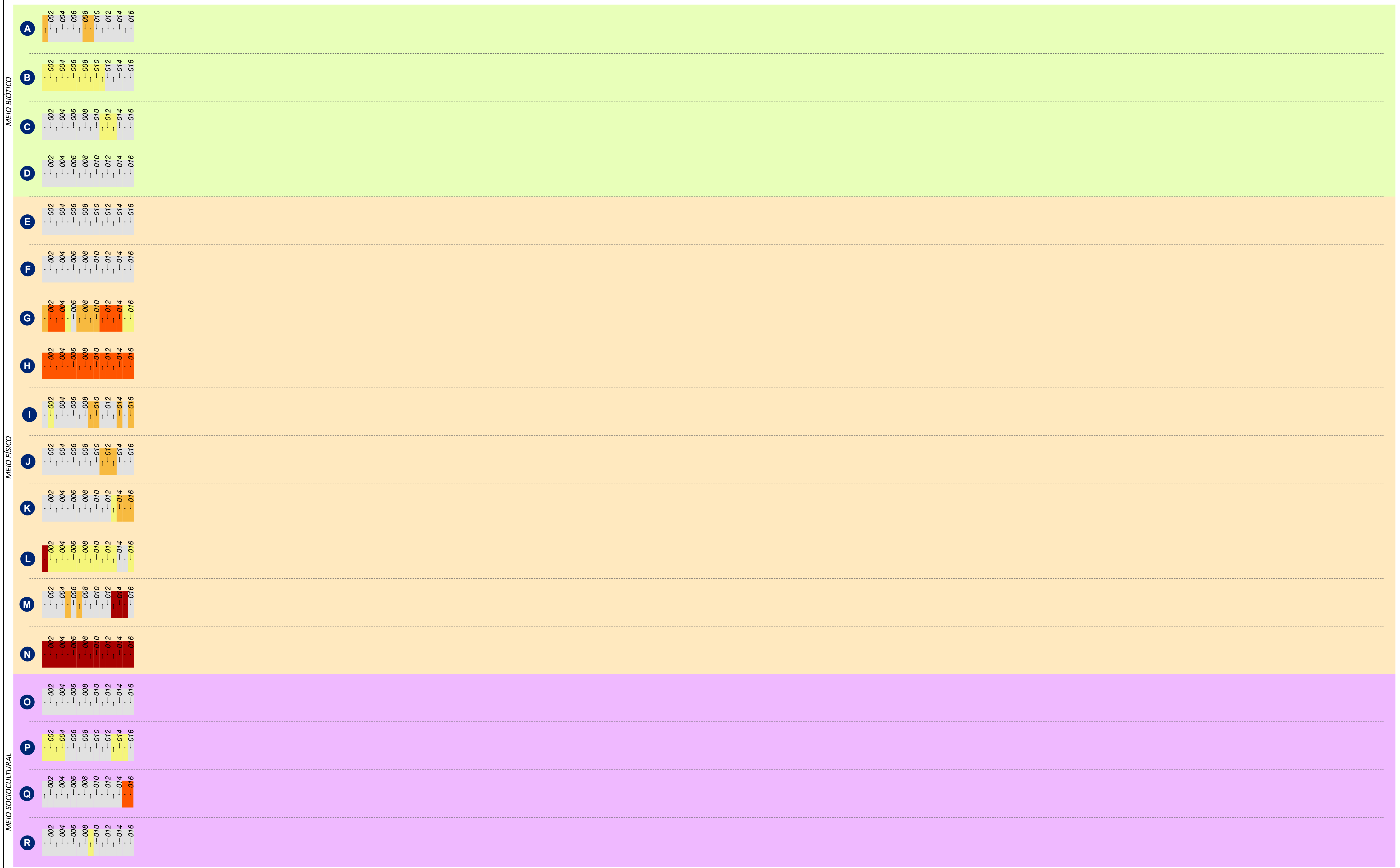
Figure 3.7.10: BR-487 bridge on the Amambaí River (stretch 2). (Panoramio, 2013)

b) Social-environmental Vulnerabilities

The Amambaí Waterway is also located in the already described Paraná River basin; 154 km of its extension were analyzed and divided into 16 10 km-long stretches for the purposes of this study. The waterway crosses 6 municipalities in the state of Mato Grosso do Sul, totaling 146,310 inhabitants (IBGE, 2010); the municipality of Naviraí stands out as the most populous municipality. The FIRJAN (2010) index varies from 0.76, for the municipality of Caarapó, to 0.61 for the municipality of Amambaí.

Map 38: Amambaí Waterway location

In the vicinity of its confluence with the Paraná River, this waterway crosses the Paraná River island and Floodplain Environmental Protection Area in the municipalities of Naviraí and Itaquirai (MS). It is important to stress that the Guarani-Kaiowá ethnic group is located in stretches 15 and 16, in the area called Jarará, in the municipality of Juti (MS) (FUNAI, 2012). There are also APCBs in stretches 11 to 13, between Iguatemi and Amambaí.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO

- Ⓐ Unidade de Conservação - Proteção Integral
- Ⓑ Unidade de Conservação - Uso Sustentável
- Ⓒ Áreas Prioritárias para Conservação da Biodiversidade
- Ⓓ Desmatamento do trecho

FÍSICO

- Ⓔ Mineração - Lavra e garimpo
- Ⓕ Espeleologia
- Ⓖ Sinuosidade
- Ⓗ Profundidade
- Ⓘ Empecilhos à navegação (construções)
- Ⓙ Energia do rio
- Ⓚ Leito do rio
- Ⓛ Assoreamento
- Ⓜ Anteparos naturais
- Ⓝ Largura do rio

SOCIOCULTURAL

- Ⓞ Comunidades quilombolas
- Ⓟ Assentamentos INCRA
- Ⓠ Terra indígena
- Ⓡ Ocupação lindeira

Nº dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

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DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

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3.7.1.3 The Ivaí Waterway

a) Navigability Diagnosis

The Ivaí River is one of the tributaries of the Paraná River in the state of Paraná. Its drainage area is around 36,587 km². Its spring forms in the southeast of the state by the dos Patos and São João Rivers, in the Serra da Boa Esperança, both at an altitude of over 800 m, in the state of Paraná. After crossing countless municipalities in that state, the Ivaí River empties into an arm of the Paraná River, 10 km upstream from Porto Camargo-PR (stretch 31 of the Paraná River). The main tributaries are the following rivers: Corumbataí, Mourão and Alonzo (or Rio do Peixe), Belo, Barra Grande, Ivaizinho, Ubazinho, dos Indios, das antas and do Bulha.

The average annual rainfall rate is about 1,350 mm, with a standard deviation of about 270 mm. There is no well defined flood and/or dry period. The average flow is around 690 m³/second at the Novo Porto Taquara station (see Appendix VII, Item 4.8.9).

The Ivaí Waterway addressed in this analysis consists of the stretch going from its mouth on the Paraná River to about 120 km upstream, near the municipalities of Tapira-PR and Santa Mônica-PR.

The stretch under study is located in a region of alluvial deposits, with a predominantly sedimentary bed.

There is no record of commercial navigation on the Ivaí Waterway. Due to its physical conditions, this river has adequate navigability conditions only for small and mid-size vessels.

The Ivaí River transports considerable amounts of sediments. There is silting along the waterway, forming some river islands and sandbanks, which may represent obstacles to navigation.

The declivity is almost zero in stretches 1 to 4, and on the order of 18 cm/km along the rest of the waterway (stretches 5 through 13).

The Ivaí River develops a quite sinuous standard in its waterway course, with irregular and often abrupt curves. The confluence of its waters with those of the Paraná River shows the phenomenon of hydrodynamic instability by forming vortexes.

The minimum widths are constant and oscillate between 80 and 150 m. Narrows are not seen in the river chute, but the presence of floating islands and sandbanks may narrow the river and represent restrictions to navigation.

Minimum depths are estimated as being 2.0 m, and there may be many critical stretches with even lesser depths due to spot silting.

Figure 3.7.11: Ivaí River during flooding (stretches 7/8) (JIE, 2012)

There are no dikes today in the stretch of the Ivaí River under study. The only existing bridge in the stretch corresponds to the crossing of the PR-480 (stretch 11), but it does not represent any difficulty for navigation.

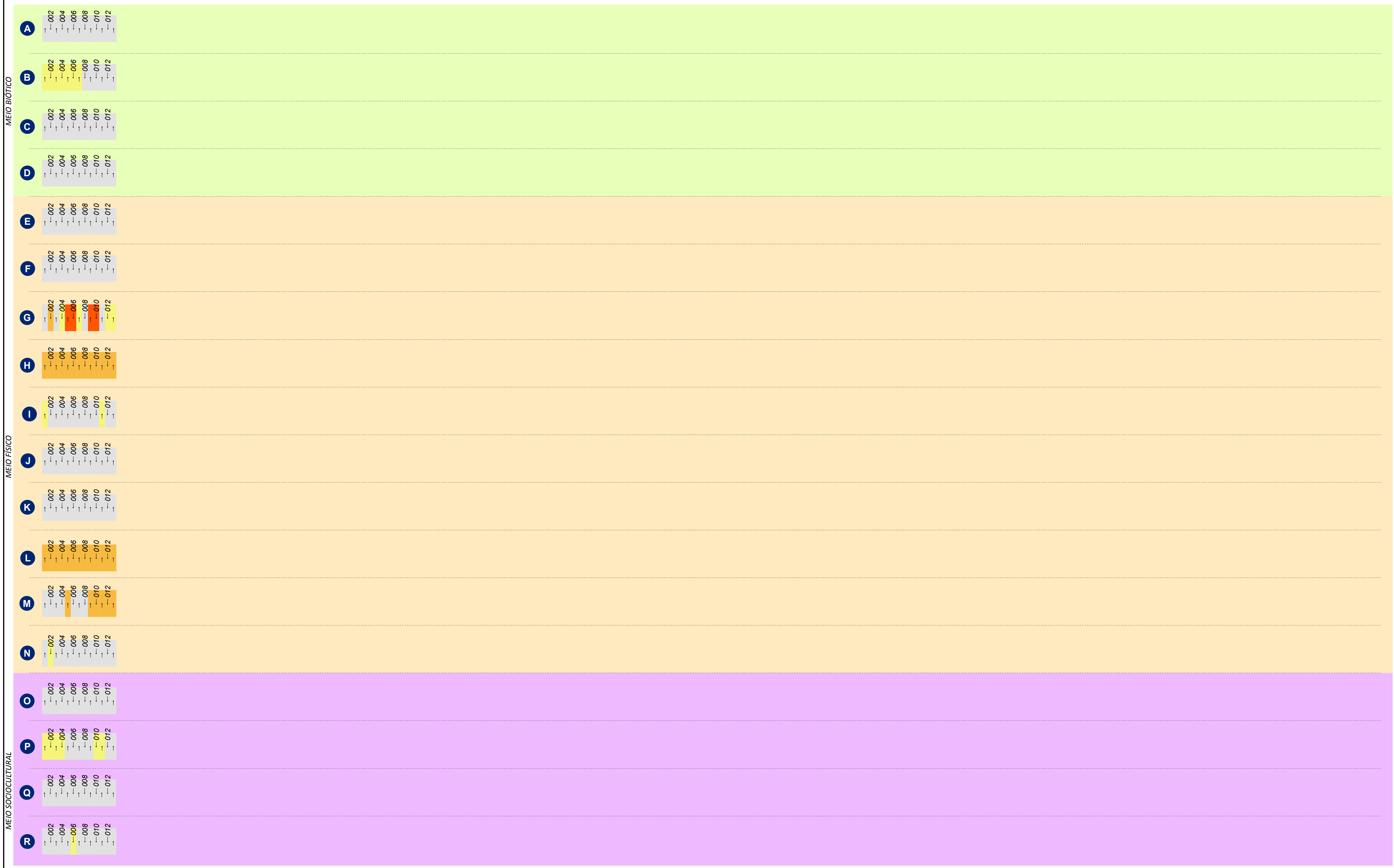
Figure 3.7.12: PR-480 bridge on the Ivaí River in stretch 11. (Panoramio, 2013)

b) Social-environmental Vulnerabilities

The Ivaí Waterway is located in the already described Paraná River basin and was considered as being 120 km long and divided into 13 stretches from its confluence with the Paraná River. The study area intercepts the territory of 11 municipalities, all in the state of Paraná, totaling 98,144 inhabitants (IBGE, 2010). The FIRJAN (2010) index values range from 0.84 for Douradina (PR) up to 0.62 in the municipality of Cidade Gaúcha (PR).

Map 39: Ivaí Waterway location

There are no Indigenous Lands or Integral Protection Conservation Units in the stretches of this waterway, but it is worth mentioning that there is a Sustainable Use Conservation unit between stretches 01 and 07, from Icaraíma to Douradina (PR), as well as INCRA settlements between stretches 01 and 04, between Icaraíma and Santa Cruz de Monte Castelo (PR), and 10 and 11 in the municipality of Santa Mônica (PR).



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais

SOCIOCULTURAL
- N Largura do rio
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

nº < Jusante

nº > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

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MA - Muito alta

REFERÊNCIAS

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- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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3.7.1.4 The Ivinhema Waterway

a) Navigability Diagnosis

The Ivinhema River is one of the right bank tributaries of the Paraná River and one of the largest rivers in the state of Mato Grosso do Sul, with a drainage area on the order of 46,500 km². Its spring is located in the Serra de Maracaju (MS) and its mouth is on the Paraná River, about 50 km downstream from Porto Rico (PR).

The annual rainfall oscillates between 1,500 and 1,700 mm, and has reached 2,000 mm in some years. Rains are concentrated between October and April. The average flow is around 365 m³/second (see Appendix VII, Item 4.8.10).

The Ivinhema Waterway addressed in this analysis consists of the stretch [that goes] from its spring, on the Paraná River, up to about 40 km upstream from the crossing of the MS-141, about 180 km long.

The Ivinhema River has adequate navigability conditions only for small and mid-size vessels. Declivities are low: Close to the spring, the river flows through swampy ground and runs parallel to the Paraná River through long stretches, whose declivities are on the order of 10 m/km. In the more upstream stretches the river declivities are on the order of 20 cm/km. There are no rapids or falls in the stretch under study.

The bed is predominantly sedimentary along the river, with the exception of the last 20 upstream kilometers (stretches 17 and 18 of the waterway).

The Ivinhema River has some stretches with high sinuosity rates and sharp curves (stretches 2 through 6). Widths are constant, on the order of 100 m.

With the increase in deforestation rates in the region, an increase in sediments produced in the basin has been seen, increasing silting effects along the river. Some river islands can be seen, and they may cause difficulties for navigation. Minimum depths are anticipated at 2.0 m, but they may be lower in the upstream stretches and in many other places due to the existing silting process.

There are no dikes or any other infrastructure in the Ivinhema River today. Also, records of studies for future dikes were not found.

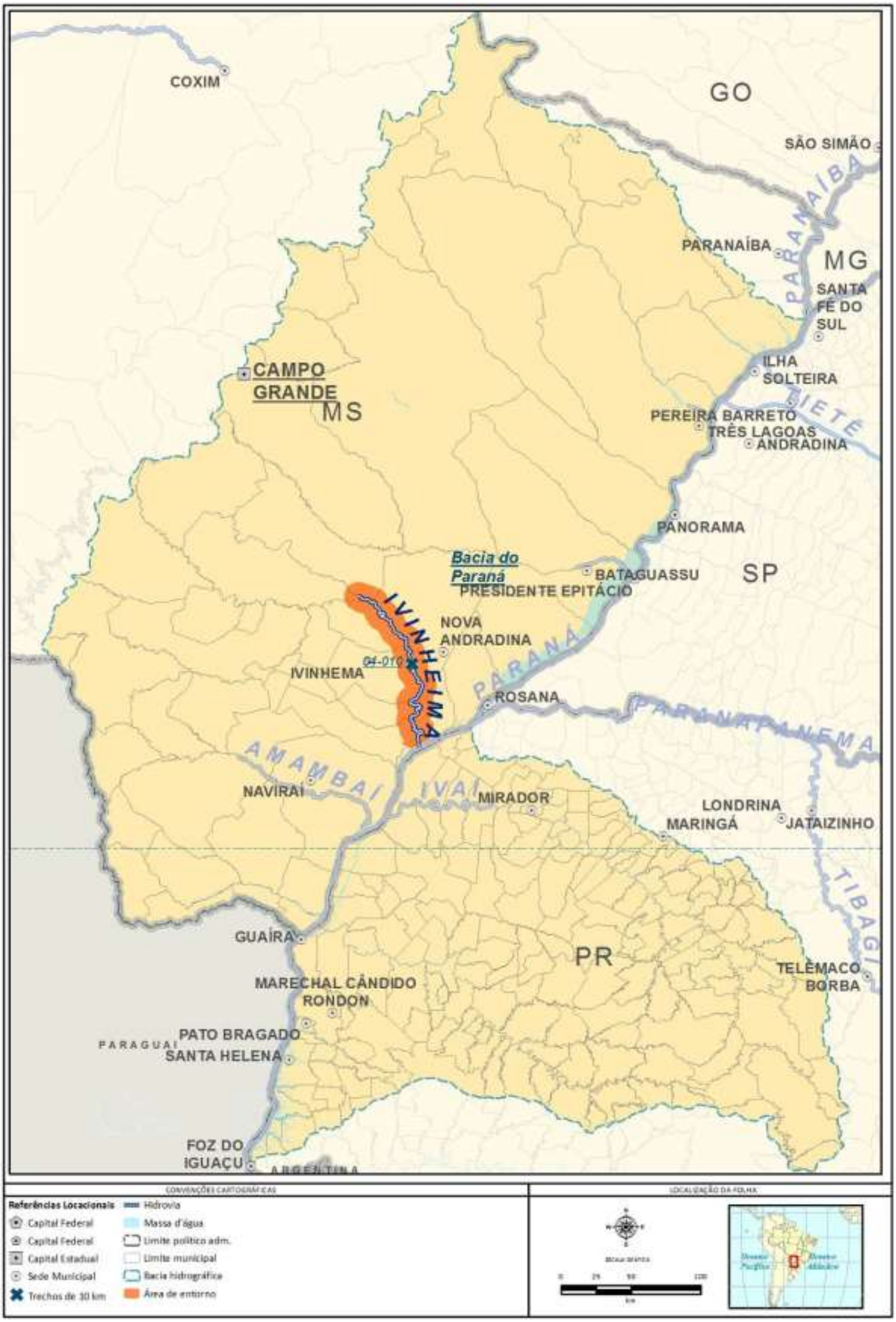
There are two bridges on the Ivinhema Waterway: BR 376 (stretch 9) and MS-141 (stretch 14), one of which is temporarily made of wood, not transposable from the commercial navigation point of view.

