WORLD RESOURCES INSTITUTE

NATURAL INFRASTRUCTURE IN SAO PAULO'S WATER SYSTEM

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PHOTO: DAVID RIAÑO CORTÉS/ PEXEL

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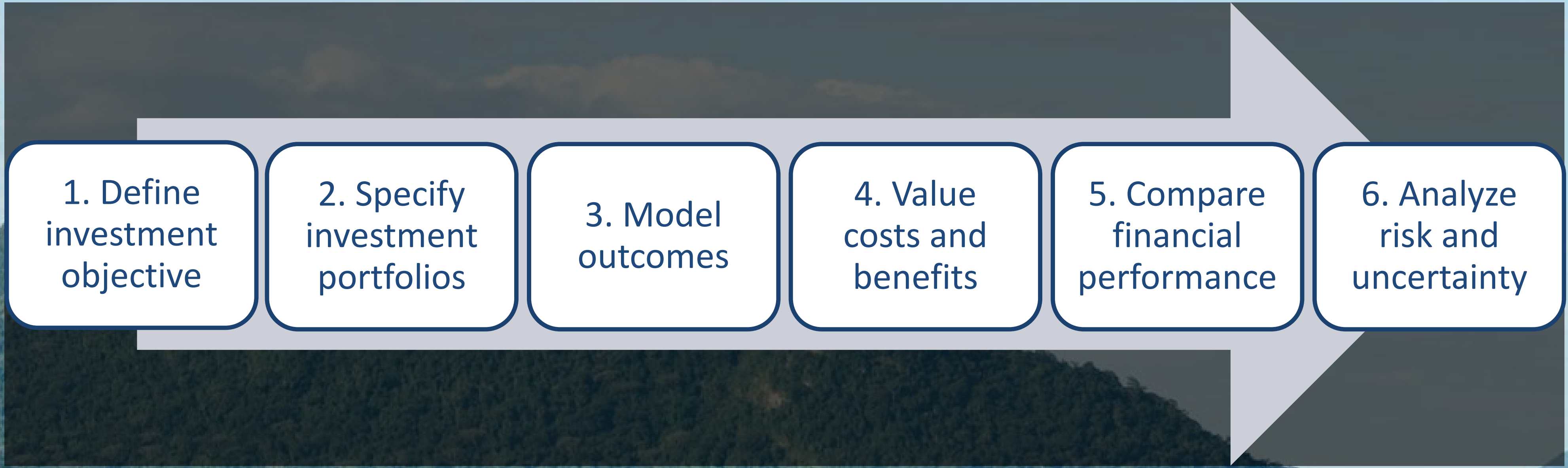
OUR MISSION | *To move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations.*

Cities | Climate | Energy | Food | Forests | Water | Oceans

GREEN-GRAY ASSESSMENT



Current case studies:

- São Paulo, Brazil
- Vitória, Brazil
- Rio de Janeiro, Brazil
- Monterrey, Mexico

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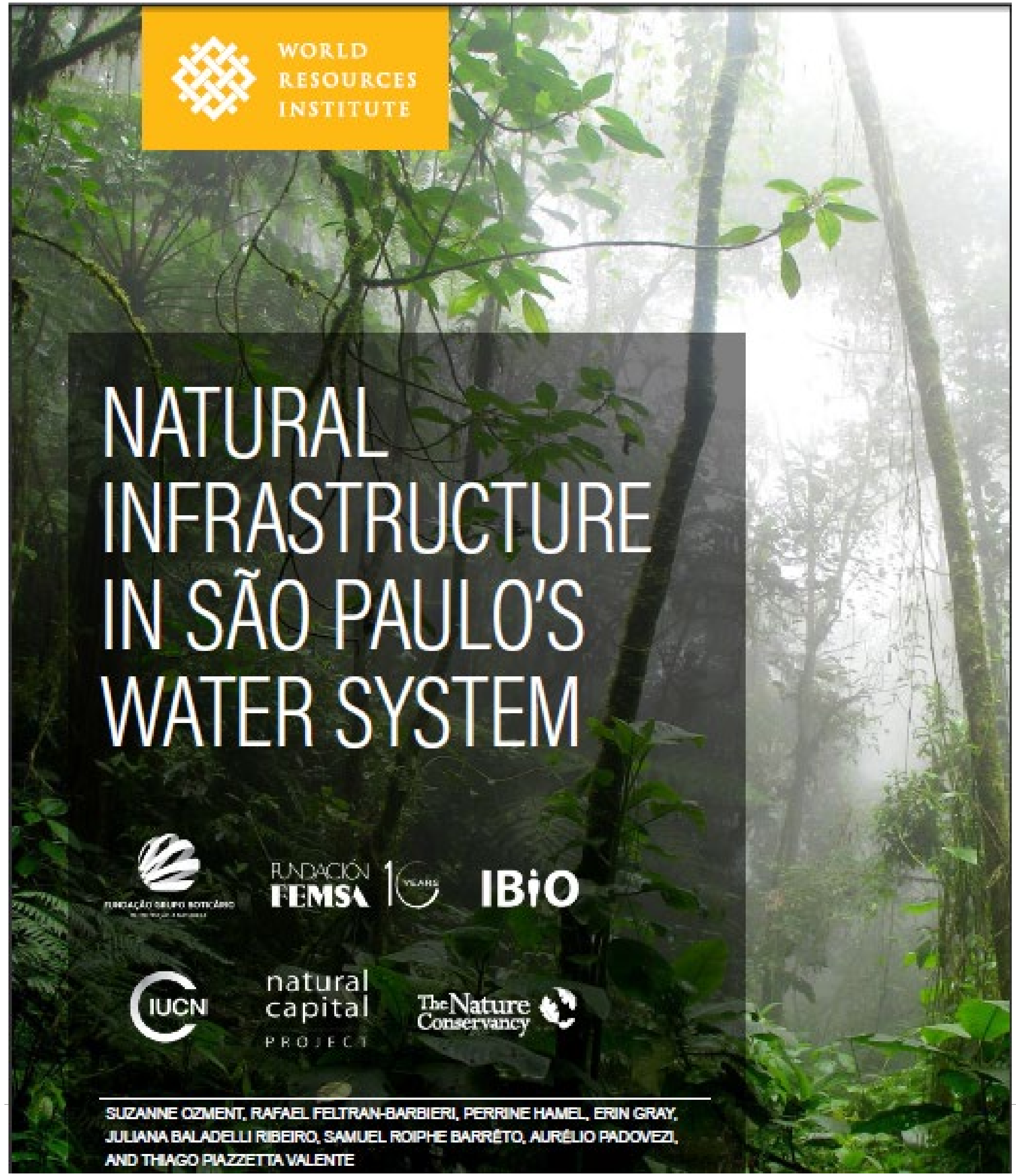
PHOTO: HAROLD PALO JR