Figure 3.7.13: Bridge on the Ivinhema River at BR 376, stretch 9. (Panoramio, 2013)

Figure 3.7.14: Bridge on the Ivinhema River at MS-141, stretch 14. (Panoramio, 2013)

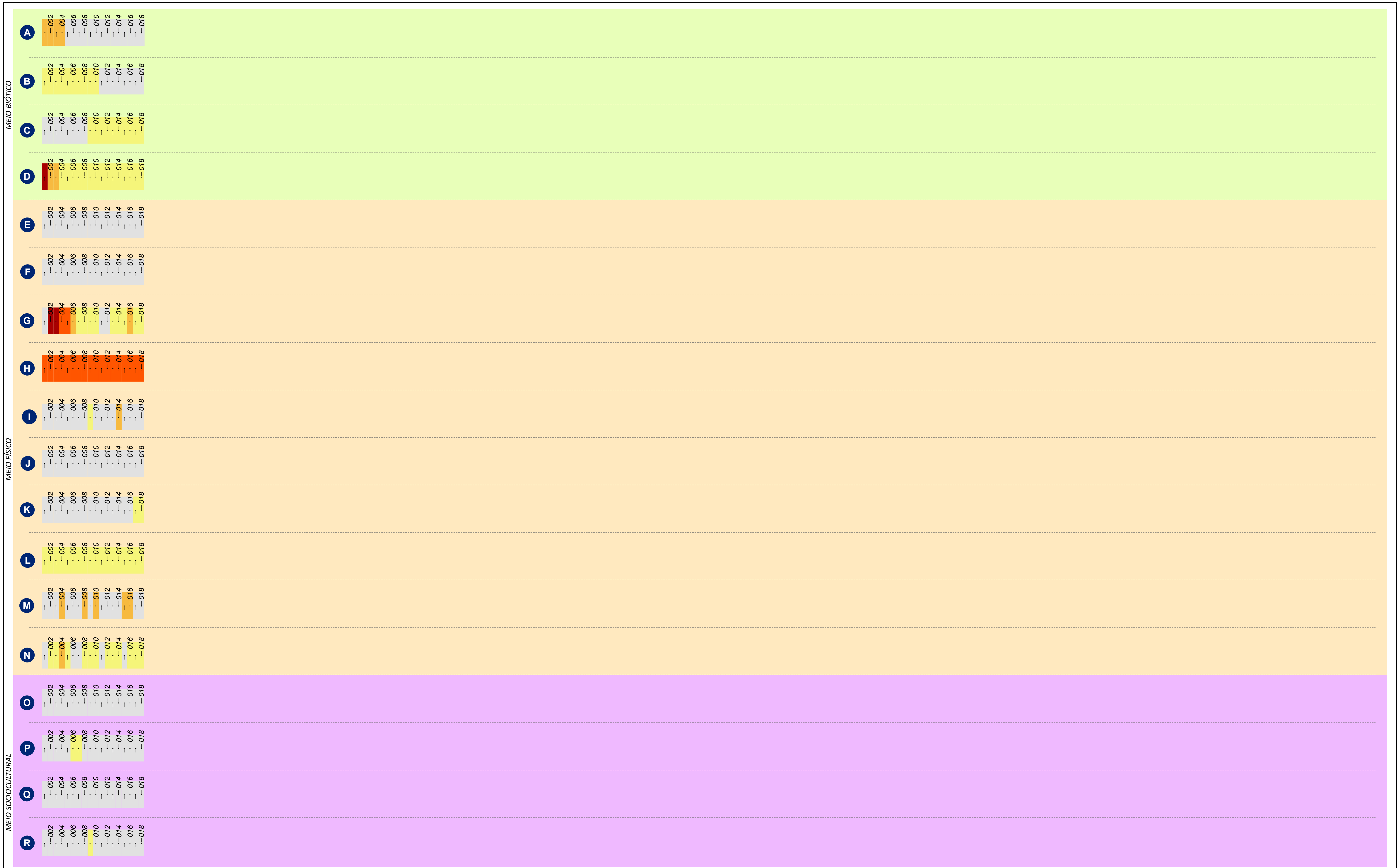
b) Social-environmental Vulnerabilities

The Ivinhema Waterway is located in the already described Paraná River basin and was considered as being 176 km long and divided into 18 stretches. The study area intercepts the territory of 8 municipalities belonging to the state of Mato Grosso do Sul, totaling 136,675 inhabitants (IBGE,2010). The municipality of Angélica has the highest FIRJAN index (2010), 0.77, while Taquarussu has the lowest, 0.64.



Map 40: Ivinhema Waterway location

Between the municipalities of Taquarussu, Jateí and Novo Horizonte do Sul (stretches 01 through 04) in Mato Grosso do Sul, there are Integral Protection Conservation Units surrounded by Sustainable Use Conservation Units extending to stretch 011. There are also APCBs in stretches 09 through 18, between Nova Alvorada do Sul and Angélica.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
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FÍSICO
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- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

nº < Jusante

nº > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

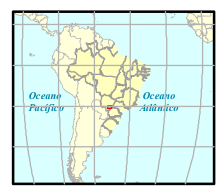
REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA



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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO IVINHEIMA	MAI/2013

3.7.1.5 The Paranapanema Waterway

a) Navigability Diagnosis

The Paranapanema River is one of the major tributaries of the Paraná River. Its area is 145,511 km². its spring is located in the Serra de Agudos Grandes, in the southeast of the state of São Paulo, about 100 km from the Atlantic coast and at an approximate altitude of 900 m, and its mouth is on the Paraná River, after running 929 km, overcoming a 570 m difference in level. The river develops in the east-west direction and is a natural divider of the territories of the states of São Paulo and Paraná. Its mouth is located on the left bank of the Paraná River, near the city of Rosana (SP).

The Itararé, das Cinzas, Tibagi, Pirapó, Laranja Doce, Capivari and Pary Veado Rivers are important tributaries of the Paranapanema River.

The average annual rainfall rate is about 1,200 mm and the flood period is between October and March. The average flow at the Rosana plant near the mouth is about 1,000 m³/second (see Appendix VII, Item 4.8.6).

The Paranapanema Waterway addressed in this analysis consists of the stretch [that goes] from its mouth on the Paraná River to the city of Ourinhos (SP), at the end of the Salto Grande UHE reservoir, being about 420 km long, with a difference in level of about 150 m.

The Paranapanema Waterway today has six implemented hydroelectric power plants, with total power of about 1,800 MW. They are the: Rosana (stretch 4), Taquaruçu (stretch 14), Capivara (stretch 22), Canoas I (stretch 33), Canoas II (stretch 37) and Salto Grande (stretch 40) UHEs. The figure that follows illustrates the division of the falls in the Paranapanema River in the stretch under study.

Figure 3.7.15: Division of Falls in the Paranapanema River. (Intertechne, 2001)

Due to the implementation of these plants, the Paranapanema Waterway is in the conditions of a lacustrine regime along almost its entire alignment. The exceptions are the stretch downstream from the Rosana UHE and the stretches between the end of the reservoir of one of the plants and the dike of the upstream plant, under a free current regime Navigability conditions in the stretches of reservoirs are adequate, and the more critical stretches to navigation are those under a river regime.

it is worth mentioning that none of these UHEs have a lock system, thus preventing the transposition of vessels through the dams and representing the main constraint to navigation on the Paranapanema Waterway.

Figure 3.7.16: Rosana UHE (stretch 4). (Prefeitura Municipal de Rosana, 2012)

In the stretch under study, there are 9 bridges crossing the Paranapanema River, and many of them restrict commercial navigation that also depends on the water levels in the reservoirs.

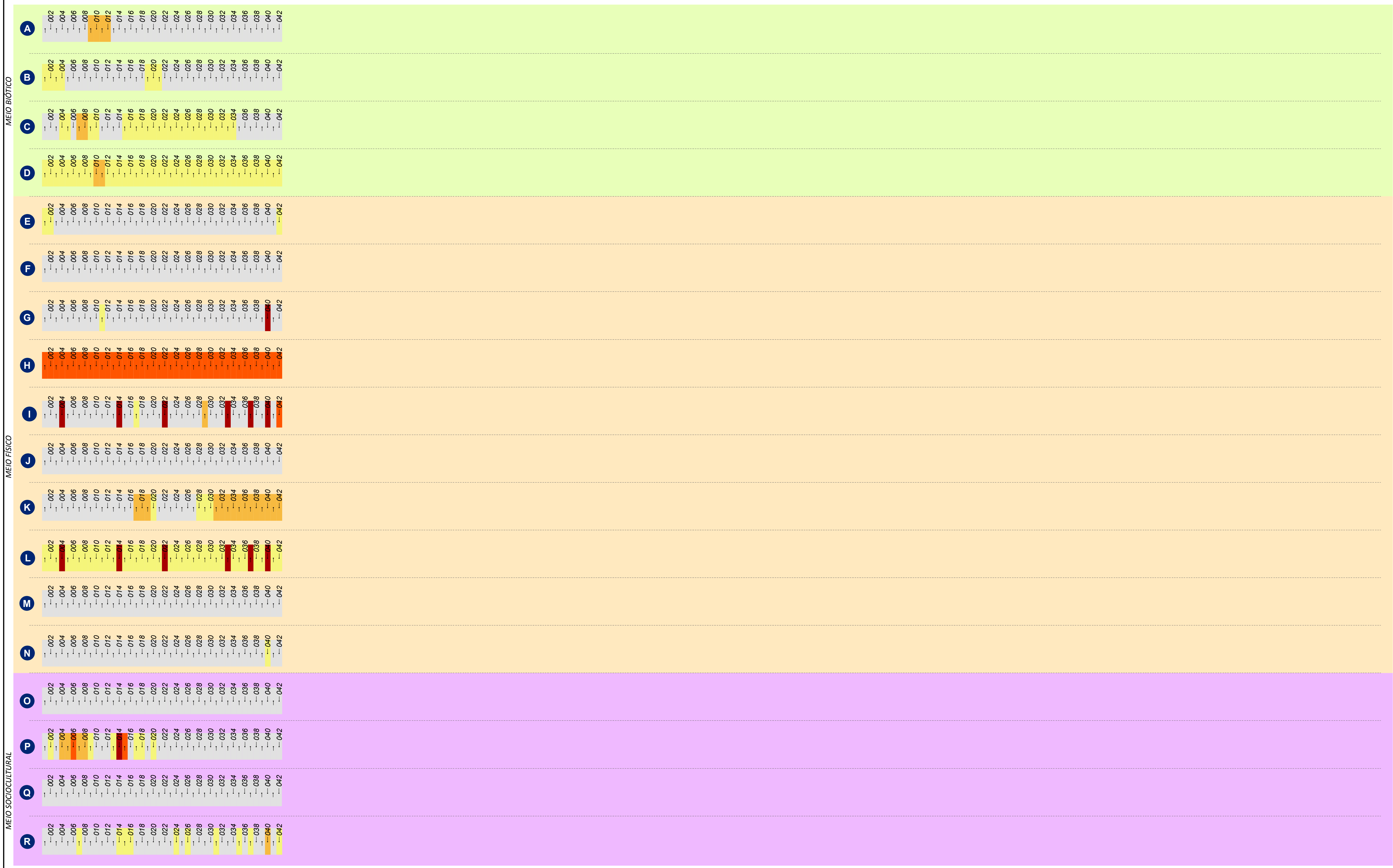
Figure 3.7.17: Bridge on the Paranapanema River, PR-463 and SP-425 highways, stretch 17. (Panoramio, 2013)

b) Social-environmental Vulnerabilities

Were analised 414 km of the Paranapanema Waterway, which is located in the already described Paranapanema River basin, were analyzed. The study area limit goes through 52 municipalities that, together, have a population of 693,013 inhabitants (IBGE, 2010) distributed between the states of São Paulo and Paraná. The FIRJAN (2010) index ranges from 0.84 for the municipality of Ourinhos (SP) to 0.63 in the municipalities of Alvorada do Sul, Diamante do Norte and Primeiro de Maio in Paraná, with an average of 0.72 for all the municipalities intercepted by the waterway.

Map 41: Paranapanema Waterway location

The waterway was divided into 42 10 km-long stretches for this study, and it is worth highlighting the existence of Integral Protection Conservation Units between stretches 09 and 12, near the municipality of Teodoro Sampaio/SP (Parque Estadual do Morro do Diabo). It is also worth highlighting the presence of APCBs of very high action priority between stretches 15 (Sandovalina/SP and Itaguajé/PR) and 32 (Florínia/SP and Leópolis/PR).



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

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AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
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3.7.1.6 Anhanduí/Pardo Waterway

a) Navigability Diagnosis

The Anhanduí River or Pardo River consists of one of the tributaries of the Paraná River right bank. Its spring is located in the Campo Grande (MS) Center Urban Gerion, in the confluence of the Segredo and Prosa creeks running towards the South of this municipality. Its moutn is located in the Paraná River, next to Bataguaçu (MS), about 120km upstream of Porto Primavera UHE (hydroelectric power plant) dam.

The average anual rainfall rate is approximately 1,300 mm, with the flood period between October and April. The average flow is 380 m^3/s (see Apendix VII, Item 4.8.11).

With the construction of the Porto Primavera UHE, put into operation in 1999, and the impoundment caused by damming in the Paraná River, the Anhanduí River was inundated from its mounth up to approximately 60 Km upstream.

The Anhanduí Waterway discussed in this analysis consists of the inundated stretch, from its mouth, in the Paraná River, up to 40 km upstream (stretchstretch 40), next to the municipality of Bataguaçu (MS), the main city covered by the waterway.

Due to the artificial lacustrine conditions caused by the Porto Primavera UHE reservoir, the Anhanduí Waterway has proper navigation conditions from its mounth up to the crossing with MS-395 (stretches 1 to 4). The mininum width checked in the stretchstretch is 300 m, and the minimum depths are in the order of 3 m and vary according to the operation of the reservoir of the Porto Primavera UHE. There are no natural obstacles that may represent difficulties for the navigation in this stretch.

The only existing bridge in the stretch corresponds to the crossing of MS-395, nonetheless, it does not represent a restriction to navigation of small and medium-size vessels.

In stretches 5 and 6 the influence of the reservoir is smaller, and there are many river islands and sandbanks which reduce the navigable widths and depths, and could restrict navigation.

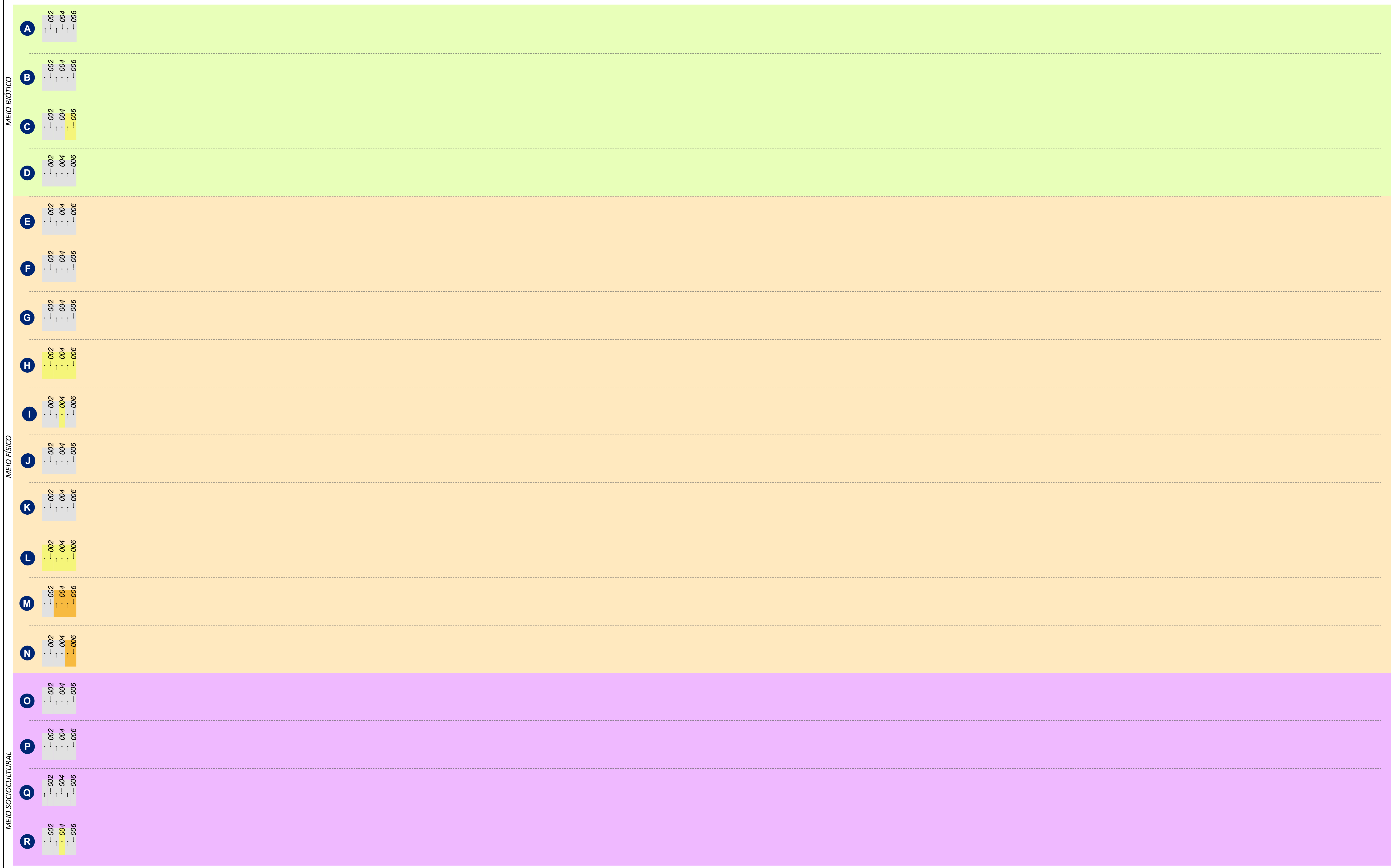
b) Social-environmental Vulnerabilities

The Anhanduí Waterway runs through the Paraná basin (as previously described), and its navigation length was estimated in 50 kilometers, divided into 06 stretches of 10 km. The municipalities of Bataguassu and Santa Rita do Pardo, both located in Mato Grosso do Sul state, are included in the area of study for this waterway. Together these municipalities amount to a population of 27,098 inhabitants (IBGE, 2010) and the FIRJAN index (2010) is 0.69 and 0.62, respectively.

Map 42: Location of Anhanduí Waterway

Consórcio ARCADIS logos

The surrounding of this waterway does not show stretches with the presence of Indigenous Lands or Integral Protection Conservation Units, and it is worth mentioning the occurrence of APCB of very high action priority in stretches 05 and 06 between the municipalities of Santa Rita do Pardo and Bataguassu (MS), indicating regions where there is the imminence of government action in the conversion of these regions into some category of legally protected area.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
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- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante
BA - Baixa
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MA - Muito alta

REFERÊNCIAS

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- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO ANHANDUÍ	MAI/2013

3.7.1.7 Sucuriú Waterway

a) Navigability Diagnosis

The Sucuriú River consists of two tributaries of the Paraná River, and runs through the North and East of Mato Grosso do Sul state. Its spring is located in Serra dos Caiapós, a watershed in whose plateau is located the Parque Nacional das Emas (MS) Its mouth is located in the Paraná River, close to the city of Três Lagoas (MS).

With the construction of the Jupiá UHE, put into operation in 1974, and the impoundment caused by this damming in the Paraná River, the Sucuruí River was inundated from its mouth up to approximately 45 Km upstream.

The Sucuriú Waterway, considered in this analyis, consists of the inundated stretch, from its mouth to the bridge over BR-158, with 18 km in length.

The average rainfall in the region is approximately 1,250 mm, with the flood period between October and March. The flow and depth regime in the waterway stretch changes according to the action of the Jupiá UHE reservoir which operates as run-of-river without significant reservoir oscillations.

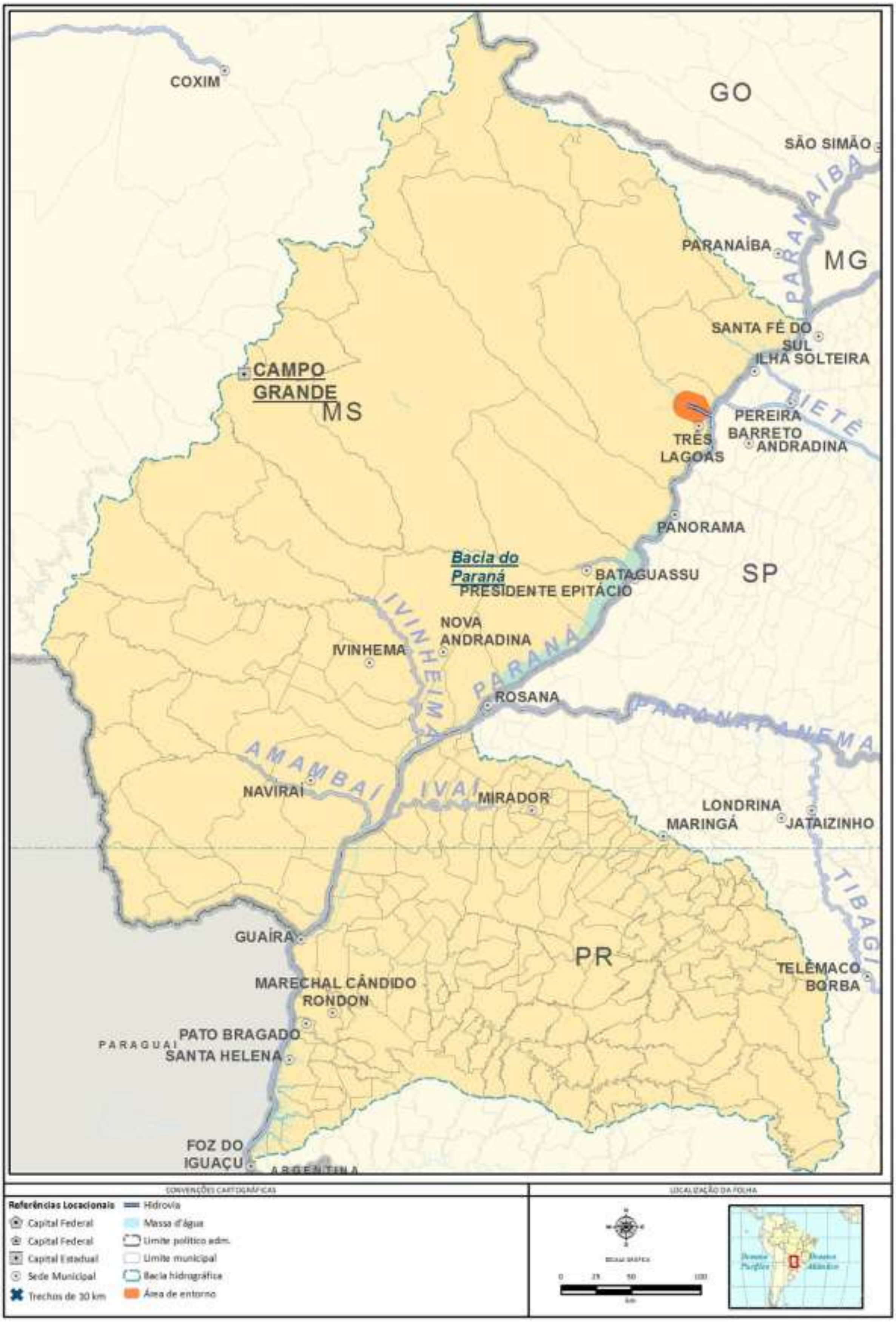
Due to the artificial lacustrine conditions caused by the Jupiá UHE reservoir, the Sucuruí Waterway offers proper navigation conditions. The mininum width is 1.5 km, and the minimum depths are in the order of 5 m and vary according to the operation of the reservoir of Jupiá UHE. There are no natural obstacles that may represent difficulties for navigation.

The bridge over the BR-158, at the end of the waterway, has a low free height and prevents commercial vessels from passing through upstream.

Figure 3.7.18: Bridge over Sucuriú River, at the end of stretch 2. (Panoramio, 2013)

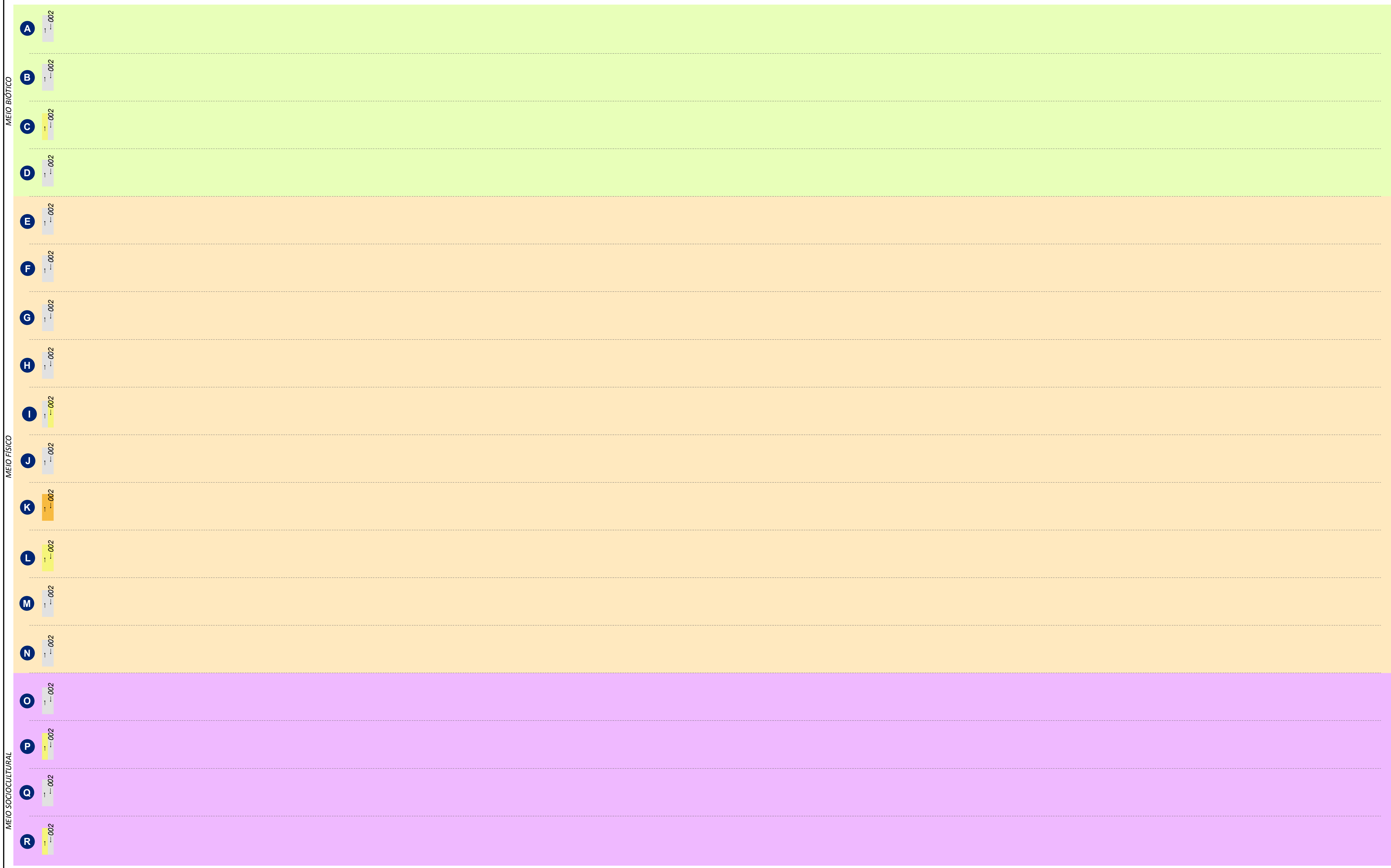
b) Social-environmental Vulnerabilities

The Sucuriú Waterway runs through the Paraná basin (as previously described), and 18 Km of its length were considered and were divided into 2 stretches for the analysis of the social-envionmental analysis. The waterway crosses the municipalities of Castilho (SP) - with a population of 18,003 inhabitants (IBGE, 2010) and FIRJAN index (2010) of 0.69 - and Três Lagoas (MS), with a population of 101,791 inhabitants (IBGE, 2010) FIRJAN index (2010) of 0.70.



Map 43: Location of Sucuriú Waterway

With regard to the social-environmental vulnerability, this waterway does not have any critical stretch.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
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FÍSICO
- E Mineração - Lavra e garimpo
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- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

nº < Jusante

nº > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
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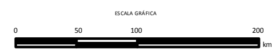
- ANA, 2010
- PNTL, 2010



LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
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3.7.1.8 Tietê Waterway

a) Navigability Diagnosis

The Tietê River basin has an approximate area of 71,500 km². The region climate is the altitude tropical climate type, and in the headwaters there is a rainfall rate of 1,500 mm annually, and in the low and medium courses it varies between 1,200 and 1,700 mm/year.

The Tietê River is 1,136 km long, passing by 62 municipalities in the São Paulo state, and this is the only state that the Tietê River runs through. Its spring is in Salesópolis (SP), in the Serra do Mar (sea mountain chain), 1,120 m high. In spite of being only 22 kilometers from the seashore, the serra do Mar slopes direct the river to the opposite direction, towards the country side, crossing São Paulo state from the Southeast to the Northwest region until discharging its water in the lake formed by the Jupiá UHE, in the Paraná River, between the municipalities of Itapura (SP) and Três Lagoas (MS), approximately fifty kilometers downstream of the city of Pereira Barreto (SP).

The Low Tietê shows that the geological substrate of the region is composed of sedimentary and volcanic rocks, belonging to ther Paraná Basin, together with recent alluvial and colluvial formations and deposits, and the river bed is predominantly sedimentary. The High Tietê region shows a layer of tertiary sediments (consequently the river bed is sedimentary) over altered crystalline rocks. The Medium Tietê area consists of rocks that range in age from the Precambrian to the Cenozoic periods?

The Tietê River is part of the Tietê-Paraná waterway, and is currently navigable between the cities of Anhembi (SP), in the Tietê River and São Simão (SP), Paranaíba River, and the Itaipu UHE in the Paraná River, reaching approximately 1,650 km of navigable length. The average flow is approximately 60 m³/s in Tietê (SP) (stretch 64), and 600 m³/s next to the Três Irmãos UHE (stretch 6) (see Apendix 7, Item 4.8.4). The flood period is takes place between November and April, and drought period between May and October.

In the navigable stretch of the Tietê River there are 6 hydroelectric power plants: The Três Irmãos UHE (stretch 3), Nova Avanhandava UHE (stretch 16), Promissão UHE (stretch 21), Ibitinga UHE (stretch 32), Bariri UHE (stretch 40) and Barra Bonita UHE (stretch 46), with a total installed power of approximately 1.8 GW and average difference in level of 26 m.All these UHEs are equipped with locks (12 m wide x 144 m long) enabling navigation along the Tietê River between its mouth and the end of the Barra Bonita UHE (stretch 53).

Table 3.7.1: Hydroelectric Power Plants implemented in the Tietê River between its mouth and Anhembi

Hidroelectric Power Plant	Power (MW)	NA Máx Normal (max. operating water level) (m)	NA Máx Normal (min. operating water level) (m)	NA normal de jusante (downstream water level) (m)
Três Irmãos	807.5	328.0	323.0	280.0
Nova Anhanhandava	347.4	358.0	356.0	328.0
Promissão	264	384.0	379.7	358.7
Ibitinga	132	404.0	403.5	382.5
Bariri	144	427.5	426.5	405.0
Barra Bonita	140	451.5	439.5	428.0

The Tietê waterway considered in this study covers the segment between its mouth and the municipality of Mogi das Cruzes (SP), with 900 km in length.

The Tietê waterway goes through different navigation contexts, namely:

- In the segment between the mouth of the Tietê River and Anhembi (SP) (stretches 1 to 53) navigation can be fully achievable and under lacustrine conditions, showing a low sinuosity index, stretches with minimum widths of 150 m and minimum depth of 3.0 m. The only natural obstacle of some relevance is a cluster of rocks downstream of the Nova Anhanhandava UHE (stretches 15 and 16), with approximately 5 km in length.

The hydroelectric power plants in this segment are equipped with locks and currently operate in their full capacity. It is worth mentioning that due to the size of these locks only the transposition of 2x1 convoys at the time is possible.

Figure 3.7.19: Nova Anhanhandava lock (stretch 21). (Map of the region, 2012)

Depending on the water level of the Barra Bonita UHE reservoir, navigation could be resctricted between the mouth of the Piracicaba River and Anhembi (SP) (stretches 49 to 53).

This segment has 15 bridges (stretches 2, 3, 5, 13, 16, 19, 21, 28, 40, 42, 43, 45, 46, 50 and 53) which enable the passing of at least one 2x2 type of convoy. This segment has appropriate signaling and beaconage installed.

Figure 3.7.20: Bridge of SP-333 (stretch 28) (Logistics BR, 2009)

- Between Anhembi (SP) and Salto (SP) (stretches 53 to 73) navigation is possible only between a few stretches and under bad conditions. There are too many sinuous stretches (stretches with indexes above 2) with sharp curves and narrow stretches (stretches 60, 61 and 72), additionally, there are sandbanks and rock outcrops which could restrict or even turn navigation impracticable. The minimum depths are estimated in 1.8 m until Tietê (SP) and smaller until Salto (SP). The bridges that exist over the river, many of them in urban areas (stretches that represent burdens to commercial convoys). Also, between Salto-SP and Anhembi (SP) the construction of four new small hydroelectric power plants has been planned, namely, Anhembi Alto, Laranjal, Tietê and Porto Feliz PCHs, all of them including lock systems. The construction of these PCHs will enable a fully efficient navigation between the end of Barra Bonita UHE reservoir until the municipality of Salto (SP).

The figures below illustrate the division of the Tietê River falls in the stretch between Anhembi (SP) and Salto (SP), and a stretch of the Tietê River (stretches 60 to 62) with high sinuosity index, respectively.

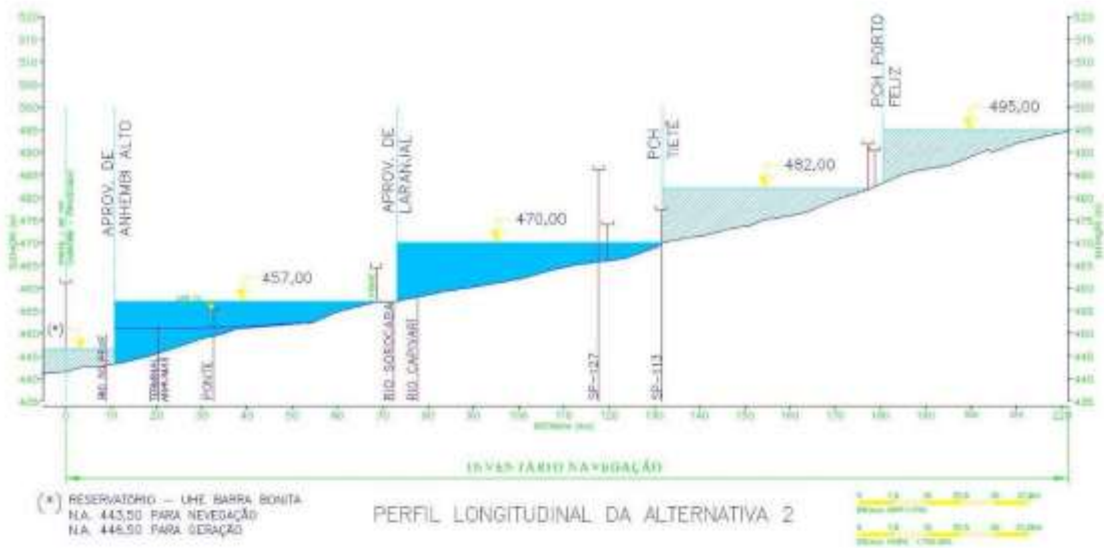

Figure 3.7.21: Division of Falls between Anhembi (SP) and Salto (SP) (Arcadis Logos, 2013)

Figure 3.7.22: Sinuous segment in Tietê River Source: (Google Earth, 2013)

- From Salto (SP) to Santana de Parnaíba (SP) (stretches 73 to 81) the Tietê River does not have adequate conditions for the commercial navigation due to the unfavorable physical and morphologic aspects, in addition to a large number of existing physical hindrances. In this segment the river features stretches with accentuated slopes (declivities), rapids, falls, rock outcrops, bottlenecks, and stretches with high sinuosity rate. The river chute is narrow with abrupt curves. Some stretches pass through intensely urbanized areas (stretches 73, 74, 79 and 81), with urban bridges that prevent navigation. There are four dams in this segment: Porto Góes (stretch 73), São Pedro (stretch 74), Pirapora (stretch 79) and Rasgão (stretch 79), which are not equipped with locks, preventing transposition by vessels.

Figure 3.7.23: Tietê River in Salto (SP). Prominent rapids and rock outcrops existing in the river (stretch 73). (Panoramio, 2013)

Figure 3.7.24: Rasgão Plant (stretch 79) (EMAE, 2012)

According to the hydroelectric power inventory of the Tietê River for the stretch being analyzed, new small hydroelectric power plants are expected (Jurumirim, Pedra Azul, Guaxatuba, Piraí I PCHs) for this segment, which will use the already existing falls, but locks have not been anticipated.

- In the segment between Santana de Parnaíba (SP) (stretch 81), where the Edgard de Souza UHE is located, to Mogi das Cruzes-SP (stretch 90) a large portion of the Tietê River is channeled (stretches 82 to 85) and merges into an urbam stretch (metropolitam region of São Paulo City). This segment of the river features various physical hindrances such as bridges (whose dimensions do not allow the passing of commercial vessels) and dams without locks (excepting the Cebolão Dam – stretch 83). The segment faces various problemas such as low depths, small widths, silting problems, and discharge of sewage and solid residues, wastes, and currently is not adequate for the commercial navigation.

Figure 3.7.25: Tietê River in São Paulo (SP). (G1, 2011)

The Hidroanel Metropolitano de São Paulo - RMSP (São Paulo Metropolitan Waterway Ring) is currently being studied, and consists of a network of navigable channels that makes up a waterway ring composed of rivers and man-made lakes existing in the São Paulo metropolitam regions, in addition to an artificial channel, totaling 170 km of urban waterways. The main focus of this waterway ring is to help with the magement of RMSP (São Paulo Metropolitan Region) solid residues.

Figura 3.7.26: Barragem e eclusa do cebolão (trecho 83) (Águas Claras do rio Pinheiros, 2013)

b) Social-environmental Vulnerabilities

A hidrovia do rio Tietê, para fins deste estudo, foi considerada em 899 quilômetros de sua extensão, os quais se inserem na bacia do rio Tietê (descrita anteriormente).The Tietê waterway, for the purpose of this study, was considered in 899 kilometers of its total length, which are located within the Tietê River basin (as previously described) Its surrounding area covers the territory of 102 municipalities in São Paulo state, which, together, represent a total population of 20,316,725 inhabitants (IBGE, 2010). The most populous cities are the state capital city of São Paulo, accounting for 55.51% of the total of the São Paulo metropolitan region. The FIRJAN index (2010) reaches the value of 0.93 in the municipality of Barueri, while Cafelândia shows the lowest value of 0.63.

Map 44: Location of Tietê Waterway

As to social-environmental vulnerability, there is an Integral Protection Conservation Unit (UC) in stretches 51 to 52 (Barreiro Rico Ecological Station) in the municipality of Anhembi, and in stretches from 83 to 90 (Jaraguá State Park) in São Paulo, where the Jaraguá Indigeneous Land is located.