Study objectives:

- Provide robust evaluation of natural infrastructure's value proposition
- Determine if and how to integrate green infrastructure in local water management
- Identify data-driven opportunities to strengthen the value proposition
- Refine replicable method for site-based analysis

WATER CRISIS IN THE CANTAREIRA SYSTEM

- Reservoirs hit 4% Capacity
- Water utility, SABESP, suffers $470 million loss

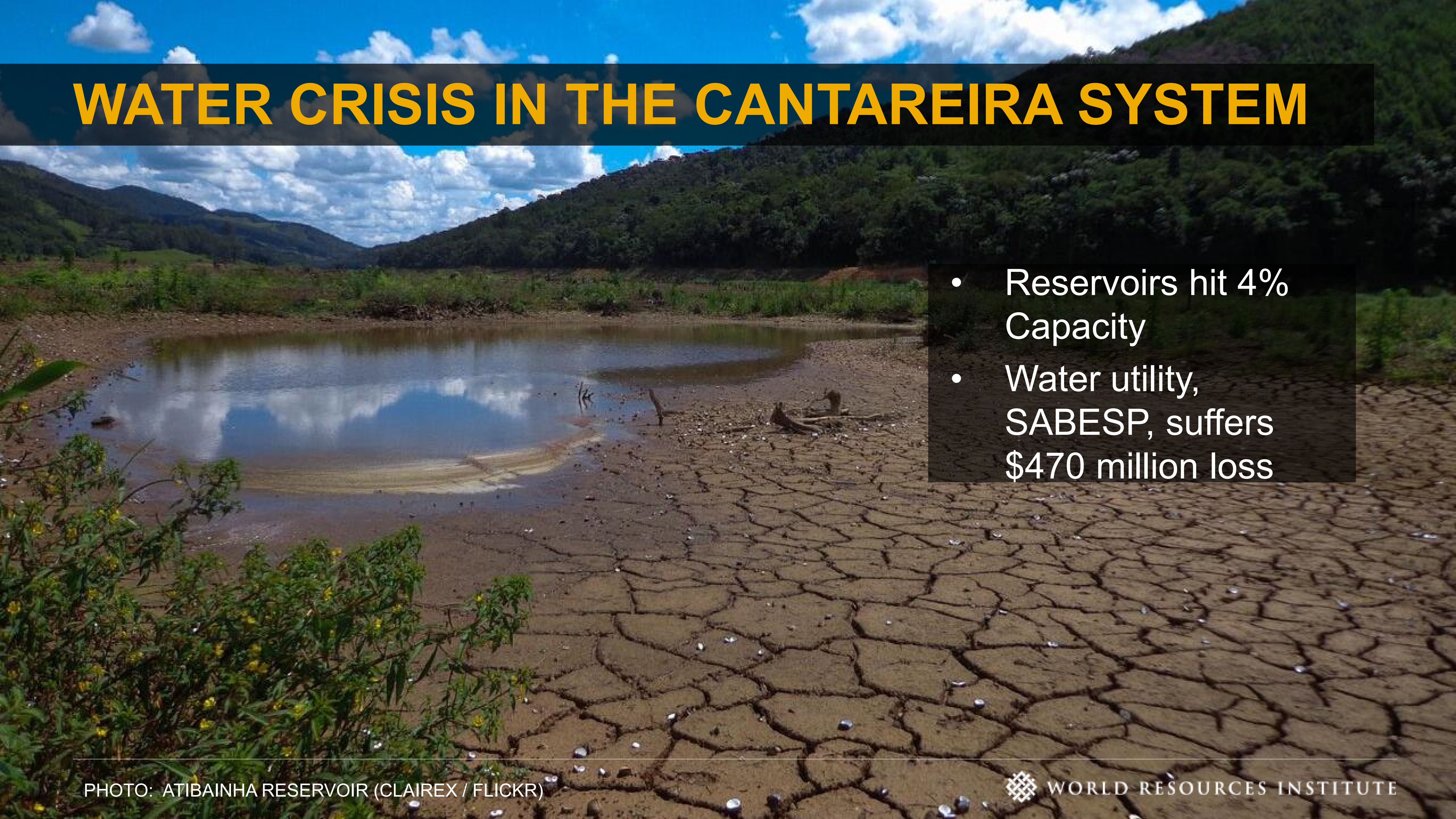
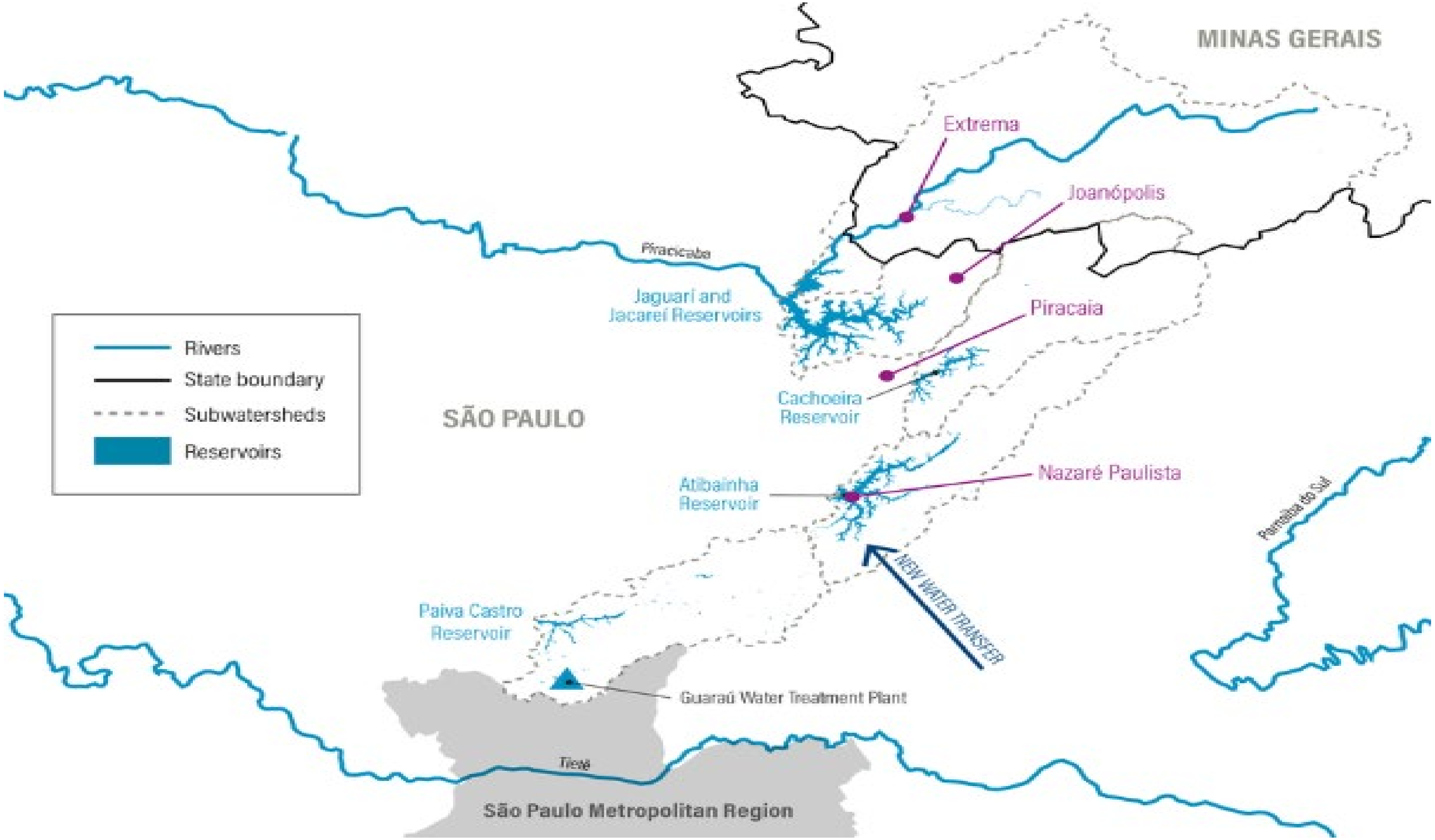
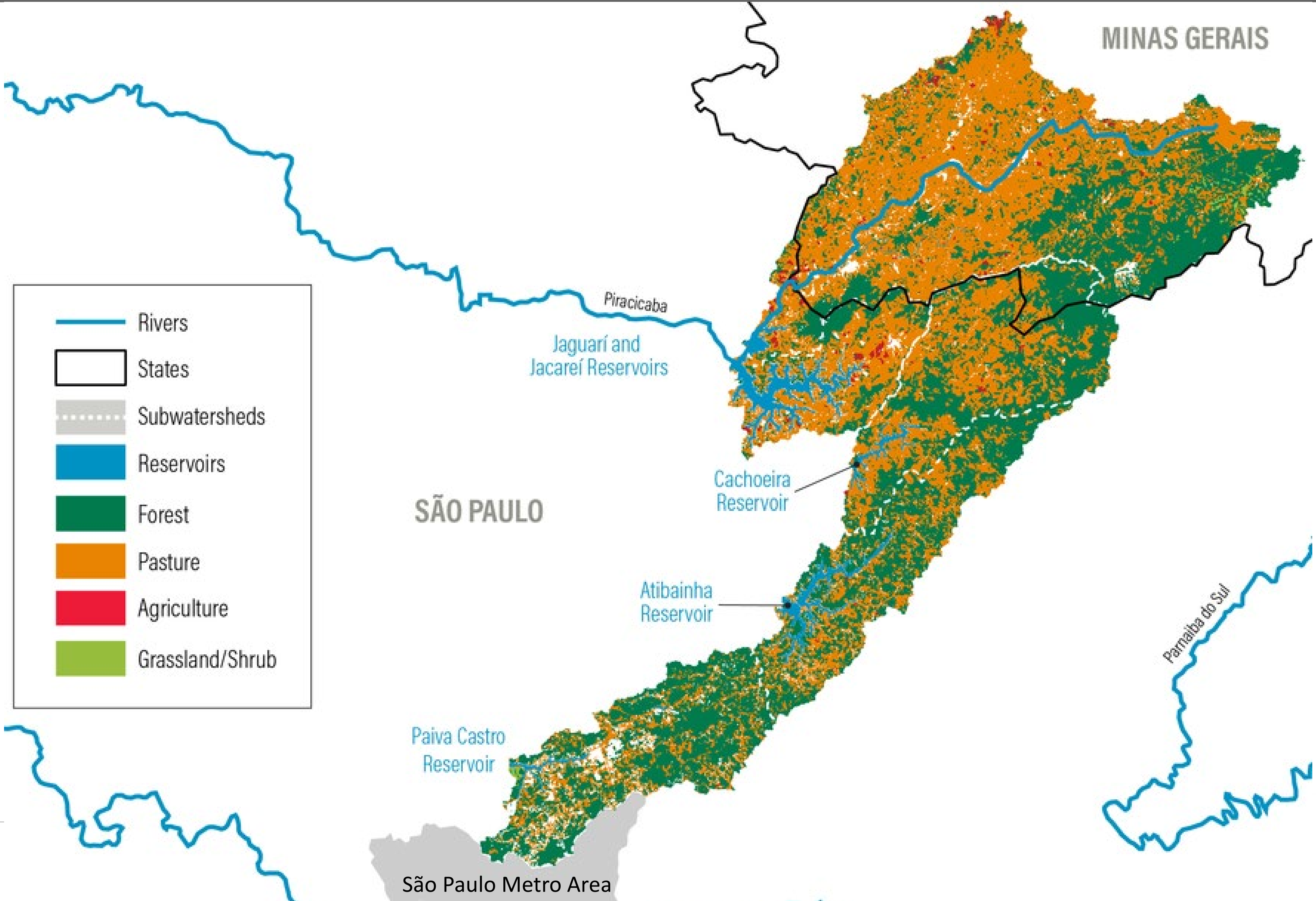


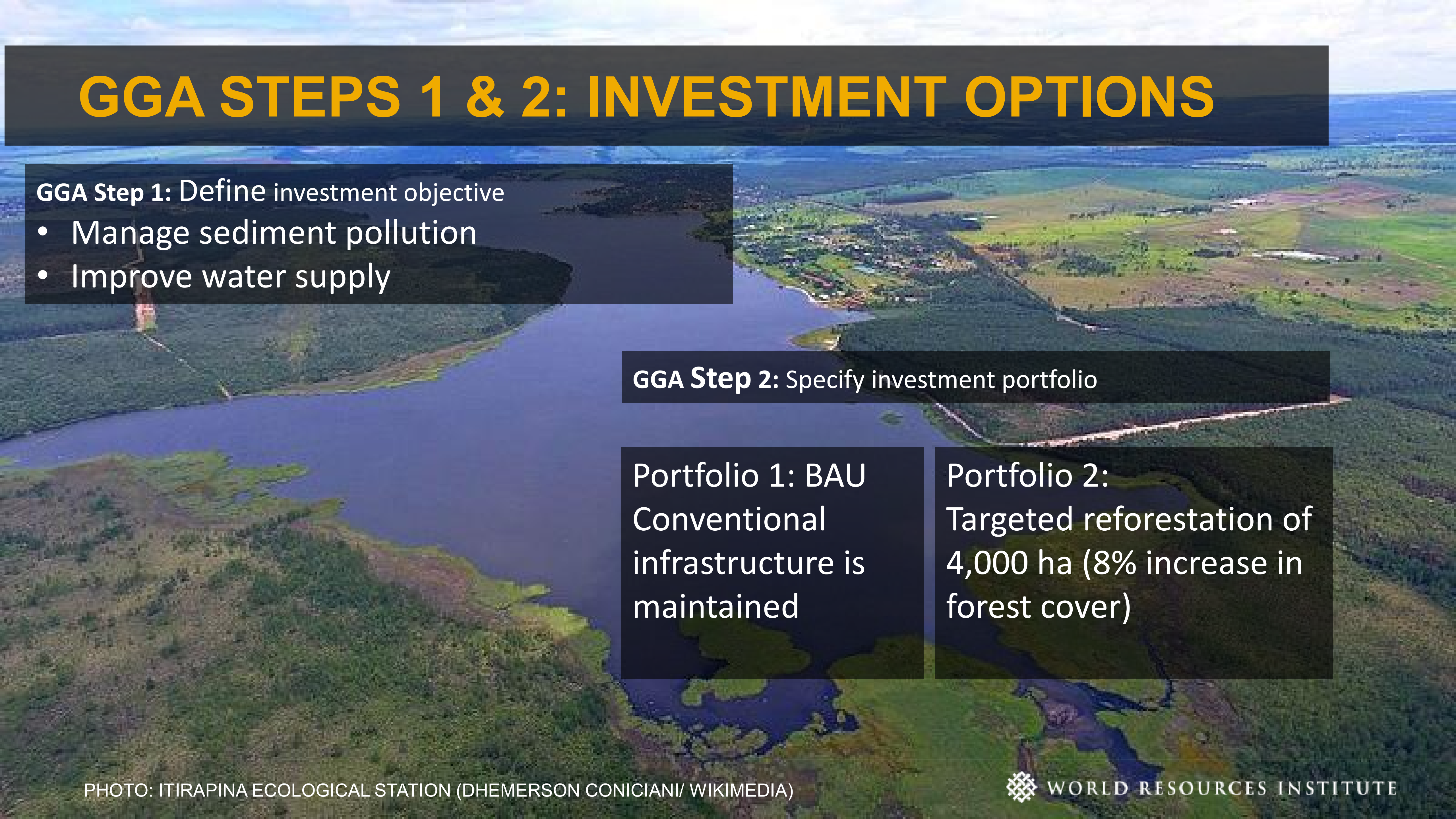
PHOTO: ATIBAINHA RESERVOIR (CLAIREX / FLICKR)