Beginning at stretch 79, in the municipality of Pirapora do Bom Jesus, there are two occurrences of Sustainable Use UCs. APCBs (Biodiversity Conservation Priority Areas) xof extreme and very high action priority Priority Areas in stretches 01 (in the municipalities of Castilho and Itapura), 09 (in Santo Antônio de Aracangá), 49 (in Botucatu), 51 and 52 (in the municipality of Anhembi). In the stretches 03 (in Ilha Solteira), 16 (in Buritama) and 21 (between Ubarana and Permissão), there are occurences of INCRA (National Institute for Colonization and Agrarian Reform) settlements.

CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
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- J Energia do rio
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- L Assoreamento
- M Anteparos naturais
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SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

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nº > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

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- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO TIETÊ	MAI/2013

3.7.1.9 São José dos Dourados Waterway

a) Navigability Diagnosis

The São José dos Dourados River is one of the tributaries from the left bank of the Paraná River and is located in the state of São Paulo. Its drainage area is 6,783 km² with the spring lacated in Mirassol (SP), running in parallel with the Tietê River, and having its mouth in the Paraná River, next to the city of Ilha Solteira (SP).

The average rainfall in the region is approximately 1,250 mm, with the flood period between October and March.

With the construction of the Jupiá UHE, put into operation in 1978, and the impoundment caused by this damming in the Paraná River, the São José dos Dourados River was inundated from its mounth up to approximately 55 Km upstream.

Additionaly, the São José dos Dourados River, together with the Pereira Barreto Canal interconnects the reservoirs of Hydroelectric Power Plants of Ilha Solteira, in the Paraná River, and Três Irmãos, in the Tietê River, providing an integrated hydroelectric operation of the two power plants and representing today an essencial part of the Tietê-Paraná waterway system interconnecting the Paraná and Tietê Rivers.

The São José dos Dourados Waterway covered in this analysis consists of the inundated stretch from its mouth to the entry of the Pereira Barreto Canal, about 38 km long.

Due to the man-made lacustrine conditions caused by the Ilha Solteira UHE, the São José dos Dourados Waterway is currently navigable by commercial convoys.

The mininum width is 300 m, and the minimum depths are in the order of 3 m and vary according to the operation of the reservoir of the Ilha Solteira UHE. In a general manner, between April and July, during the drought period, the reservoir level is higher, resulting in higher depths in the São José dos Dourados River. Beginning in July water levels in the reservoirs, and consequently, in the São José dos Dourados River are lower.

There are neither sinuous stretches nor natural obstacles that may represent difficulties for navigation.

The only bridge that exists in the stretch consists of the Barrageiros Highway (SP-595) bridge, which became an issue to be solved by means of changes to anable the passing of 2 x 2 convoys, and currently does not show navigation difficulties.

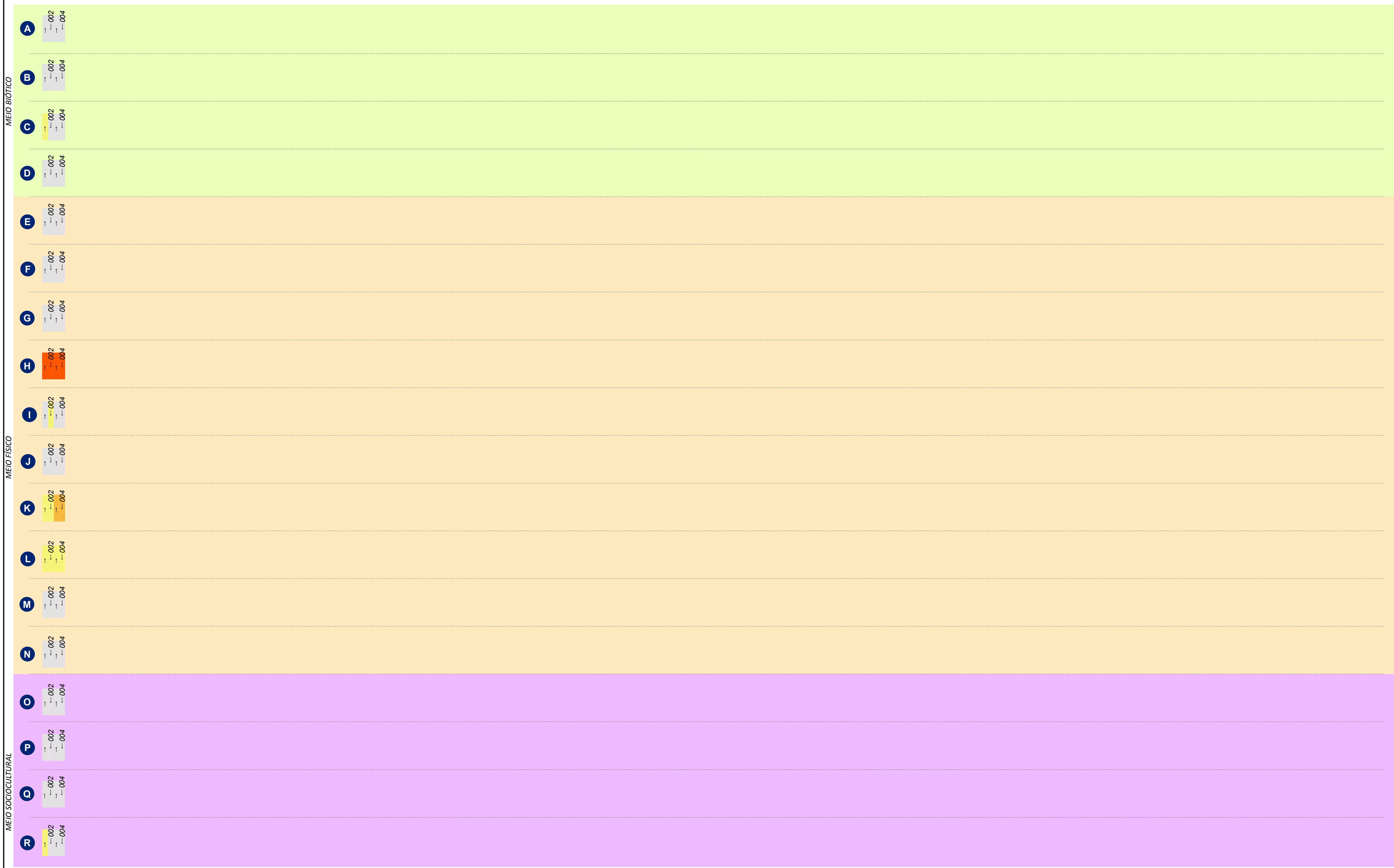
Figure 3.7.27: Bridge of SP 595 (stretch 2). (Panoramio, 2013)

b) Social-environmental Vulnerabilities

The São José dos Dourados River has a length of 38 quilômetros and is located within the Tietê River basin (as previously described). The mouth of the São José dos Dourados River is in the Paraná River, parallel to the Tietê River, and is connected to it by means of the Pereira Barreto Canal; its surrounding covers 4 municipalities in São Paulo state, representing a population of 60,844 inhabitants (IBGE, 2010). The higher FIRJAN index (2010) is 0.84 in the municipality of Suzanápolis, followed by the municipalities of Sud Mennucci, Ilha Solteira, and Pereira Barreto with indexes of 0.76; 0.75 and 0.74, respectively.

Map 45: Location of the São José dos Dourados Waterway

The waterway is divided into 4 stretches which do not show any occurrence of Indigenous Lands nor Integral Protection Conservation Units, there is only an APCB (Biodiversity Conservation Priority Area) in stretch 01 where the municipality of Ilha Solteira (SP) is located.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO SÃO JOSÉ DOS DOURADOS	MAI/2013

3.7.1.10 Grande River Waterway

a) Navigability Diagnosis

The Grande River, together with the Paranaíba River is one of the rivers derived from the Paraná River. The Grande River has a river basin (drenage area) of 143,000 km², and 1.360 km in length, in addition to serve as the natural borderline between the states of São Paulo and Minas Gerais for about 600 km. It consists of a plateau river with its headwaters located in the Serra da Mantiqueira, in Bocaina de Minas (MG), and its confluence with the Paranaíba River takes place 10 km upstream of the city of Rubinéia (SP).

With the construction of the Ilha Solteira UHE, put into operation in 1978, and the impoundment caused by this damming in the Paraná River, the Grande River was inundated from its mounth up to approximately 80 Km upstream, near the Água Vermelha dam. The Grande River waterway, considered in this analyis, consists of the inundated stretch, from its mounth to the Água Vermelha UHE, with approximately 80 km in length.

Figure 3.7.28: Água Vemelha UHE (GeoLocation, 2011)

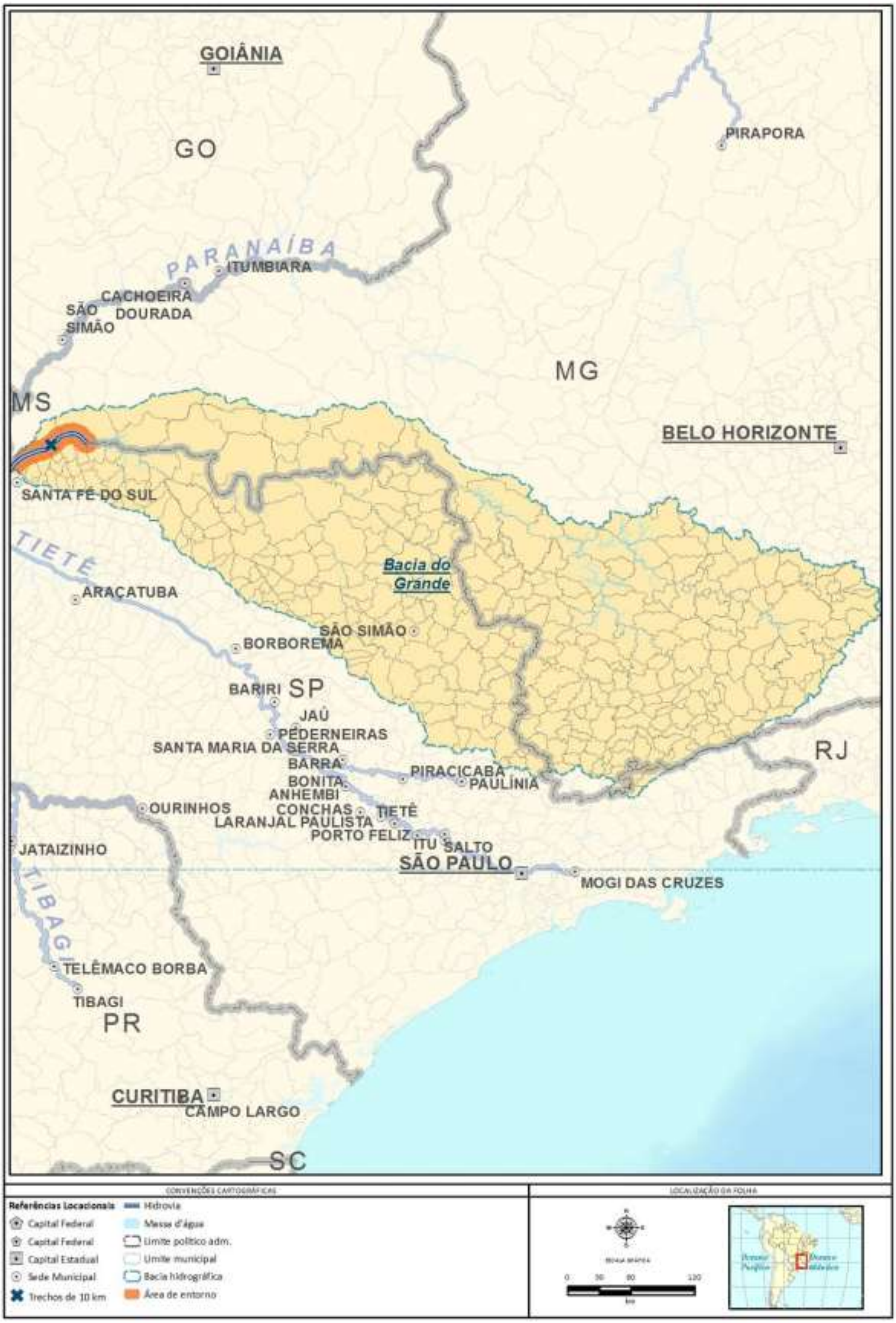
The average rainfall in the region is approximately 1,200 mm, with the flood period between October and March. The flow regime in the waterway stretch depends on the operation of the Ilha Solteira UHE, in the Paraná River, and the reservoirs operated in the Grande River, upstream of the waterway. The average flow in the Água Vermelha UHE is higher than 2,100 m³/s (see Appendix VII, Item 4.8.2).

Due to the man-made lacustrine conditions caused by the reservoirs of the Jupiá UHE , the Grande River waterway offers proper navigation conditions. There are no difficulties related to the sinuosity, width, declivities. The average depths are higherthan 5 m and variable due to the operation of the Ilha Solteira UHE. There are no natural obstacles that may represent difficulties for navigation. The bridge over highway MG-426, at the waterway upstream end, could restrict the commercial navigation.

b) Social-environmental Vulnerabilities

The Grande River basin has an area of 143,232 km², covering 393 municipalities in the states of Minas Gerais, São Paulo, and Mato Grosso do Sul, with a population of 11,453,352 inhabitants (IBGE, 2010).

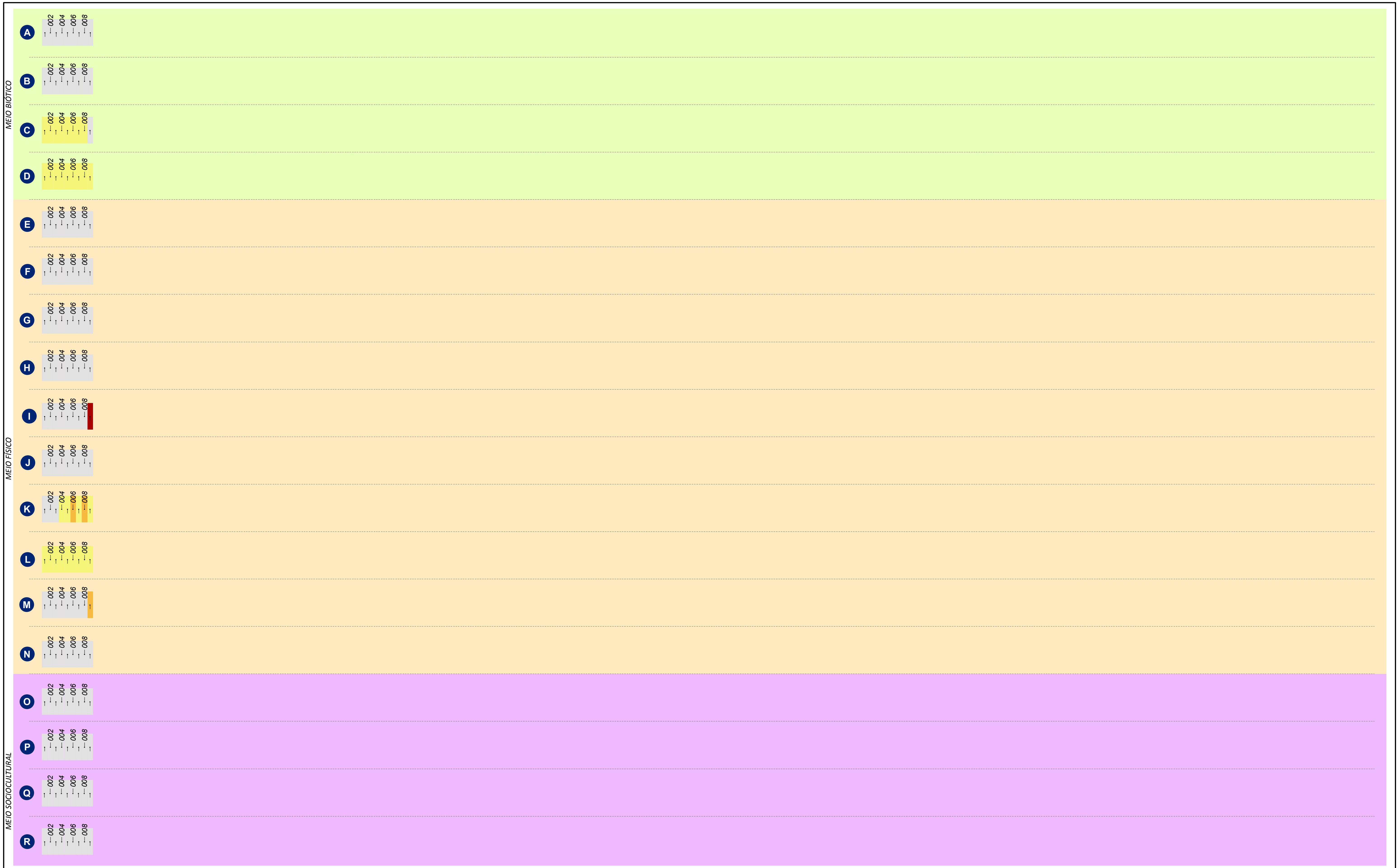
With regard to the conservationist aspects, 47% of the river basin area is located within the Cerrado Biome, and 53% within the Mata Atlântica (Atlantic Forest) Biome. The river basin area includes 1,907 mining prospection areas, 18 Integral Protection Conservation Units (UCPI's), 35 Biodiversity Conservation Priority Areas (APCB's) of extreme or very high action priority, and 36 INCRA settlements.



Map 46: Location of Grand River Waterway

The Grande River waterway was considered in 84 kilometers of its entire length that were divided into 9 stretches that cross the territory of 12 municipalities – 2 in Minas Gerais state, 8 in São Paulo state, and account for a population of 127,115 inhabitants (IBGE, 2010). The FIRJAN index (2010) varies from 0.80 in Santa Fé do Sul (SP) to 0.68 in the two cities of Minas Gerais state reached by the waterway, Carneirinho and Iturama.

There are neither Indígineous Lands nor Integral Protection Conservation Units in this waterway, however, the presence of APCBs can be noticed in the entire surrounding of the waterway.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais

SOCIOCULTURAL
- N Largura do rio
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Nº dos trechos

nº < Jusante

nº > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA: 0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO GRANDE - MG	MAI/2013

3.7.1.11 Paranaíba Waterway

a) Navigability Diagnosis

The Paranaíba River, together with the Grande River is one of the rivers derived from the Paraná River. The Paranaíba River has a drainage area of 222,767 km², and 1,160 km in length, in addition to serve as the natural borderline between the states of Minas Gerais and Goiás. The river basin covers the states of Goiás, Minas Gerais, Federal District, and Mato Grosso do Sul. Its spring is located in the municipality of Paranaíba, in the Serra da Mata da Corda , at an altitude of 1,140 m, and its confluence with the Grande River is located 10 km upstream of the city of Rubinéia (SP). Its main tributaris are the following rivers: São Marcos, Corumbá, Meia Ponte, Bois, Claro, Verde, Corrente and Aporé, Bagagem, Dourados, Araguari and Tejuco.

The hydrological regime of the Paranaíba River is regulated by the rainy season, which has a well defined flood period between October and March, and also depends on the operation of the UHEs existing along the river basin. The average flow of the São Simão UHE is over 2,000 m³/s. (see Appendix VII, Item 4.8.3).

The Paranaíba Waterway considered in this analysis consists of the stretch from its mouth, in the Paraná River, until the Emborcação UHE (stretch 54), about 540 km long.

The Paranaíba River is navigable uunder good conditions from its confluence with the Grande River until the São Simão dam (stretch 17), where the city of São Simão (GO) is also located. This stretch shows minimum depths of 5.0 m.