MAP OF EXISTING WATER INFRASTRUCTURE



LAND COVER IN THE CANTAREIRA SYSTEM





GGA STEPS 1 & 2: INVESTMENT OPTIONS

GGA Step 1: Define investment objective

- Manage sediment pollution
- Improve water supply

GGA Step 2: Specify investment portfolio

Portfolio 1: BAU	Portfolio 2:
Conventional infrastructure is maintained	Targeted reforestation of 4,000 ha (8% increase in forest cover)

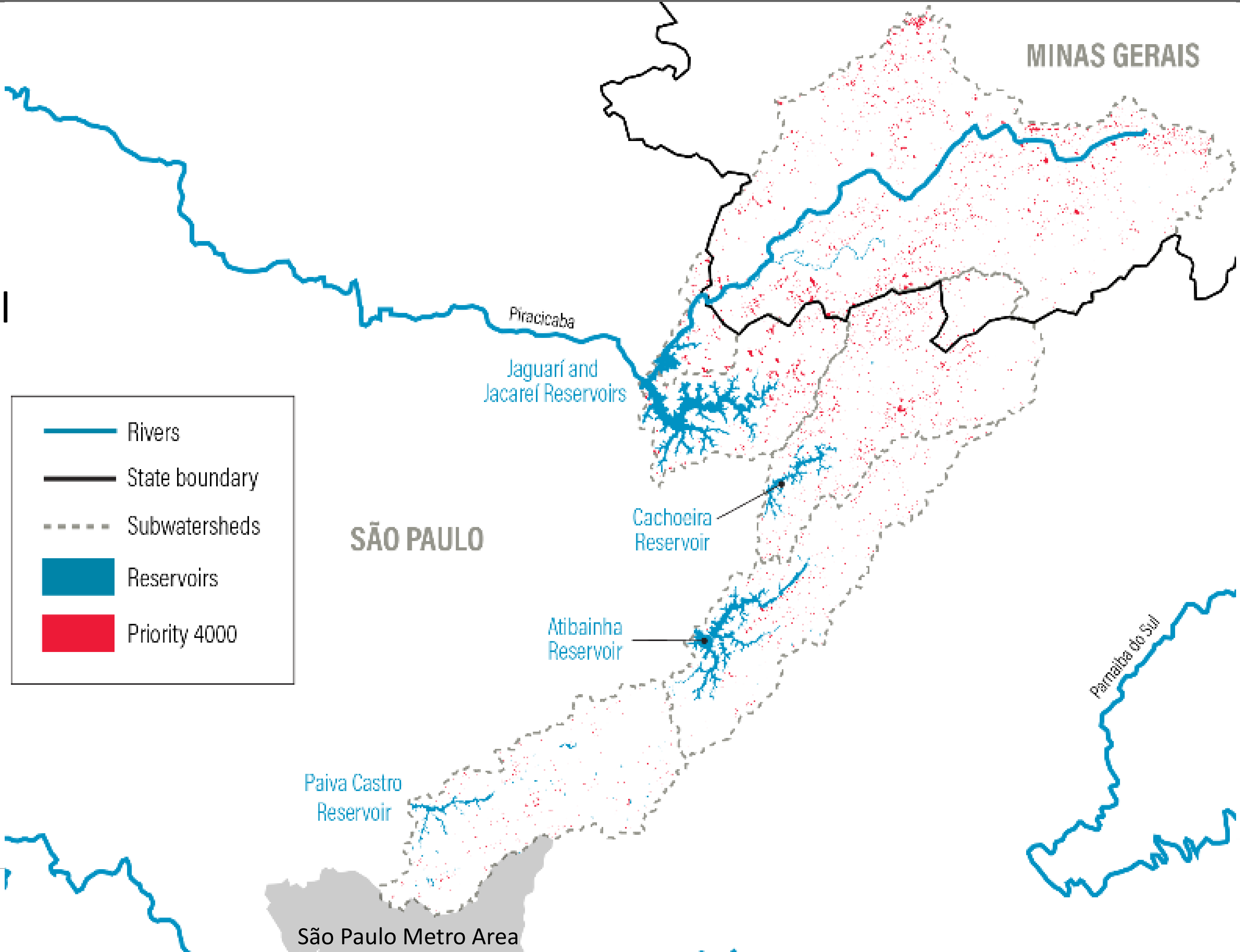
PHOTO: ITIRAPINA ECOLOGICAL STATION (DHEMERSON CONICIANI/ WIKIMEDIA)