Currently, the Paranaíba Waterway has four power plants, without locks, with a total capacity of 4,000 MW. The UHEs are: São Simão (stretch 17), Cachoeira Dourada (stretch 33) and Itumbiara (stretch 40).

Due to the implementation of these plants, the Paranaíba Waterway offers navigation under a lacustrine regime conditions in almost its entire course. The exceptions are: The initial stretch downstream of the Grande River, which, depending on the level of the Ilha Solteira UHE could form a long free current stretch (without restrictions to navigation), the final stretches upstream of the São Simão, Cachoeira Dourada and Itumbiara UHEs, feature a free current regime. The navigability conditions in the reservoir stretches are satisfactory, and the more critical stretches for navigation are those under river regime.

It is worth mentioning that these UHEs do not have lock systems, preventing the transposition of vessens over the dams, and account for the main obstruction to navigation in the Paranaíba Waterway. The difference of power plant levels are on the order of 40 to 50 m, and the dams arelocated in valleys and canions.

In the stretch under study, there are 7 bridges crossing the Paranaíba River, some of which restrict the commercial navigation, depending on the reservoir levels. The bride over BR-497 highway (stretch 6), which is located in the current navigable stretch, does not represent any restriction to navigation.

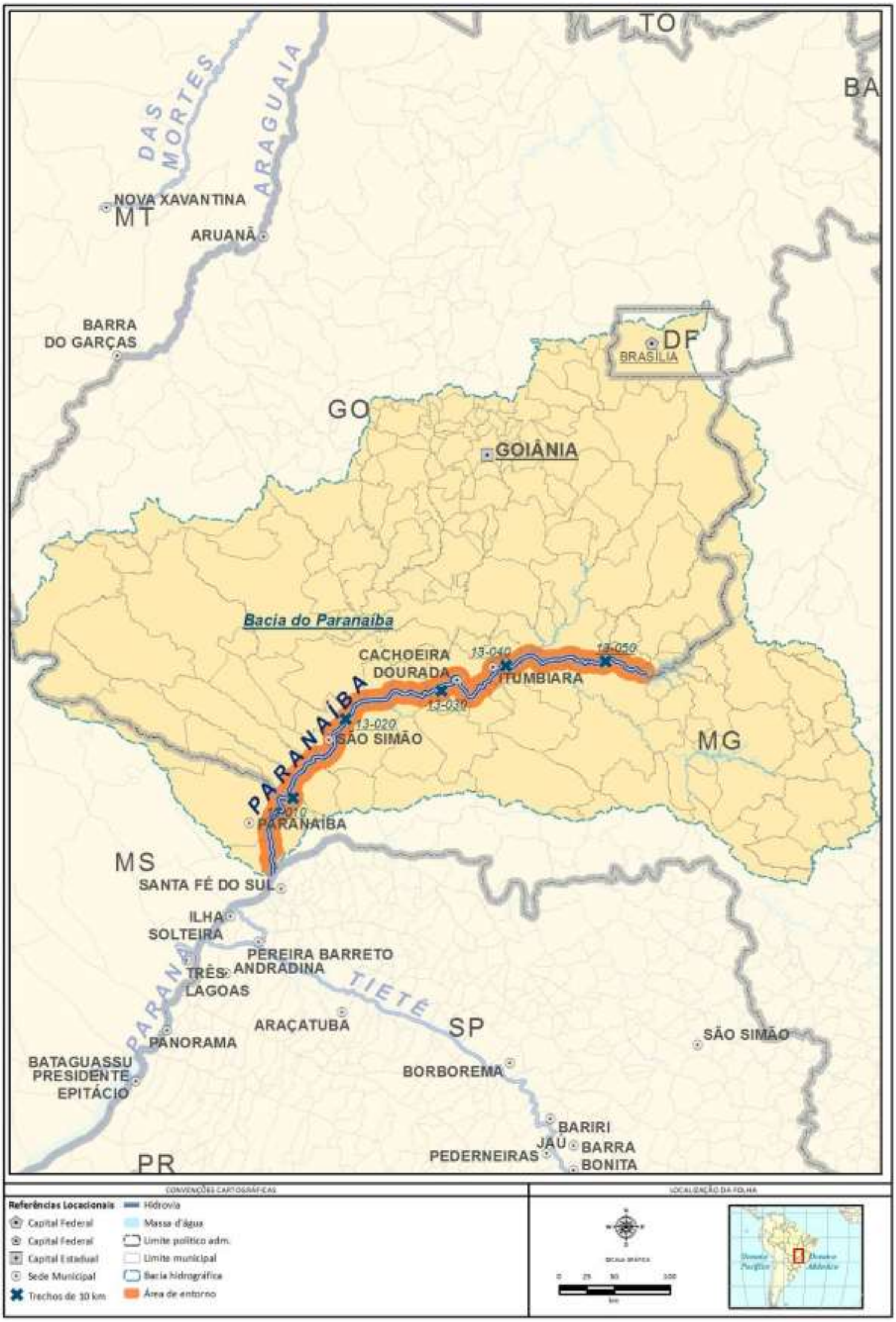
Figure 3.7.29: São Simão Power Plant (stretch 17). (CEMIG, 2013)

Figure 3.7.30: Bridge over Highway BR 497 in Paranaíba River (stretch 6). (Ministry of the Transportation, 2012)

b) Social-environmental Vulnerabilities

The Paranaíba River basin has an area of 222,839 Km², with a population of 9,905,864 inhabitants, distributed in 209 municipalities in the states of Goiás, Mato Grosso do Sul, São Paulo and Minas Gerais. The most populous cities are the Federal Capital City, Brasília, the State Capital City Goiânia (GO), in addition to Uberlândia in Minas Gerais.

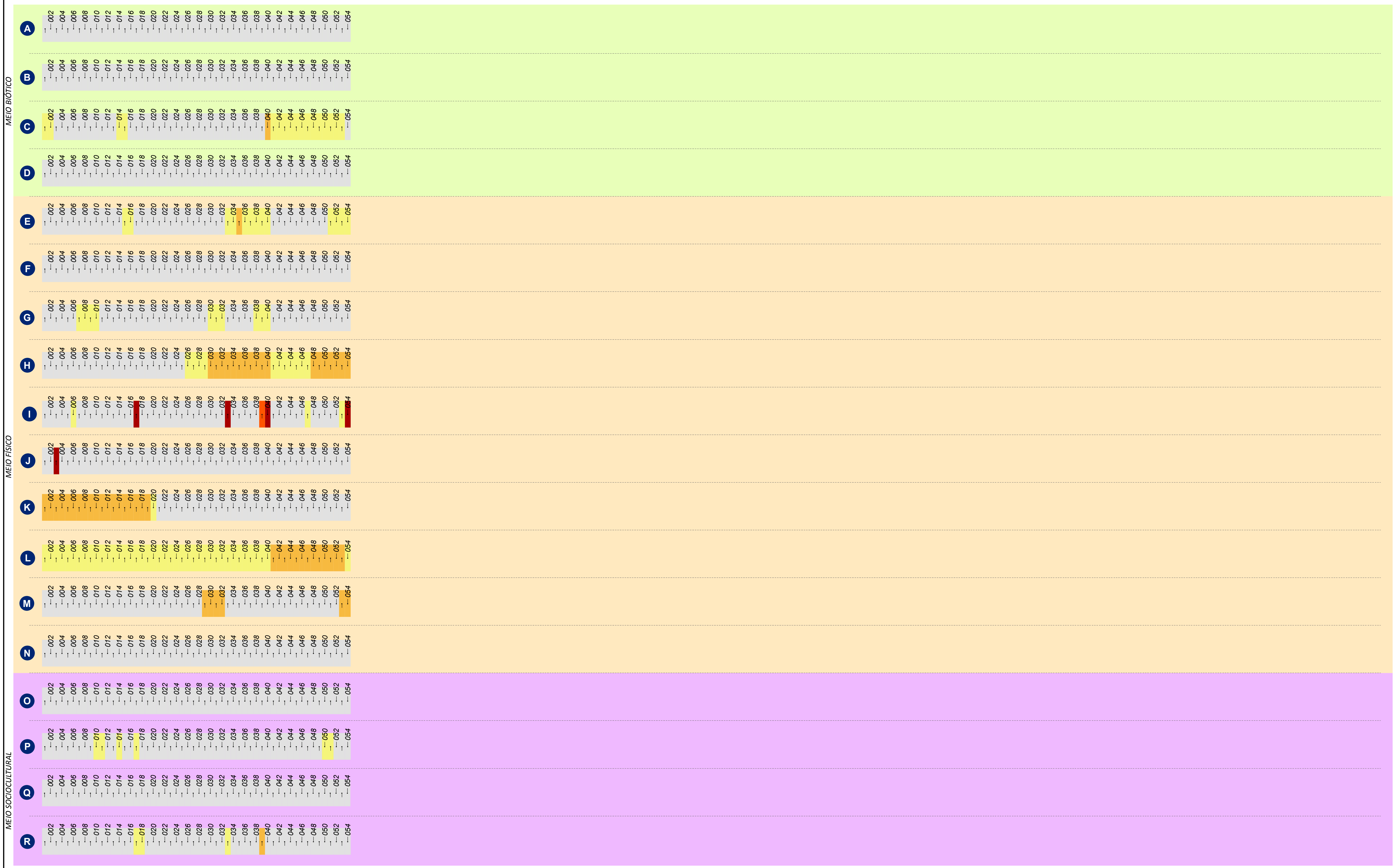
With regard to the conservationist aspects, the river basin is within the Cerrado Biome (91%) and the Mata Atlântica (Atlantic Forest) Biome (9%). Its area includes 1,118 mining prospection areas, 17 Integral Protection Conservation Units (UCPI's), 25 Sustainable Use Conservation Units (UCUS), 30 Biodiversity Conservation Priority Areas (APCB's) of extreme or very high action priority, and 122 INCRA settlements.



Map 47: Location of Paranaíba Waterway

The Parnaíba Waterway was considered in a length of 537 kilometers which were divided into 54 stretches, crossing 32 municipalities in the states of Minas Gerais, São Paulo, Mato Grosso do Sul and Goiás.These municipalities amount to a total population of 696,493 inhabitants (IBGE, 2010). The FIRJAN index (2010) varies from 0.83 for the municipalities of Santa Vitória (MG) and Caçu (MS), to 0.61 in the municipality of Itajá (GO).

There are neither Indigenous Lands nor Integral Protection Conservation Units in this waterway. However, there are APCBs in stretches 40 and 53, in the vicinities of Carneirinho (MG).



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais

SOCIOCULTURAL
- N Largura do rio
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

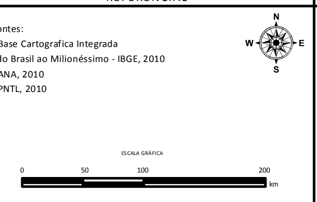
N° dos trechos
n° < Jusante
n° > Montante

Escala de ponderação dos temas
1 - 5 (baixa - alta)

IN - Insignificante
BA - Baixa
ME - Média
AL - Alta
MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010



LOCALIZAÇÃO DA FOLHA

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO PARANAÍBA	MAI/2013

3.7.1.12 The Tibagi Waterway

a) Navagibility Diagnosis

The Tibagi River is the main tributary of the Paranapanema River. Its basin has 24,712 km² of drainage area and is one of the largest river basins in the state of Paraná. Its source is located between the municipalities of Campo Largo (PR), Palmeira (PR) and Ponta Grossa (PR), in the central-south of the state of Paraná, at an altitude of close to 1,150 m. Its mouth is located on the left bank of the Paranapanema River, near the city of Primeiro de Maio (PR), on the border between the states of Paraná and São Paulo. The main tributaries are the Taquara River, Apertados Creek and Três Bocas Creek, the Iapó River, the São Jerônimo River and the Congonhas River. The main cities along the waterway are São Jataizinho (PR) (Stretch 8), Telêmaco Borba (PR) (Stretch 29) and Tibagi (PR) (Stretch 33).

The Tibagi River basin has an annual rainfall distribution that varies between 1,400 and 1,700 mm., reflecting the good distribution of rain throughout the year and without a well-defined rainy period. The average flow is on the order of 400 m³/s (see Appendix VII, Item 4.8.7).

The Tibagi Waterway addressed in this plan consists of the stretch from its mouth on the Paranapanema River, to the city of Tibagi (PR), with a length of close to 330 km.

The Tibagi River basin is found in a plateau geological region, with diverse rocky formations. The bed is rocky in the stretches from 1 to 14 and sedimentary in the remaining upstream stretches.

With construction of the Capivara UHE (Stretch 22 of the Parapanema River), inaugurated in 1978, and the damming caused by this barrier on the Paranapanema River, the Tibagi River was inundated from its mouth to close to 60 km. upstream (Stretch 6).

Figure 3.7.31: Inundated Area of the Tibagi River, in Stretch 1 (Panorâmio, 2013)

From its mouth at the Capivara UHE reservoir to the city of Jataizinho (PR) (Stretch 8), the Tibagi River has low declivities and runoff speeds, minimal widths of close to 100 m. and some river islands as natural barriers. The minimum depths are on the order of 3 m., but may be shallower in occasional stretches and variable as a function of the Capivara UHE reservoir. This reservoir oscillates by up to 3 m., between its minimum and maximum water levels.

There is a crossing of two urban bridges, one highway and one railway, in the city of Jataizinho (PR) (Stretch 8). There is insufficient information on their dimensions, however, it can be seen that the bridges could restrict navigation depending on the Tibagi River water level.

Figure 3.7.32: Bridges on the Tibagi River (Stretch 8) (Panorâmio, 2013)

The Tobagi River does not have navigation conditions upstream of the city of Jataizinho (PR) (Stretches 8 to 33). The river shows high rates of sinuosity and a number of rapids, steps, rock outcrops and narrow points of the river chute, unbridgeable by commercial vessels. In this stretch, there is also the Mauá PCH (Stretch 22), close to 210 km. from the mouth, that is not equipped with a system of locks. Other hydroelectric power plants are expected along the river, without plans for locks. The existing bridges do not permit the passage of commercial vessels. Navigation in this stretch is only possible for small vessels in isolated stretches. The figures below illustrate some of these impediments.

In addition, the feasibility of navigation on the Tibagi Waterway depends on the feasibility of navigation on the Paranapanema River.

Figure 3.7.33: Tibagi River (Stretch 29) (Fotos do Brasil, 2012)

Figure 3.7.34: Bridge over the Tibagi River (Stretch 29) (Fotos do Brasil, 2012)

Figure 3.7.35: Salto Mauá UHE (Stetch 22) (Eletrosul, 2013)

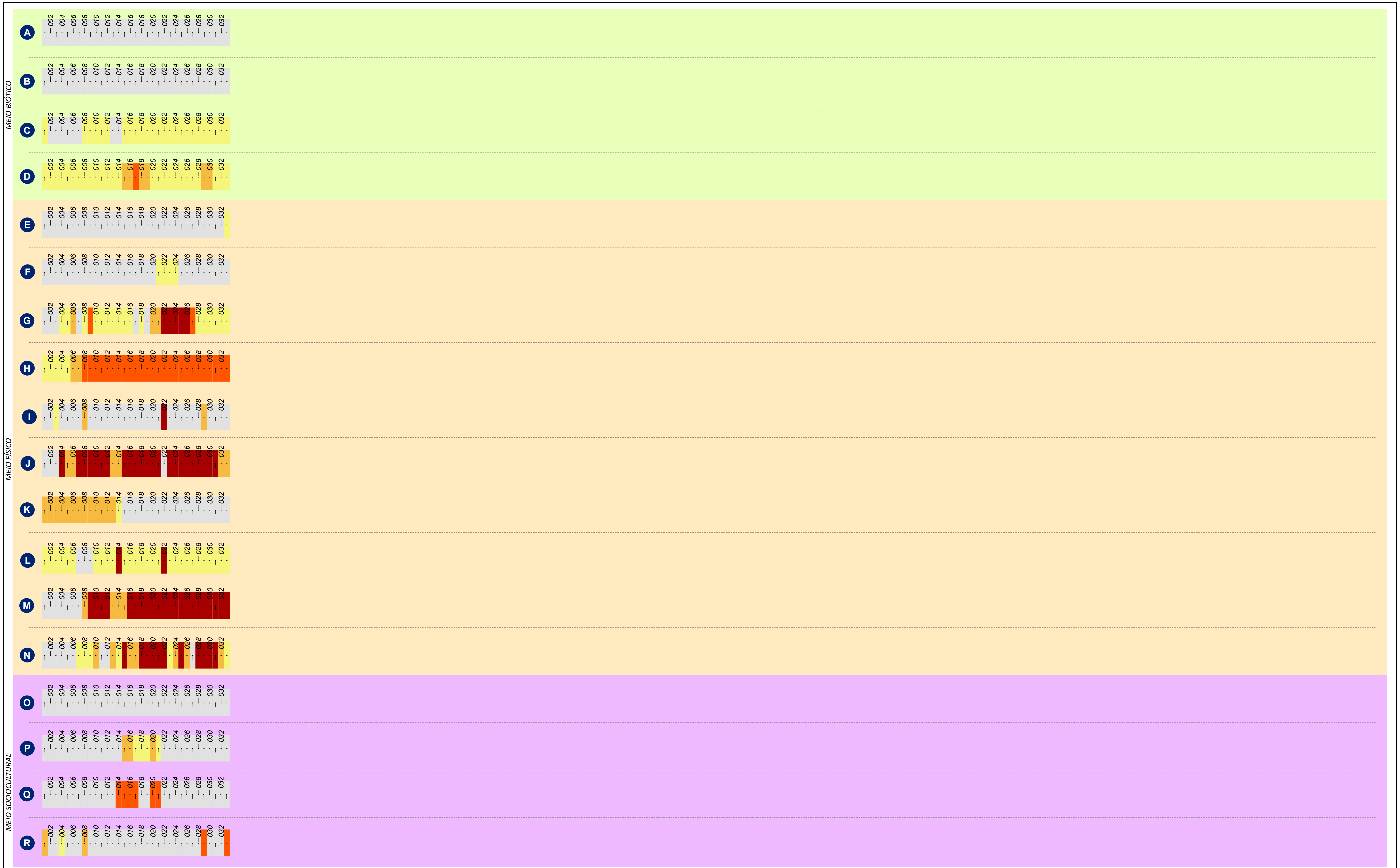
b) Social and Environmental Vulnerabilities

The Tibagi Waterway was considered for over 322 kilometers of its length and it flows through the Paranapanema River basin (described previously). The limits of the study area encompass 19 municipalities located in the state of Paraná, which have a combined population of 806,524 inhabitants (IBGE, 2010). The most populous municipality is Londrina, which also has the highest FIRJAN index (2010) of 0.87, while the lowest index of 0.54 is found in the municipality of Imbaú.

Map 48: Location of the Tibagi Waterway

The Tibagi Waterway was divided into 33 stretches for the purpose of this study. Based on the analysis of social and environmental vulnerabilities perceived in the surroundings of this waterway, it is worth highlighting the presence of indigenous lands in the stretches from 14 to 17, corresponding to the area called Barão de Antonina, in the municipality of São Jerônimo da Serra (PR), and also the Apucarana Indigenous Reserve, in the municipality of Tamarana (PR), in addition to the area called Tibagy/Mococa, in the municipality of Ortigueira (PR) in stretches 20 and 21.

There are also APCBs of extreme or very high action priority in Stretch 21 (Paraná municipality of Sapopema) and Stretch 33 (in Tibagi/PR).



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- (A) Unidade de Conservação - Proteção Integral
- (B) Unidade de Conservação - Uso Sustentável
- (C) Áreas Prioritárias para Conservação da Biodiversidade
- (D) Desmatamento do trecho

FÍSICO
- (E) Mineração - Lavra e garimpo
- (F) Espeleologia
- (G) Sinuosidade
- (H) Profundidade
- (I) Empecilhos à navegação (construções)
- (J) Energia do rio
- (K) Leito do rio
- (L) Assoreamento
- (M) Anteparos naturais

SOCIOCULTURAL
- (N) Largura do rio
- (O) Comunidades quilombolas
- (P) Assentamentos INCRA
- (Q) Terra indígena
- (R) Ocupação lindeira

Nº dos trechos
n° < Jusante
n° > Montante

Escala de ponderação dos temas
1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante
BA - Baixa
ME - Média
AL - Alta
MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES
ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO TIBAGI	MAI/2013

3.7.1.13 The Piracicaba Waterway

a) Navagibility Diagnosis

The Piracicaba River basin covers 12,531 km² and is located in one of the most developed regions of the state of São Paulo, holding important municipalities like Bragança Paulista (SP), Campinas (SP), Limeira (SP), Americana-SP, Atibaia (SP), Rio Claro (SP), Santa Bárbara d'Oeste (SP) and Piracicaba (SP). The mouth of the Piracicaba River is found in the Tietê River, flooded by the Barra Bonita plant reservoir.

The climate of the basin is humid subtropical. The rainfall is close to 1,500 mm. annually at the headwaters and it varies from 1,200 to 1,700 mm/year in the medium and low courses. The average flow is close to 130 m³/s at Piracicaba (see Appendix VII, Item 4.8.5).

The Piracicaba River is the largest tributary in terms of water volume of the Tietê River and is responsible for supplying the Campinas Metropolitan Area (SP) and part of Greater São Paulo (SP). The waterway under study on the Piracicaba River runs close to 177 km, from its mouth on the Tietê River to Paulínia (SP).

The bed of the Piracicaba River is predominantly sedimentary from its mouth to the proximity of the city of Piracicaba (SP). From this point heading upstream, the river has a mixed bed, with characteristics both sedmentary and rocky.

From the mouth of the Piracicaba River to the proximity of the city of Santa Maria da Serra (SP) (Stretch 4), the river has better navigation conditions, in a lacustrine environment, dependent, however, on the water level in the Barra Bonita UHE reservoir. The first 20 km. are effectively navigable today (from the mouth to the SP-191 bridge, at elevation 446.50). The Barra Bonita reservoir varies between elevations of 451.00 and 443.50 m. The SP-191 bridge does not impede navigation in the stretch. Stretches 3 and 4 have better navigation conditions when the Barra Bonita reservoir is at its highest levels.

From the end of this reservoir to the city of Piracicaba (SP), the river has many meanders, some abrupt curves and narrow stretches, with minimum widths of 50 m. and it can be even narrower as a function of natural obstacles such as sandbanks, river islands and rock outcropings. The minimum depth during the droughts is estimated at close to 1.5 m.

In the city of Piracicaba (SP) there are a number of rapids, making navigation impossible in that stretch. In addition, thre are a number of urban bridges in this municipality that can make navigation difficult.

Figure 3.7.36: Rapids in the Piracicaba River (Stretch 11) (Agenda Cultural de Piraciaba, 2013)

The Piracicaba River has sinuous and narrow stretches (widths less than 20 m.), with problems of silting and rock outcrops from this city to the Salto Grande UHE (close to 160 km. from the mouth – Stretch 16), which does not have locks and interupts navigation.

Construction of the Santa Maria da Serra project is planned on the Piracicaba River at the end of the Barra Bonita reservoir, which, if built with locks, will allow navigation to the city of Artemis (SP) (Stretch 8), 20 km. from Piracicaba (SP).

Figure 3.7.37: SP-191 Bridge over the Piracicaba River (Stretch 3) (Jcnavegatur, 2013)

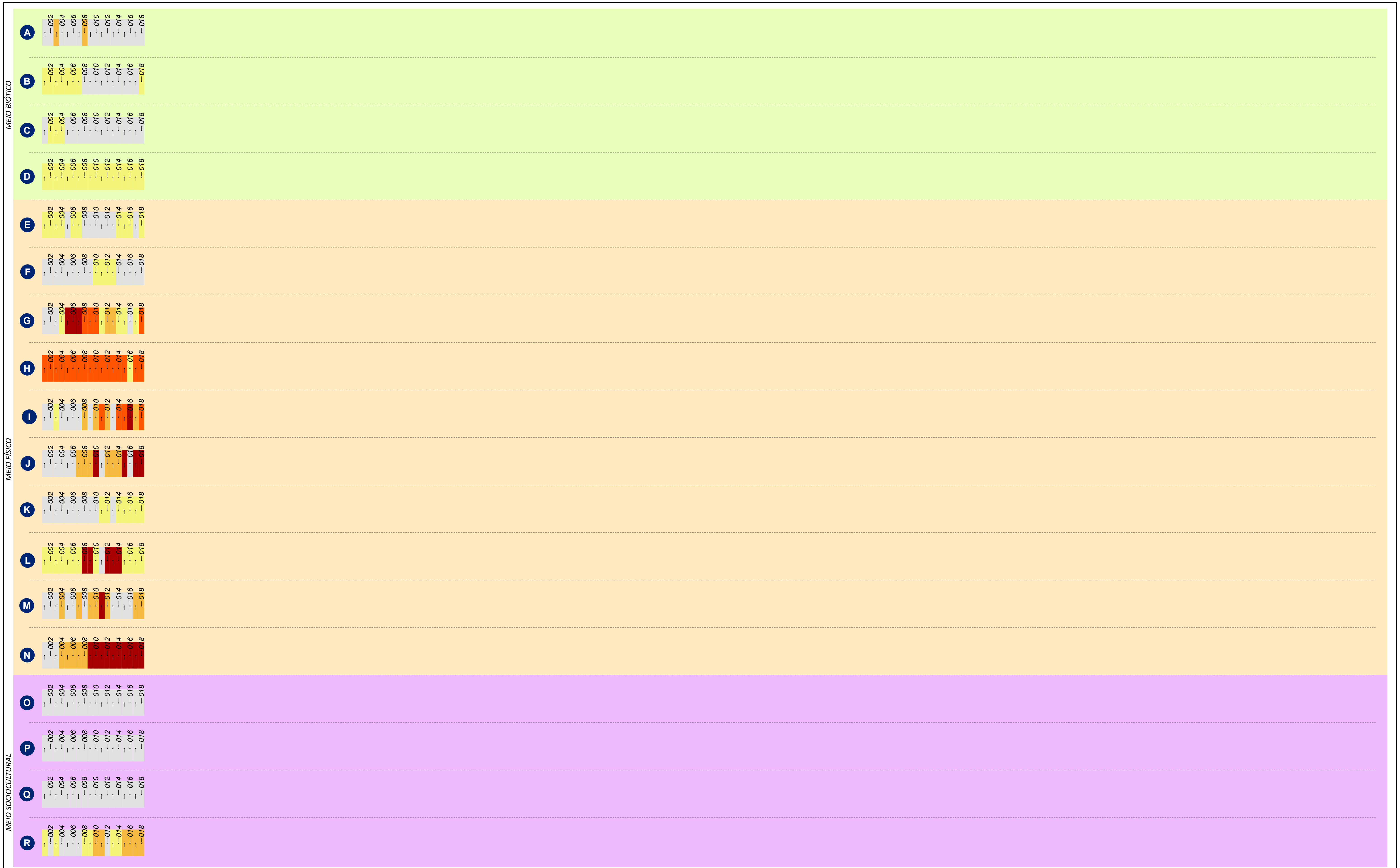
b) Social and Environmental Vulnerabilities

The present study considered 117 km. of the Piracicaba River, which are found in the Tietê River basin (described previously). The borders of the study area for this waterway intercept the territory of 22 municipalities in the state of São Paulo whose total population is 2,944,381 inhabitants, with Campinas being the most populous city, responsible for 36.63% of the total (IBGE, 2010). Paulínia has the highest FIRJAN index (2010), of 0.93, while the lowest of 0.65 is for the municipality of Santa Maria da Serra. The average development index of the municipalities in the study area is 0.80.

Map 49: Location of the Piracicaba Waterway

Consórcio ARCADIS logos

In relation to the social and environmental vulnerability, of the 16 stretches into which the waterway was divided, it is worth highlighting the Integrated Protection CU in streches 3 and 8 corresponding to the Barreiro Rico Ecological Station, in the municipality of Anhembi, and the Ibicatu Ecological Station, in the municipality of Piracicaba. In the initial stretches, it is worth highlighting the presence of the Sustainable Use CU and the APCBs (Stretch 3 – between Anhembi and Santa Maria da Serra – and Stretch 4 – between São Pedro and Piracicaba).



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO

- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO

- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL

- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO PIRACICABA	MAI/2013

3.7.1.14 The Pereira Barreto Channel

a) Navagibility Diagnosis

The Pereira Barreto Channel, 9.6 km. in length, connects the Ilha Solteira hydroelectric power plant on the Paraná River to the Três Irmãos hydroelectric power plant on the Tietê River. Today, it constitutes an essential part of the Tietê-Paraná Waterway System, connecting the Paraná and Tietê Rivers.

This connection was necessary due to the absence of functioning locks at the Ilha Solteira UHE on the Paraná River. For this, the Pereira Barreto Channel uses the São José dos Dourados River, a tributary of the Paraná River, allowing commercial navigation to pass through the south and north courses of the Paraná waterway, connecting the states of São Paulo, Mato Grosso do Sul, Minas Gerais and Goiás.

Second to its waterway connector function, the Pereira Barreto Channel provides integrated energy operations for the Ilha Solteira and Três Irmãos plants by connecting the two reservoirs. The channel was configured to operate at the Ilha Solteira UHE's minimum WL, which usually occurs in mid-October.

Figure 3.7.38: The Pereira Barreto Channel (Map of the Region, 2012)

The water level of the channel is a function of the operating levels of the Ilha Solteira and Três Irmãos UHEs, with basically two typical scenarios:

- Between April and July, during the drought period, more water is reserved than used for power generation by the plants of the two UHEs. Thus, the water level of the channel remains at higher levels.

- Starting in July, the power generation flows of the plants are raised, together with the water levels of the reservoirs and, consequently, of the channel, decline.

The current dimensions of the Pereira Barreto Channel are adequate for commercial navigation, with a width of 50 m. and a depth of 12 m. at the maximum upstream elevation and 8 m. at the minimum elevation. The channel allows passage, therefore, of one convoy at a time (2 x 1 formation), with the Brazilian Navy in charge of passing operations along this channel.

There is one bridge crossing the channel, configured to allow the passage of commercial convoys.

b) Social and Environmental Vulnerabilities

The Pereira Barreto Channel waterway has a length of 9.6 kilometers and passes through the Tietê River basin (described previously). It surrounding area intercepts the municipalities of Pereira Barreto (SP), with 24,962 inhabitants (IBGE, 2010), and Suzanápolis (SP), with 3,383 inhabitants (IBGE, 2010). Their FIRJAN indexes (2010) are 0.74 and 0.84, respectively. The channel has no variables that would allow a listing of vulnerabilities for the region.

3.7.2 Economic Aspects

3.7.2.1 Current inland waterways transport

The transport on the Tietê and Paraná rivers has two main functions. In the first place the Paraná – Tietê is part of a transport chain for export of agricultural commodities via the port of Santos. The second function is for local transport of commodities over (usually) short distances. Local transport is mainly found in the southern bench of the Paraná River (From Tres Lagoas until Guaira). No passengers are transported on these waterways.

Total transport on the Paraná -Tietê River has grown from about 3.5 million tons in 2005 to almost 5.8 million tons in 2011. In transported volume the three different segments all contribute about the same amount. The three segments are:

- Transports on the Paraná
- Transports on the Paraná - Tietê
- Transports on the Tietê

Table 3.7.2 gives the transport distance on the different segments. It turns out that the average distance on both the Tietê and the Parana are very low (between 30 and 40 km), while transport on the Paraná – Tietê is on average 660 kilometers.

Table 3.7.2: Transport volume and performance per river segment (2011)

	Tons (*1000)	Tonkm (*1000)	Distance (km)
Paraná	1.713	69.247	40
Paraná Tietê	1.999	1.319.035	660
Tietê	2.062	70.279	34
Total	**5.774**	**1.458.561**	**253**

The breakdown of commodities transported over the Paraná – Tiete River in terms of volume is presented in Table 3.7.3.

Table 3.7.3: Commodities transport on Paraná – Tietê 2011 (in 1000 tons)

	Paraná	Paraná Tietê	Tietê	Total
Soy	5	1.168		1.173
Soy meal		343		343
Corn	122	480		602
Wheat	18			18
Sugarcane			935	935
Sugar		7		7
Cassavas	22			22
Fertilizers	55			55
Sand	1.490		1.127	2.616
Cements	0			0
Tires	1			1
Other products	1			1
Total	**1.713**	**1.999**	**2.062**	**5.774**

On the Paraná river most transport is sand, coming from Mundo Novo that is transported over short distances (13 and 28 kilometers). The other large flow, Panorama – Presidente Epitácio, also consists of sand. A part of the transport over short distances is actually international transport between Brazil and Paraguay. Terminal Paraguaios and Porto Itaipu Pora are both locations in Paraguay.

The Paraná-Tietê stretch concerns soy, soy meal, corn, and sugar, all having their origin in Sao Simão. The destinations are Pederneiras, Anhembi and S.M Serra. These are all terminals where the commodities are transshipped to rail or truck for further transport to the port of Santos. From Santos the commodities are exported over sea.

Transport on the Tietê alone is very short distance (about 50 to 100 km) transport of sugarcane between terminals and plants for processing the sugarcane. The only other flow consists of sand transported over a shirt distance between locks.

3.7.2.2 Planned developments

The main terminals for the export function of agricultural commodities are Sao Simao (Goiás) as the loading place and Pederneiras (SP), Anhembi and S.M de Serra (SP) as unloading terminals. Although Rio Tietê does not reach the port of Santos, the majority of transported commodities are exported via the port of Santos. A typical example is the transport of soy from Sao Simão via inland waterways (Paraná – Tietê) to Pederneiras. In Pederneiras soy is transshipped to railway and transported to the port of Santos for export over sea. The port of Santos is therefore important for transport on the river Tietê and the Parana.

Concerning the port of Santos we can conclude:

Santos has a large share in the exports of Sao Paulo, Mato Grosso and Goiás. For inland waterway transport(IWT) on the Paraná-Tietê, especially the exports from Mato Grosso and Goiás are important. The share of IWT in the exports of soy through the port of Santos was in 2011 12.7% (almost 1.2 million tons). This is soy transported between Sao Simao and Pederneiras / Anhembi.

There is a growing tendency to transport soy to the northern ports of Itacoatiara, Vila do Conde, and Itaqui. This would imply a shift from southeast (Parana – Tiete) to road, rail and or waterway in northern direction. The reason behind this shift is the waiting time in Santos. This is on average (!) 15 days, according to the interviews. Another factor is the tax of 12% on multimodal transport in the state of Sao Paulo. In the forecast we assume that the share of Eastern ports for the exports from soy from Mato Grosso will decline from 82.5% in 2011 to 50% in 2015 and later forecast years. For Goiás we assume a decline from 100% to 60%. We expect a future shift from Santos to the Northern ports, total volumes hence remaining more or less the same in absolute numbers.

For ethanol, the Sao Paulo region is by far the most important production and consumption region within Brazil. That is why Petrobras has developed a logistic system to transport ethanol from production to consumption and export regions. According to the plans the major part of the logistic system consists of pipelines. But a part of the transport will take place through tankers from Presidente Epitácio, Aparecida, and Aracatuba to Anhembi. From Anhembi a pipeline connection to Paulínia will be used. Paulínia acts as a central collection and distribution hub. According to the plans the amount transported over water will start in 2013 and reach four billion liters (=3.2 million tons) in 2017. After that the volume will increase to 7 million tons in 2031.

Cellulose will be a new major commodity flow on the Paraná – Tietê due to the construction of a pulp factory Eldorado in Três Lagoas (MS). This mill will begin with a production of 1.5 million tons. The goal is to reach 5 million tons in 2020. The intermediate goal in 2017 is to start the second line with production of 3.5 million tons.

3.7.2.3 Future inland waterways transport

This paragraph summarizes the forecasts for inland waterway transport on the Paraná – Tietê River. The forecasts will be split in three segments (Parana, Paraná - Tiete and Tiete River). More detailed information is provided in the background reports concerning commodities and river basins.

According to the forecast, total transport, measured in tons, will grow strongly. Especially on the Paraná-Tietê segment an impressive growth is expected. The transport volumes (and performance) shows a strong growth. This is mainly the result of the two new big flows: ethanol and cellulose.

Table 3.7.4: Transport forecasts Paraná River (in 1000 tons)

	2011	2015	2023	2031
Soy	5	5	6	7
Corn	122	97	131	161
Wheat	18	19	22	25
Cassavas	22	24	26	29
Fertilizers	55	65	89	123
Sand	1.490	1.690	2.174	2.798
Other products	2	2	2	3
Total	**1.714**	**1.902**	**2.450**	**3.146**

Table 3.7.5: Transport forecasts Paraná – Tietê (in 1000 tons)

	2011	2015	2023	2031
Soy	1.168	881	1.124	1.361
Soymeal	343	224	275	325
Corn	480	260	331	390
Sugar (bulk)	7	117	135	158
Ethanol	-	2.500	4.204	5.702
Wood	-	500	1.667	1.667
Cellulose	-	1.500	5.000	5.000
Oil Products	-	250	500	500
Total	**1.999**	**6.232**	**13.236**	**15.103**

Table 3.7.6: Transport forecasts Tietê River (in 1000 tons)

	2011	2015	2023	2031
Sugarcane	935	994	1.295	1.577
Ethanol	-	1.250	2.102	2.851
Sand	1.127	1.127	1.127	1.127
Total	**2.062**	**3.371**	**4.524**	**5.555**

3.7.3 Transport System

3.7.3.1 Transported Cargo

Currently, transport on the Paraná waterway system can be divided into two categories: local (short distances of up to 30 kilometers), in which sand, sugarcane and other commodities are transported; and long distance, whose main cargo is destined for export via the Port of Santos. The transport analysis will concentrate on the long distance category.

The cargos shipped through this waterway system are presented in Chapter 3.7.2. The main ones are related to the agricultural products coming from Mato Grosso and Goiás, which corresponded to approximately 2 million tons in 2011. In 2031, this type of cargo is expected to have limited growth, due to a change in shipment of grains through ports in the northern region. The increase in cargo for this system Consist of potential flows of ethanol, wood and pulp. The volumes are presented in the table below.

Table 3.7.7: Commodities Shipped Through the Paraná Waterway System, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011 (2011 Cargo Transport on Brazilian Waterways))

Commodity	2011	2031
Soybeans	1,168	1,361
Soy meal	343	325
Corn	480	390
Sugar	7	158
Ethanol	-	5,702
Wood	-	1,667
Pulp	-	5,000
Petroleum derivatives	-	500
Total	**1,999**	**15,103**

3.7.3.2 Infrastructure

This section describes the existing infrastructure in the Paraná waterway system that, as mentioned in Chapter 3.7.1, includes the Amambaí, Anhanduí, Ivaí, Ivinheima, Paranapanema, Paranaíba, Paraná, Piracicaba, Sucuriú, São José dos Dourados, Tibagi, Tietê and Grande Rivers and the Pereira Barreto Channel. In addition, it describes the existing roadways and railways.

a) Waterway/River Infrastructure

The physical characteristics of the Paraná waterway complex, as well as the existing and planned dams, were already mentioned in Chapter 3.7.1. Consequently, only the ports/terminals and locks will be described.