GGA STEP 2: SPECIFY PRIORITY AREAS

Used the InVEST model

Convert pasture to forest

4,000 ha for sediment control



Source: Ozment et al. 2018

GGA STEP 3: ESTIMATE OUTCOMES ON SEDIMENT AND TURBIDITY

BIOPHYSICAL OUTPUT	BASELINE SCENARIO	R4000	CHANGE
Sediment yield (total tons input to the system over 30 years)	6,797,561	4,382,372	**-36%**
Turbidity level (NTU) in year 30	7.9	4.0	**-48%**

Source: Ozment et al. 2018

GGA STEP 4: COST OF GREEN INFRASTRUCTURE

	Assisted Restoration	Natural Regeneration	R4000
	(USD/ha)	(USD/ha)	(USD 1,000)
TOTAL COSTS (current values)	**13,273**	**9,469**	**37,603**
Investments in Assisted Restoration	*3,351*	*-*	*10,082*
Investments in Natural Regeneration	*-*	*1,110*	*1,010*
Opportunity cost of land	*6,194*	*6,194*	*13,751*
Operations & Maintenance Costs AR	*2,156*	*-*	*6,487*
Operations & Maintenance NR	*-*	*823*	*816*
Transaction Costs	*1,572*	*1,342*	*5,368*

Source: Ozment et al. 2018

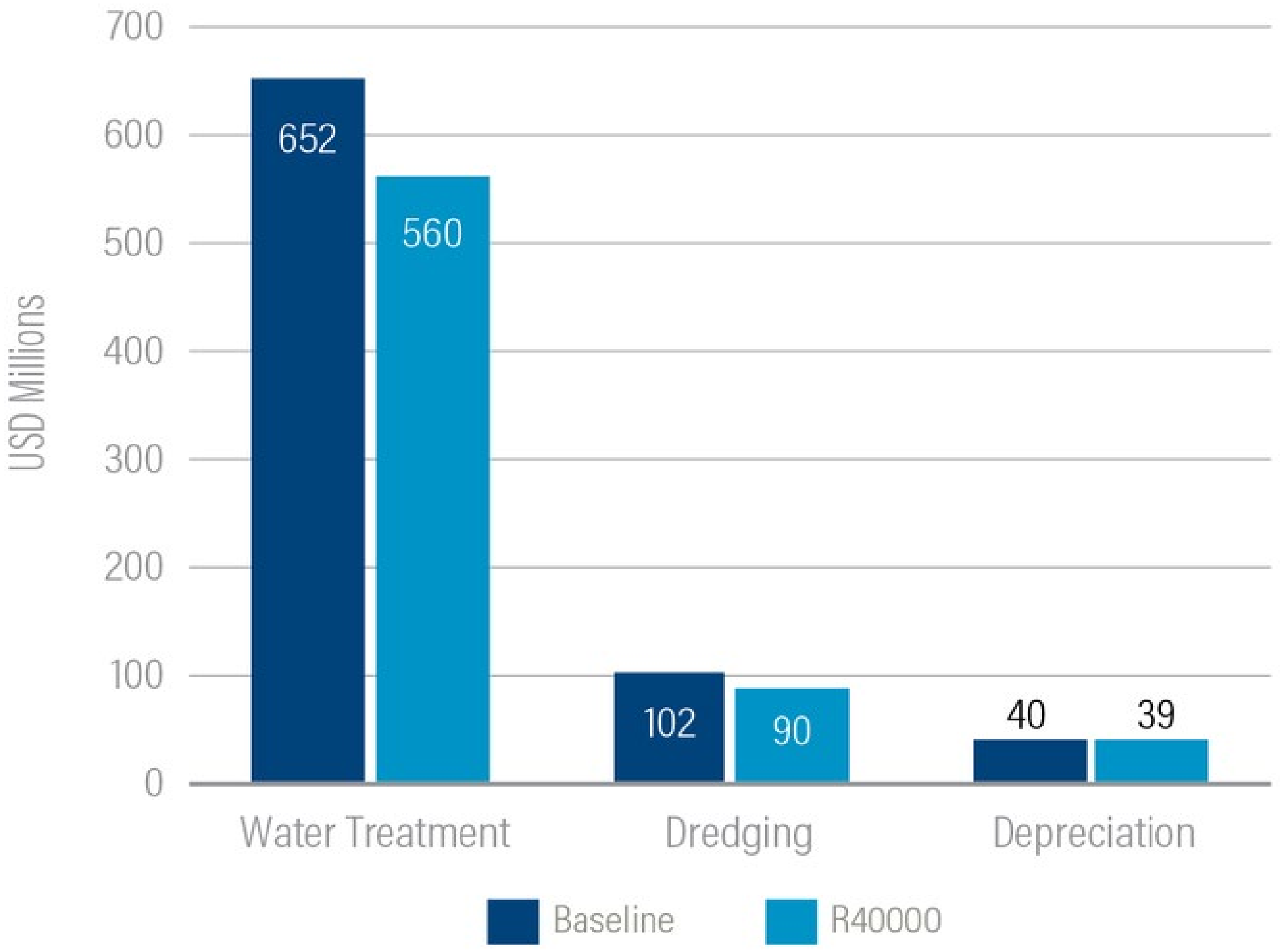
GGA STEP 4: COST SAVINGS BREAKDOWN

Costs related to sediment pollution:

Turbidity treatment
- Workforce
- Energy
- Chemical products
- Sludge removal
- Anthracite replacement
- Sand replacement