Ports/Terminals

The database resulting from the PNIH was used for analysis of the Paraná Waterway System terminals, supplemented with information collected during interviews and from recent reports. This base lists 38 terminals, 14 of which have no current information on their status and 19 are in operation. The number of terminals by status can be seen in the table below.

Table 3.7.8: Status of the Ports of the Paraná Waterway System (Source: Developed based on the PNIH database, 2013)

Status	Quantity	Percentage
Operating	19	50%
Planned	5	13%
No information	14	37%
Total	**38**	**100%**

The analysis of the current status was made based on data of the terminals classified as "operating" and the others were not considered.

The Table 3.7.9 presents a list of the main ports/terminals operating in the region, as well as the rivers on which they are located and the land connections.

Table 3.7.9: List of the Main Operating Ports/Terminals

Port/Terminal/Complex	Location	Land Connections
São Simão	Paranaíba River	BR-364
Pederneiras	Tietê River	BR-225, EF-366
Anhembi	Tietê River	SP-147
Santa Maria da Serra	Piracicaba River	SP-191
Três Lagoas	Paraná River	BR-158, EF-265

These were considered to be the main terminals as a function of the representativeness of their movement in relation to the waterway total. They will be described by location below.

There are other terminals in the south course of the Tietê-Paraná waterway, such as that at Santa Helena, Hernandárias, in which there is primarily local transport of bulk agricultural products and fertilizers.

São Simão

A complex of terminals is located in São Simão (GO), focused on shipment of bulk agricultural products, primarily soybeans, soy meal and corn. The companies located in this region are: Louis Dreyfus, ADM/Sartco, Nova Roseira and Torque in partnership with Caramuru. This last one has a soybean processing unit in this terminal.

In 2011, approximately 2 million tons of bulk agricultural products, particularly soybeans and their derivatives, were shipped through this terminal complex, as can be observed on the tables below.

Table 3.7.10: Cargo Shipped from São Simão, by Destination, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011 (2011 Cargo Transport on Brazilian Waterways))

Municipality	2011
Anhembi	273
Pederneiras	1,549
S. M. Serra	176
Total	**1,999**

Table 3.7.11: Cargo Shipped from São Simão, by Commodity, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011 (2011 Cargo Transport on Brazilian Waterways))

Commodity	2011
Corn	480
Soybeans	1,168
Soy meal	343
Sugar	7
Total	**1,999**

Pederneiras

The municipality of Pederneiras hosts a terminal complex that ships soybeans, soy meal, corn and pulp (transport only began at the end of 2012). The companies that have terminals in this area are: Torque in partnership with Caramuru, ADM/Sartco and Louis Dreyfus. The cargos shipped from this terminal have the Port of Santos as their final destination for export. The table below presents the volume received, by type of cargo and by origin.

Table 3.7.12: Cargo Shipped from Pederneiras, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011 (2011 Cargo Transport on Brazilian Waterways))

Commodity	Origin	2011
Corn	São Simão	361
Pulp	Três Lagoas	0
Soybeans	São Simão	899
Soy meal	São Simão	288
Total		**1,549**

Anhembi

The city of Anhembi hosts the Torque Cargo Transshipment Station that handles bulk agricultural products. This is less used than the Pederneiras one, due to the lack of a railway connection. The table below presents the cargo shipped through this terminal. At the end of 2012, shipment of Wood as return cargo to Três Lagoas began.

Table 3.7.13: Cargo Shipped by Origin in 2011, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011 (2011 Cargo Transport on Brazilian Waterways))

Commodity	Origin	2011
Corn	São Simão	38
Soybeans	São Simão	174
Soy meal	São Simão	54
Sugar	São Simão	7
Total		**273**

Santa Maria da Serra

In Santa Maria da Serra, ADM/Sartco has a cargo transshipment station for bulk agricultural products (soybeans and corn).

Table 3.7.14: Cargo Shipped by Origin in 2011, in 1,000 tons (Source: ANTAQ report – Transporte de cargas nas Hidrovias Brasileiras 2011 (2011 Cargo Transport on Brazilian Waterways))

Commodity	Origin	2011
Corn	São Simão	81
Soybeans	São Simão	95
Total		**176**

Três Lagoas

Another pole is located at Três Lagoas (MS), where the Eldorado Celulose plant is installed near its exclusive-use terminal that entered operation at the end of 2012, as well as Cargill's mixed private use terminal used for shipping bulk agricultural products (soybeans and corn)

It was not possible to find out the amount of cargo shipped from the municipality of Três Lagoas, consequently, it is not indicated in this report.

Locks

The Paraná waterway system has a total of eight locks, whose dimensions and other information are presented below.

Table 3.7.15: Characteristics of the Locks in the Paraná Waterway System

Lock	Operator	Dimensions (Length x Width x Water Level)	River
Sérgio Motta UHE (Porto Primavera)	CESP	210m x 17m x 4m	Paraná
Engenheiro Souza Dias UHE (Jupiá)	CESP	210m x 17m x 4m	Paraná
Três Irmãos UHE	CESP	142m x 12m x 4m (two chambers)	Tietê
Nova Avanhandava UHE	AES Tietê	142m x 12m x 3m (two chambers)	Tietê
Promissão UHE	AES Tietê	142m x 12m x 3m	Tietê
Ibitinga UHE	AES Tietê	142m x 12m x 3m	Tietê
Bariri UHE	AES Tietê	142m x 12m x 3m	Tietê
Barra Bonita UHE	AES Tietê	142m x 12m x 3m	Tietê

According to the studies conducted by DH and the AHRANA, the current capacity of the Tietê-Paraná waterway is 12,000,000 tons per year. This capacity will increase to 19,000,000 tons per year after completion of lock access improvement works, such as construction of fixed anchoring bridges closer to the locks, which will reduce their cycle time. This information is presented in the report titled "Paraná Waterway Data and Information," dated March 2012 and prepared by the AHRANA.

According to the document titled "Tietê-Paraná River Capitancy Standards and Procedures," passage through the locks can be made 24 hours per day, without interruption.

Roadways

The main roadways that are part of the Paraná waterway system are described below. It is worth emphasizing that, as a function of the extensive roadway network, not all the roadways that can connect the producing regions to the export port were mentioned.

SP-300

Rodovia Marechal Rondon (Marechal Rondon Roadway) or the former Via Marechal Rondon (Marechal Rondon Way) and denominated SP-300 is a roadway in the state of São Paulo, Brazil. It runs toward the west of the state and receives this name in the municipality of Itu, connecting municipalities such as Porto Feliz, Tietê, Laranjal Paulista, Conchas, Botucatu, São Manuel, Lençóis Paulista, Agudos, Bauru, Pirajuí, Cafelândia, Lins, Penápolis, Birigui, Araçatuba, Valparaíso and Andradina and it ends at the border with Mato Grosso do Sul. It is administered over its entire length by three concessionaires. They are Rodovias das Colinas (Itu to Tietê), Rodovias do Tietê (Tietê to Bauru) and Via Rondon (Bauru to Castilho).

It is a very important route, since it is part of the transport corridor for shipping commodity production from the Brazilian mid-west, mainly Mato Grosso and Mato Grosso do Sul, to the ports of Santos (SP) and Paranaguá (PR). The most important stretch is that which connects the city of Três Lagoas (MS) to the city of Lins (SP). From this city, trucks continue with the traffic on roadway BR-153. It is a very good roadway, very well conserved. It is dual Lane in the sense that there are two traffic lanes plus shoulders. In addition, there are operating emergency services and an ample service network along the roadway. There are operating toll plazas along the route.

BR-153

BR-153, also known as the Rodovia Transbrasiliana (Transbrazilian Roadway), is the fourth largest roadway in Brazil. It connects the city of Marabá (PA) to the municipality of Aceguá (RS) and is 4,355 km. in length. Along its entire course, BR-153 passes through the states of Pará, Tocantins, Goiás, Minas Gerais, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul. Currently, BR-153 is privatized in the São Paulo stretch whose concession belongs to BRVias.

BR-153 connects with BR-300, which is one of the main routes for cargo entering the state of São Paulo, along with roadways SP-327 and BR-376, which are part of the corridors that connect the producing zone to the ports of Santos (SP) and Paranaguá (PR), respectively. It crosses important São Paulo municipalities, such as Lins, Marília and Ourinhos.

In general, the roadway is in good condition with only a few superficial defects at isolated points of the road. It consists of single lane and wide shoulders on both sides for most of its route. The São Paulo stretch has better signage and is in better condition than the Paraná stretch, however traffic moves normally on both.

BR-374

Rodovia Presidente Castelo Branco (President Castelo Branco Roadway) (SP-280, also denominated BR-374) is the main connection between the São Paulo Metropolitan Region and West São Paulo. It begins at the Complexo Viário Heróis de 1932 (Heros of 1932 Road Complex), popularly known as the "Cebolão" (“Big Onion"), at the access to the Tietê and Pinheiros Expressways, in São Paulo, and ends at the junction with SP-225, in Santa Cruz do Rio Pardo.

It has intense traffic on the stretch from the border of São Paulo with Osasco and Barueri, being the main road connection between the capital and the western region of Greater São Paulo. In this stretch, the traffic is relieved by side roads constructed in 2001. In the remainder of the route, the roadway is the main Western São Paulo artery and serves as access to Rodovia Marechal Rondon, which completes the connection between São Paulo and the Mid-west. The number of vehicles on the roadway was close to 290 thousand per Day in 2011.

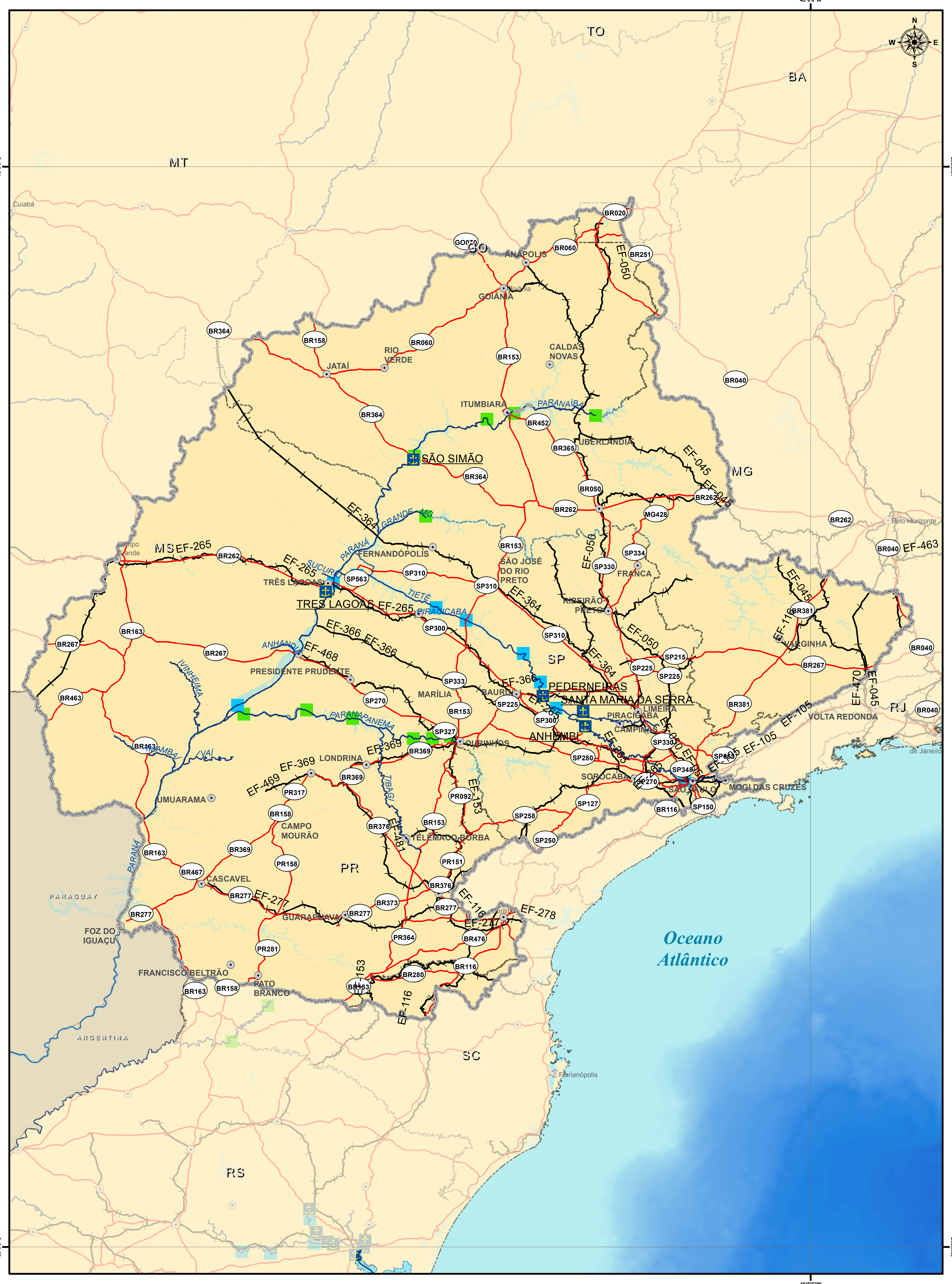
In the stretch between São Paulo and the Alphaville access, in Barueri, it has four traffic lanes in each direction, with four-lane side roads as well, totaling eight in each direction. Between the Alphaville access and the junction with SP-75 (Rodovia Senador José Ermírio de Moraes) (Senator José Ermírio de Moraes Roadway), there are three traffic lanes in each direction. On the other hand, between the junction with SP-75 and the end of the roadway at the junction with SP-255, in Santa Cruz do Rio Pardo, there are two traffic lanes in each direction.

Production from the Brazilian Mid-west is channeled through BR-374 when the final destination is the Port of Santos (SP). Arriving at São Paulo (SP), the traffic that continues on to Santos takes SP-150 to the port access.

SP-150

Rodovia Anchieta or formerly, Via Anchieta (SP-150) connects the São Paulo capital, São Paulo, to the Santos Lowlands where the Port of Santos is located, passing through the São Paulo ABC region. It is one of the roads with the highest movement of people and merchandise in all Brazil, as is Rodovia dos Imigrantes (Immigrants Roadway) that is part of the same Via Anchieta system, the Anchieta-Imigrantes System. It is part of the BR-050 system that connects Brasília to Santos. The roadway is the largest export corridor in Latin America.

SP-150 is the connection between all the roadways that arrive in São Paulo at the Port of Santos, consequently, it is one of the most important road corridors in Brazil. It has dual lanes with very good signage and constant monitoring. During times of heavy fog and low visibility, Ecovias and the State Roadway Police lead the vehicles in all the lanes and ensure they travel at low speeds, thus minimizing the risk of accidents. The Curva da Onça, located at Km. 43 of the descending lane of Via Anchieta is the most dangerous stretch of the Anchieta-Imigrantes System (SAI), with high rates of accidents.



CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais
- Bacia Hidrograficas

Barragem existentes
- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes
- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 37,5 75 150 km
SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES
ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE
TRANSPORT CHARACTARISTICS HIDROVIA DO PARANA - TIETE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:5.500.000	- BRASIL -	JUL/2013

Railways

The main railways that are part of the Paraná waterway system are described below.

EF-265

EF-265 is a cross-country railway that connects the states of São Paulo (Santos, Mairinque, Bauru) and Mato Grosso do Sul to the border with Bolivia. Its route runs parallel to BR-262 and, consequently, the Miranda River, crossing the Paraná River at the city of Três Lagoas (MS).

EF-265, which was named as Ferrovia Novoeste S.A. and, currently, as América Latina Logística Malha Oeste S.A. (ALLMO), has been in operation since 7/1/1996 and connects the city of Corumbá (MS) to the state of São Paulo. The gauge is metric and the main cargo transported are petroleum derivatives, iron ore and manganese, soybeans, steel products and soy meal. It is operated by América Latina Logística Malha Oeste S.A.

EF-364

EF-364 is a diagonal railway that connects Santos, São Paulo, Campinas, Araraquara, Rubinéia, Aparecida do Taboado and Alto do Araguaia.

EF-364, which was named as Ferrovia Bandeirantes S.A. and, currently, as, América Latina Logística Malha Paulista S.A. (ALLMP) up to Aparecida do Taboado and América Latina Logística Malha Norte, has been in operation since 1/1/1999. It is a wide-gauge line and the main cargos transported are petroleum derivatives, fertilizers, grains, minerals and pellets.

EF-366

EF-366 connects Panorama, Bauru and Itirapina, all in the state of São Paulo, passing through the Pederneiras Intermodal Terminal. As in the case of EF-364, EF-366 was named as Ferrovia Bandeirantes S.A., however there was a change in name to América Latina Logística Malha Paulista S.A. (ALLMP), and it has been in operation since 1/1/1999. It is a wide-gauge line and the main cargos transported are petroleum derivatives, fertilizers, grains, minerals and pellets.

3.7.3.3 Characteristics of the Existing Fleet and the Operating Companies

a) Vessels

As can be seen on the table below, the total static capacity of the barges is 118,136 tons. The main shipping companies are TNPM (Torque) and PBV Transporte Hidroviário. Both have 24 barges and the total fleet is 107. SARTCO has the greatest number, however, less capacity. The maximum nominal draft is 3.52 m. The figure below schematically presents the convoy used by the shipping companies.

Figura 3.7.39: Used convoy by the Paraná waterway system shipping companies.

Table 3.7.16: Shipping Companies – Longitudinal Cargo Transport (Source: Prepared based on the ANTAQ Statistical Yearbook, 2011)

Company	Total static capacity (in tons)	Minimum static capcity (in tons)	Maximum static capcity (in tons)	Number of barges	Maximum draft (m)	Average age (years)
Pbv Transporte Hidroviário Ltda.	37,547	1,500	1,638	24	3.04	11,7
Tnpm Transporte, Navegação E Portos Multimodais Ltda.	36,384	1,500	1,628	24	3.00	14,3
Louis Dreyfus Commodities Brasil S.A.	24,000	1,500	1,500	16	3.52	18,8
Sartco Ltda.	20,205	239	874	43	3.35	19,8
Total	**118,136**	**239**	**1,638**	**107**	**3.52**	**16,1**

b) Pusher Tugboats

There are 28 pusher tugboats in this system. SARTCO has the greatest number (28) and the most powerful pusher tugboat (2,442 HP). The table below presents the characteristics of the fleet.

Table 3.7.17: Shipping Companies – Longitudinal Cargo Transport (Source: Prepared based on the ANTAQ Statistical Yearbook, 2011)

Company	Average power (in HP)	Number of pusher tugboats	Average age (years)
Sartco Ltda.	696	14	26,7
Tnpm Transporte, Navegação E Portos Multimodais Ltda.	917	6	15,8
Pbv Transporte Hidroviário Ltda.	828	5	8,8
Louis Dreyfus Commodities Brasil S.A.	470	3	18,7
Total	780	28	17,8

3.7.3.4 Operation

The convoys used follow a 2x2 formation (Tietê Double Convoy) and one pusher tugboat with a 2.7 m. draft. The cargo capacity is 6,000 tons (1,500 for each barge).

These convoys must be split up to pass through the locks, since only two barges in line are allowed. Spliting up the convoys is also necessary to pass under some bridges, as is lowering of the cabins of some of the pusher tugboats, due to height restrictions. The single line diagram below shows the restrictions.