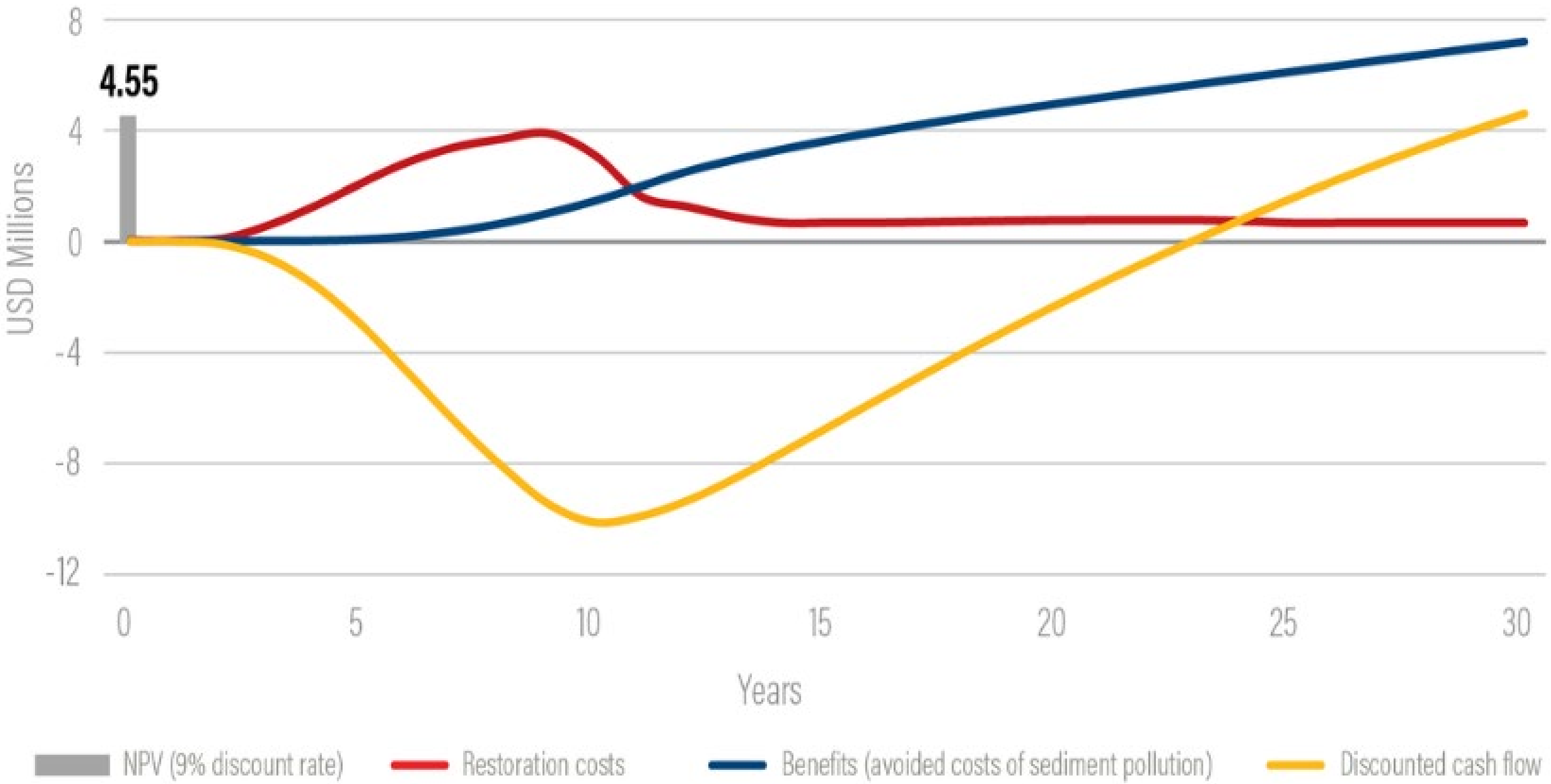
Dredging
- Machinery
- Disposal
- Workforce

Wear and tear / depreciation



Source: Ozment et al. 2018

GGA STEP 5: SUMMARY OF RESULTS



Investment in Reforestation:
US$37M

Reduction in erosion:
36%

Avoided costs of sediment management:
US$106M

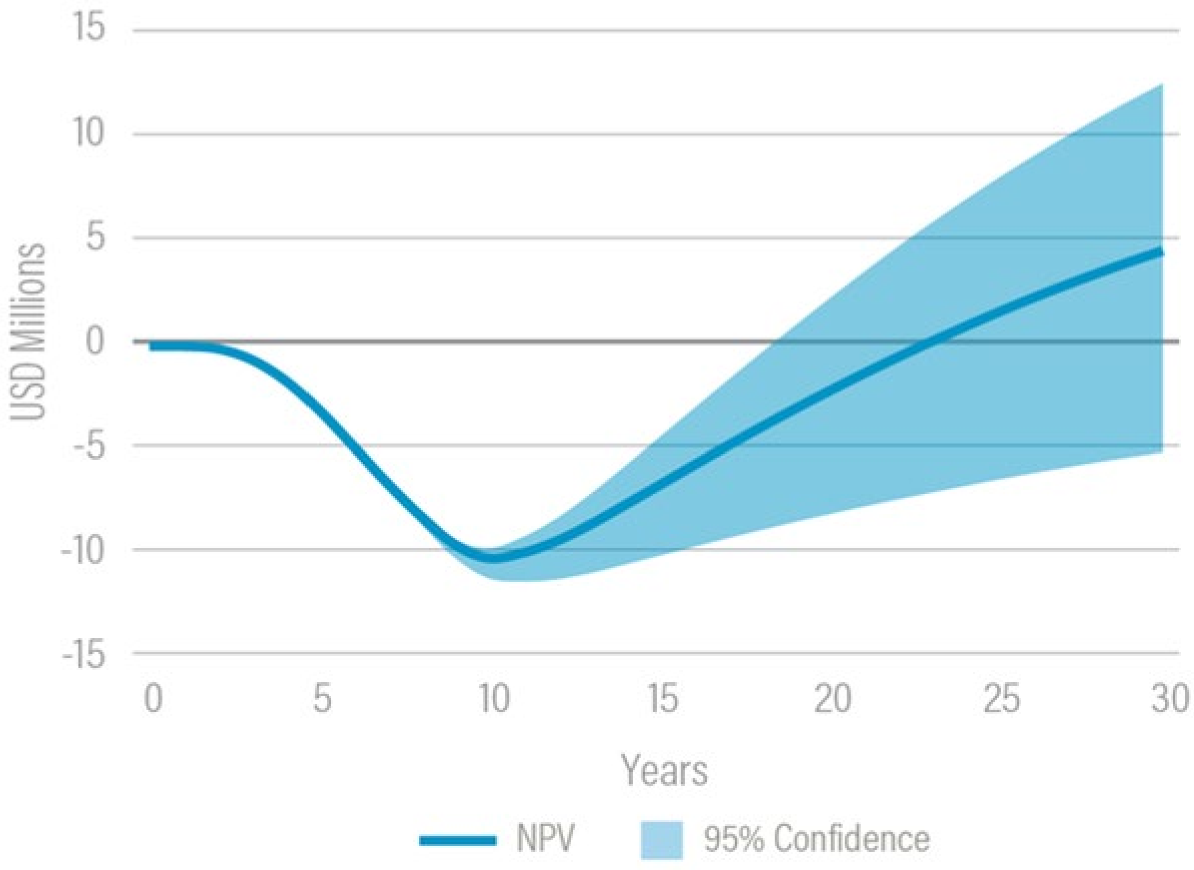
NPV: US$ 4.6M

ROI: 28%

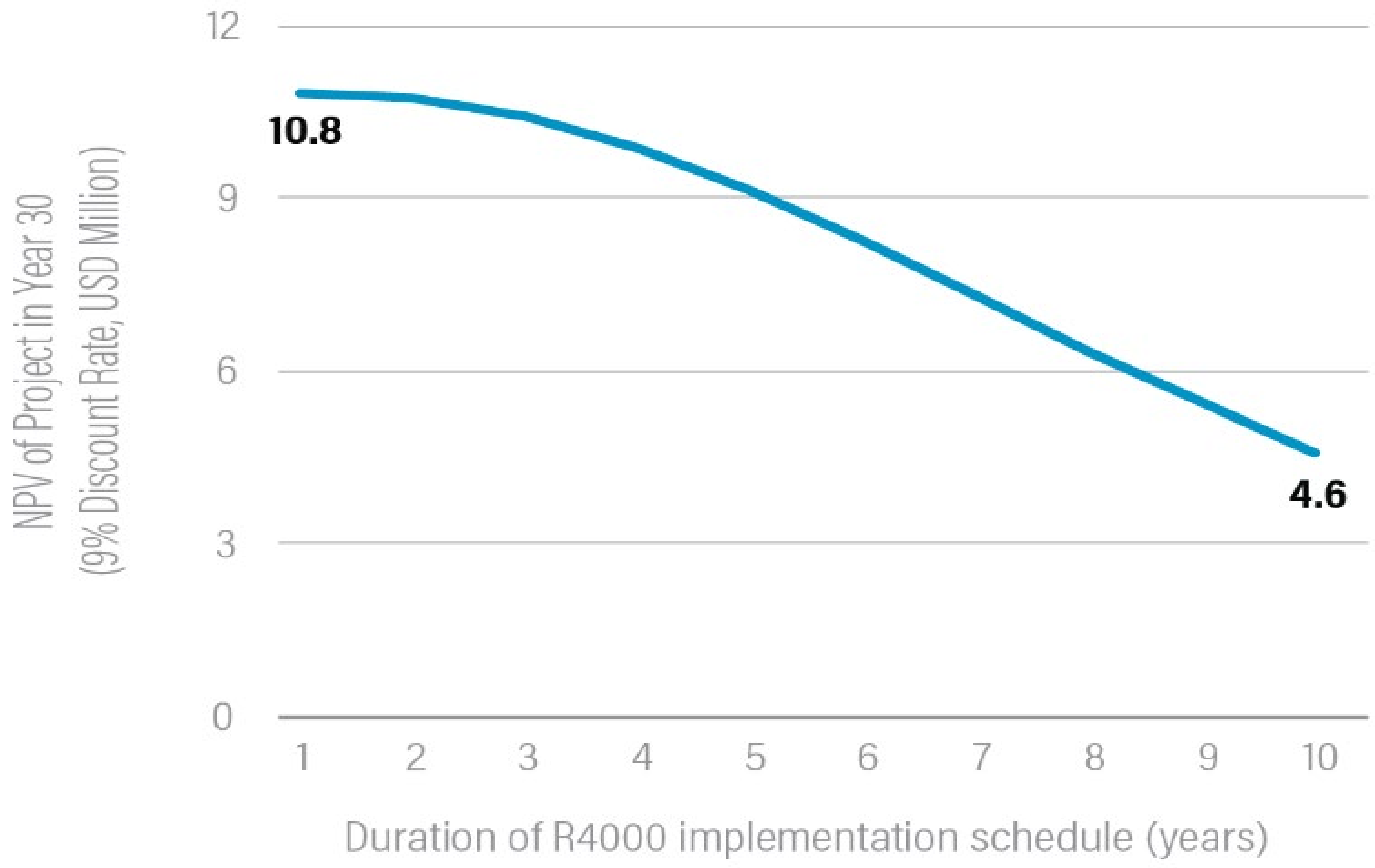
Source: Ozment et al. 2018

GGA STEP 6: SENSITIVITY ANALYSIS

NPV of R4000, Considering Ranges of Uncertainty for Sediment Retention



PROGRAM DESIGN IMPACTS FINANCIAL PERFORMANCE



Implementing the project 2x as fast could double the NPV, and ensure a positive NPV even if sediment retention is weaker than expected