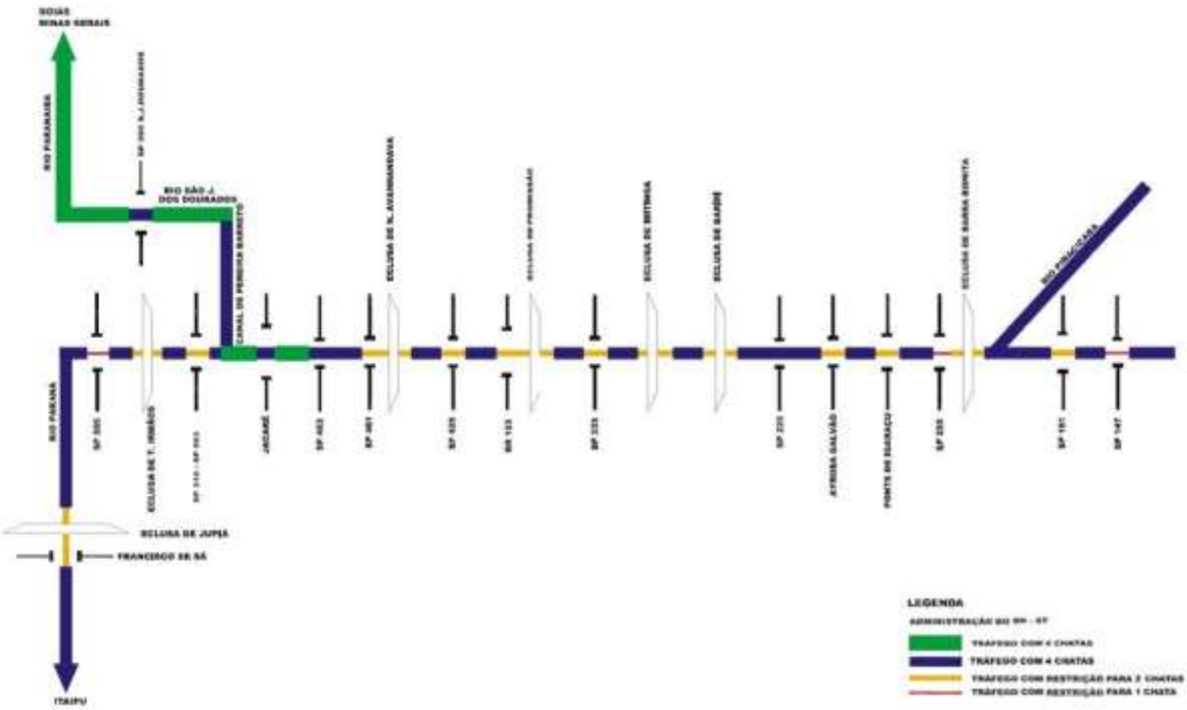


Figure 3.7.40: Traffic Restrictions - Tietê-Paraná Waterway (Source: Paraná Waterway Data and Information – AHRANA, 2012)

These restrictions add 30% to the total trip time.

As a result of PAC investments together with the São Paulo state government, some bridges are having their spans widened and pilars protected against impacts, in addition to the improvements already mentioned to increase the efficiency of lock operations.

As can be observed, waterway transport in this system is controlled by a limited number of operators, with PBV Transporte Hidroviário and TNPM (Torque) the largest in terms of static capacity. These transport third-party cargo, while the others only transport their own cargo.

3.7.3.5 River Information Management System

As already mentioned in Chapter 3.7.4, AHRANA and the Departamento Hidroviário do Estado de São Paulo (DH) (São Paulo State Waterway Department) manage the Tietê-Paraná Waterway. One of the responsibilities, among others, of these two bodies is waterway maintenance, including both and dredging and signaling works. It should be mentioned here that during waterway maintenance, navigation activities are suspended for up to 30 days.

The DH has been investing in a waterway traffic control and operation center, installing câmeras under some bridges and in locks. In addition, it has a traffic management system that uses radios, providing increased operational efficiency.

The document titled "Normas e Procedimentos da Capitania Fluvial do Tietê-Paraná” (Standards and Procedures of the Tietê-Paraná River Capitancy) provides information on traffic safety, signaling and other subjects, which are detailed below.

The Tietê-Paraná Waterway, from São Simão (GO), on the Paranaíba River, to Foz do Iguaçu (PA), on the Paraná River (Itaipu UHE), has a navigation channel with beaconage and reflective buoys, as well as some luminous buoys, side lights and headlights at critical points, making night navigation possible

The Tietê-Paraná Waterway, from Anhumas (SP), on the Tietê River, to the mouth of the São José dos Dourados River, at the Paraná River, has a navigation channel with beaconage and reflective buoys, making night navigation possible. There is also navigation with beaconage and reflective buoys on the Piracicaba River from its mouth to Santa Maria da Serra (SP). It should be emphasized that the companies use GPS for navigation.

The nautical beaconage on the Tietê, Piracicaba and São José dos Dourados Rivers, as well as the Pereira Barreto Channel and the Jupiá reservoir are the responsibility of the Waterway Department (DH).

The beaconage on the Paraná and Paranaíba Rivers, except for the Jupiá reservoir, is the responsibility of the Administração da Hidrovia do Rio Paraná (AHRANA) (Paraná Waterway Management).

The Tietê-Paraná Waterway has the Atlas 2800, from Ilha Solteira to Barra Bonita, issued by the Diretoria de Hidrografia e Navegação da Marinha do Brasil (Hydrography and Navigation Board of the Brazilian Navy), containing the information for navigation on the waterway.

The hydroelectric power plant operators measure the water level. In the case of the Paraná River, this is done at the following stations: Guaíra, Caiuá, São José and Porto Primavera, and they can be requested by the Itaipu Binacional System Operations Department. AES Tietê and CESP measure the reservoirs of the operating plants.

3.7.3.6 Intermodal Competition

Based on the results presented in Chapter 3.7.2, it can be concluded that the cargo potential of this waterway system consists, in large part, of cargo destined for export from Mato Grosso and Goiás. The increase in cargo should occur as a function of the flows of ethanol, wood and pulp.

In the Paraná waterway system, various routes can be used for cargo transport to the export port (Port of Santos), as well as three modes. For example, if a company that has a terminal in Três Lagoas wants to export its cargo via the Port of Santos, the route used has three mode options: direct roadway transport, direct railway transport or multimodal (waterway and roadway or railway).

For each significant microregion (production greater than 400,000 tons of soybeans per year or which contains at least one municipality that produces more than 100,000 tons per year) the transport distances were calculated for each alternative. Based on these distances, the transport cost was calculated using cost models (see Chapter 1.3.4). The railway transport alternative consists of initial transport to Alto Araguaia by roadway, then transshipment by railway to the Port of Santos. The table below presents a comparison of the multimodal and other transport alternative costs.

Table 3.7.181: Transport Cost of Each Alternative, with the Roadway Alternative having the Lowest Cost (R$/ton)

Microregion	Santos	Santos	Santos	Santos	Santos
	Multimodal Waterway	Roadway	Multimodal THI/roadway	Railway	Multimodal THI/railway
Brasnorte	330	390	85%	235	142%
Alto Garças	173	233	74%	138	127%
Bom Jesus do Araguaia	252	326	77%	241	106%
Gaúcha do Norte	242	315	77%	230	106%
General Carneiro	187	261	72%	176	108%
Itiquira	181	241	75%	146	126%
Nova Maringá	289	333	87%	255	115%
Primavera do Leste	217	268	81%	182	120%
Querência	250	321	78%	239	105%
Sapezal	314	375	84%	279	113%
Sorriso	284	343	83%	249	115%
Tangará da Serra	269	329	82%	235	116%
Vera	287	347	83%	252	115%

The multimodal alternative has the lowest cost when compared to the roadway only alternative. The average weighted cost of the first is approximately 81% of that of the second. However, comparing this multimodal alternative to the railway one, the latter is more competitive from the cost point of view. On average, the cost of multimodal transport with a waterway is 15% higher.

Although it has this disadvantage in terms of cost, bulk agricultural product transport is made by the Paraná waterway system as a function of other factors, such as the possibility of intermediate storage in Pederneiras or Anhembi or cargo volume restrictions on movement by railway.

The increase in cargo in this waterway system, as already mentioned in Chapter 3.7.2, is related to the start of ethanol, wood and pulp transport.

3.7.4 Governance and Institutions

The Tietê-Paraná Waterway System has the AHRANA (Attachment I) in the federal sphere and the DH – Waterway Department (Attachment I) that belongs to the Secretaria Estadual de Logística e Transportes (State Secretariat of Logistics and Transport) in the state sphere as intervening institutions in matters related to waterways.

In addition to these two main agents, other institutions, both national and state, are tied to the waterway and port management of this waterway (Tietê – Paraná). It is worth emphasizing that these responsibilities reflect the content provided for by the legal text that defines them, in some cases it does not reflect their actual operation. The main ones are listed in the figure below, as well as some of their formal reponsibilities. Further on, these responsibilities will be explained, allowing visualization, in some cases, of overlapping and complementary responsibilities, as well as the way these institutions interact.

Table 3.7.19: Matrix of Formal Responsibilities of the Tietê – Paraná Waterway Agents

	Port Mgt	Inspection	Waterway Maintenance*	Licensing Process	Regulation
Waterway Administration (WA) - AHRANA			■		
Companhia Docas - CODESP	■				
Port/River Capitancy		■			
State Superintendency - DH		■	■		
State Environmental Secretariat				■	
DNIT/DAQ			■		■
ANTAQ		■			■
IBAMA				■	■
Other Agents**				■	

*Dredging, demolition, signaling.
**This block includes all agents consulted by IBAMA in the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN and the Public Prosecutor's Office).
Source: Consórcio Arcadis Logos, 2012

The DH is the body of the state of São Paulo responsible for administration of waterway infrastructure within the state in the Tietê-Piracicaba stretch. In addition to administering, it also conducts maintenance, monitoring of operations, and inspection of compliance with norms, as well as implementation and planning of new infrastructure. In addition to these tasks, the Waterway Department also should intermediate in conflicts between waterway users and power generation operators (AES and CESP), in order to maintain a water level suitable for navigation.

The Tietê-Piracibaba stretch, in addition to its navigation potential, also has great hydroelectric potential, attracting the interest of electrical power companies.

Historically, the state of São Paulo always allocated major efforts to implementating projects for multiple use of the waters in the Tietê River and part of the Paraná River. The Union also participated and contributed, including with allocation of federal resources: in the 1960s and mid-1970s, the mixed commission, CENAT (Comissão Executiva para a Navegação do Tietê-Paraná) (Executive Commission for Navigation of the Tietê-Paraná), was created to act on the works at Barra Bonita, Bariri, Ibitinga and Promissão, on the Tietê River, and Jupiá on the Paraná River. Then, in the 1980s, the federal government, with the former Portobrás and the government of the state of São Paulo, through Companhia Energética de São Paulo (CESP) (São Paulo Energy Company), resumed construction of the last energy generation and navigation projects at the interconnection of these rivers. Thus, the dams and locks of Nova Avanhandava and Três Irmãos were constructed on the Tietê River and the Pereira Barreto Channel that connects the Três Irmãos and Ilha Solteira reservoirs on the Paraná River.

CESP has a lock at the Eng. Souza Dias hydroelectric power plant (Jupiá) that allows navigation on the Paraná River and waterway integration with the Tietê River. It has another lock at the Eng. Sérgio Motta hydroelectric power plant (Porto Primavera) for navigation on the Paraná River, as well as two locks at the Três Irmãos hydroelectric power plant, which allow navigation between the north and south arms of the Tietê-Paraná Waterway. There is no fee or tax for passage through these locks since the lock operator is a public company.

The current AES Tietê administers six locks, granted by the government, along the Tiete-Paraná Waterway, at the Barra Bonita, Bariri, Ibitinga, Promissão and Nova Avanhandava hydroelectric power plants and there are also no fees charged for passage through these locks. Although AES Tietê is a private company, it is the result of the purchase of the former Companhia de Geração de Energia Elétrica Tietê (Cesp Tietê) (Tietê Electrical Energy Generation Company), a public company, and in privatizing this company, the government feared the collapse of the waterway if fees were charged for lock use, requiring the company granted the concession to operate the lock system without charging fees (Folha de Notícias, 1999).

The stretch related to the Paraná River is administered by AHRANA, since it crosses more than one state. The administration's purpose is to work in the direction of improvements located along these navigation stretches, focusing mainly on traffic safety and continuous operation of the entire system. For this, it makes improvements in the existing works, enhancing the signaling and beaconage system of these routes, but most importantly, it observes, monitors and acts to maintain minimum navigable levels in the reservoirs, thus ensuring continuous cargo transport on these waterways.

In order to ensure waterway traffic safety, the Capitania Fluvial do Tietê-Paraná (Tietê-Paraná River Capitancy) (Annex I), tied to the Navy (Annex I), inspects vessels and verifies that waterway signaling norms are being followed, and, if they are not, it informs AHRANA or the DH, depending on the stretch where the problem occurs. The capitancy should also investigate whether the administrator or Waterway Department is adequately signaling interventions made in the river stretches, mainly with regard to works.

These interventions – hydraulic works to exploit water resources (demolition) and civil works (dikes, drainage canals, dams, locks) – should have environmental licences for their execution. In the federal sphere, the Tiete-Paraná Waterway is subject to IBAMA (Annex I), in other words, it should be operated when interventions impact more than one state and in the state sphere is subject to the environmental secretariats, with those of São Paulo and Paraná being most influential. That of São Paulo is called the Secretaria do Meio Ambiente (SMA) (Secretariat of the Environment) (Annex I) and it encompasses the CESTESB (Attachment I), responsible for environmental licensing. In Paraná, the Instituto Ambiental do Paraná (IAP) (Environmental Institute of Paraná) is also responsible for environmental licensing.

The navigable stretches of the Tietê River are stretches of dammed river, "channeled rivers" is the technical term, corresponding to a series of man-made reservoirs, controlled by man, constructed for hydroelectrical power generation. Consequently, for navigation to be possible, locks were constructed that serve to ensure continuous traffic of vessels. Given this, according to IBAMA, requests for licenses are not necessary for beaconage or waterway maintenance works, since this is an “man-made” waterway. Licensing is only necessary for new interventions.

AHRANA and the DH relate via the Comitê Técnico da Hidrovia Tietê-Paraná (Tietê-Paraná Waterway Technical Committee) that is tied to the Capitania Fluvial do Tietê-Paraná, subject to the Brazilian Navy.

The committee is an advisory body for decision making. Its members meet periodically in order to establish improvements for navigability, traffic and safety on the Tietê-Paraná Waterway as a whole. The members of the committee are divided between ex-officio members (Diretoria de Portos e Costas (Directorate of Ports and Coasts), Comando do 8º Distrito Naval (Command of the 8th Naval District), Capitania Fluvial do Tietê-Paraná, Capitania Fluvial do Rio Paraná (Paraná River Capitancy), Presidente Epitácio River Police, Guaíra River Police and Centro de Hidrografia da Marinha (Navy Hydrography Center)), permanent guest members (ANTAQ, AHRANA, DH, CESP, AES-Tietê, among others) and guest members that are normally companies, universities, other captancies and the DNIT (Attachment I).

In 2006, the Tribunal de Contas da União (Federal Audit Court) conducted an evaluation of the waterway maintenance program, which resulted in an executive summary of the same name (Avaliação do Programa Manutenção de Hidrovias) (Evaluation of the Waterway Maintenance Program). In this report, the TCU highlights some good practices of the waterway managements, which should be followed by the others. In the case of the Tietê-Paraná Waterway, the presence of the technical committee and the good relationship between the hydroelectric power plant operators and the AHRANA/DH are highlighted.

In addition to this technial committee, various Comitês de Bacias Hidrográficas are present along the Tietê-Paraná waterway. Their purpose, in addition to approving the Basin Water Resources Plan, is to arbitrate conflicts over water use, in the first administrative instance, establish mechanisms, and suggest the amounts to be charged for water use.

One of the largest current studies of the Tietê-Paraná Waterway is on the transposition of the Itaipu UHE that connects the Paraná River to the Prata River in Argentina. Construction of the Itaipu hydroelectric power plant, which did not include construction of locks for economic reasons, ended up interrupting navigation on the Paraná River forming two waterway stretches: one, the Tietê-Paraná, from the source of the Paraná River to Itaipu, and the other, Paraná-Prata, from Itaipu to Buenos Aires. If this transposition is made, the waterway would have 7,000 navigable kilometers, uniting four MERCOSUL countries (Brazil, Argentina, Paraguay and Uruguay) with the capacity to service 80% of the economy of the region, generating enormous savings in transport costs, as well as greater competitiveness of its products.

Given this possibility to interconnect the Paraná and Paraguai Rivers, the Tietê-Paraná Waterway also has become the focus of international organizations, taking the issue to both the Comitê Intergovernamental de Hidrovias (Intergovernmental Waterway Committee) and the IIRSA, always in conjunction with the Paraguay Waterway itself.

3.7.5 Tietê-Paraná Waterway System SWOT

Strengths	Weaknesses
• Inland waterway transport is already in operation in this WS. • The multimodal transport cost – from the producing regions (MT and GO) to the Port of Santos – in general, corresponds to 81% of the cost of direct roadway transport. • Projects related to pulp and ethanol have been installed near the WS to integrate waterway transpor into their logistical chain. • The Comitê Técnico da Hidrovia Tietê-Paraná has been shown to be an important means of overcoming the challenges that make navigation on the rivers in the region difficult, since it brings together multiple institutions connected to waterway transport (including representatives of the energy sector), combining and organizing efforts to encourage partnerships. • The Paraná River is navigable from Itaipu to São Simão (Paranaíba River). There are adequate nautical charts and signaling for this stretch. • The Tietê River is navigable from its mouth to the end of the Barra Bonita reservoir.	• The multimodal transport chain is extensive in the region: a vast roadway network, inland navigation with port infrastructure, in large part, adequate and with a railway network that makes the connection to the Port of Santos possible. • AHRANA has difficulties operating, as a consequence of the lack of access to financial and human resources (due to the agreement signed between DNIT/DAQ and CODOMAR). • The Itaipu dam has no locks, thus impeding navigation downstream of Itaipu to Argentina and the Atlantic Ocean. • The main physical problem of the Paraná River is the stretch near the Guaíba Channel, where the maximum depth is 3 meters. • The Tietê River is not navigable upstream of the Anhembi River. • The dimensions of the locks on the Tietê River are not compatible with the convoys currently used, since these need to be separated for passage through the locks, resulting in a loss of efficiency in the process. • The Paranaíba River has many dams without locks, not currently allowing navigation upstream of the São Simão dam. • The Paranapanema River has dams without locks, not currently allowing continuous navigation. • The Amambaí, Ivaí, Ivinheima and Pardo Rivers do not currently have navigation conditions.

Opportunities	Threats
• Potential cargo in 2031 – Soybeans → 1.4 million tons – Ethanol → 5.7 million tons – Wood → 1.7 million tons – Pulp → 5 million tons – Containers and fertilizers → potencial market • More intense use of the waterway for transport purposes could influence public initiatives to eliminate the pollution of the Tietê River. • There are 5 dams with locks planned for construction on the Tietê River, allowing navigation to Salto. • Expansion of the WS, making inland waterway transport of cargo to Salto (SP) possible, should reduced the stretch of road-railway connection going to/coming from the Port of Santos. • A dam is planned for construction on the Piracicaba River, allowing navigation to the city of Piracicaba (SP). • Construction of locks would make the Paranaíba and Paranapanema Rivers navigable.	• Lines and delays at the Port of Santos could encourage diversification of the route, searching for alternatives to the Tietê-Paraná WS. • The structure of inland waterway transport in the Northern region could compete with the Tietê-Paraná WS for cargo coming from MT and GO.

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