Source: Ozment et al. 2018

NATURAL INFRASTRUCTURE AND WATER AVAILABILITY

PHOTO: UNTITLED/WIKIMEDIA

NATURAL INFRASTRUCTURE'S IMPACT ON WATER AVAILABILITY

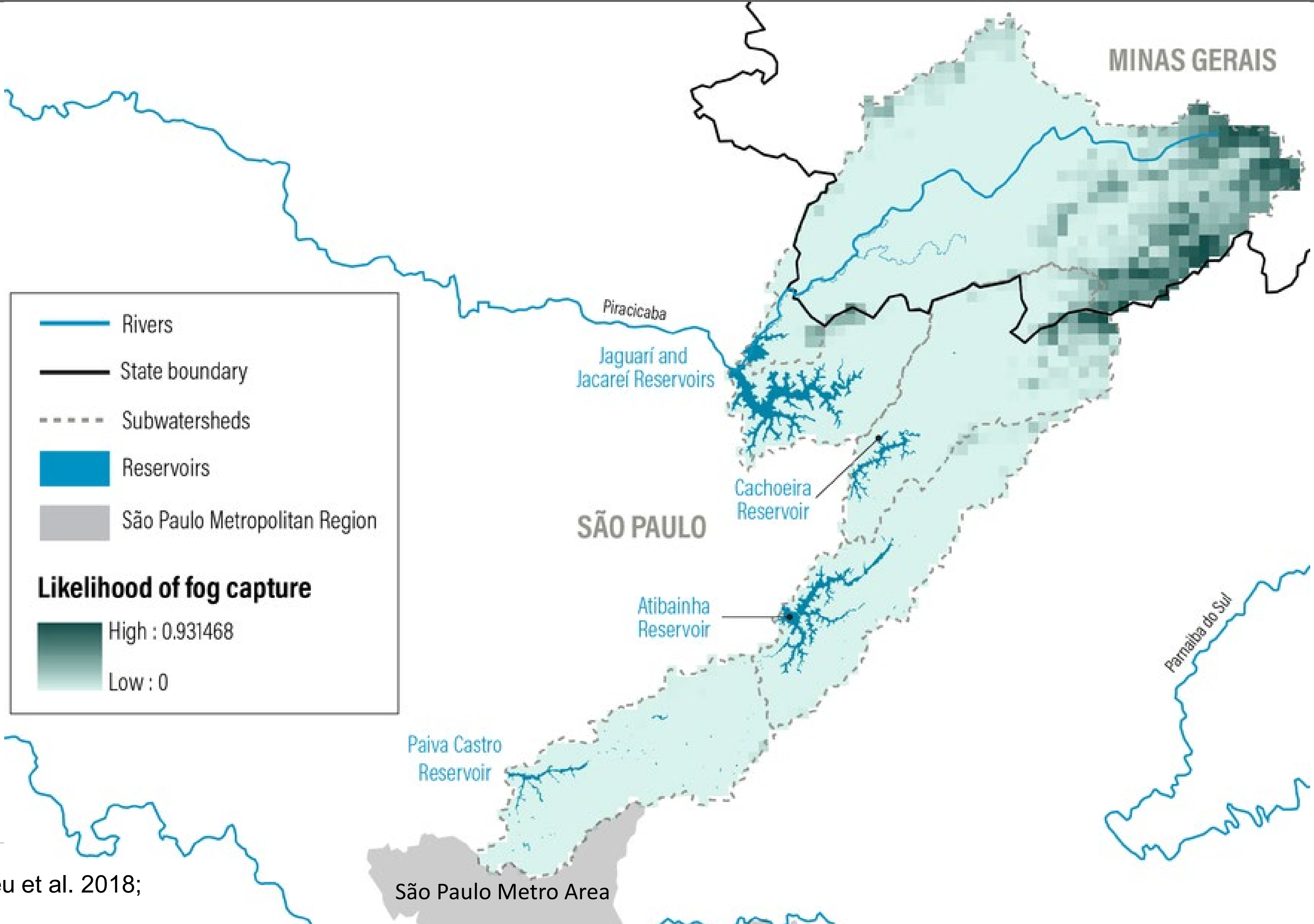
Context

- Water managers believe more trees = less water
- Global literature on this topic is inconclusive
- 40% of studies show more forest increased dry season flows
- Cloud forests = fog capture!

Our study

- **1 Model:** Dynamic Water Balance Model
- **2 hyrodolgical parameters:**
  - Baseflow
  - Total Flow
- **4 scenarios:**
  1. Baseline,
  2. 100% pasture
  3. 100% Forest
  4. R4000

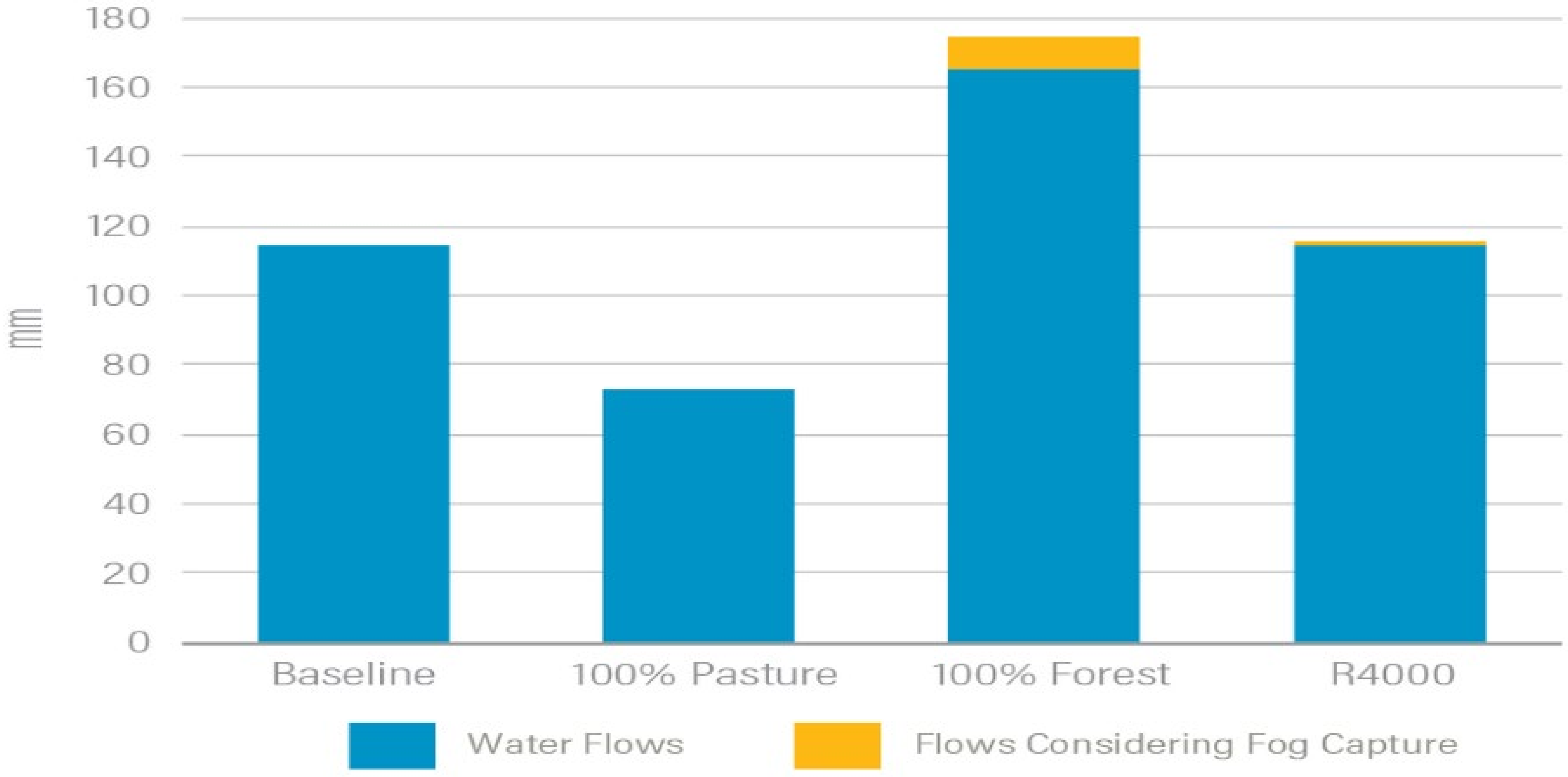
CLOUD FOREST IN THE CANTAREIRA



Source: Pompeu et al. 2018;

LAND USE IMPACT ON WATER AVAILABILITY

Impact on Dry Season Flows



Source: Ozment et al. 2018

ROADMAP TO PREPARE FOR INVESTMENT

1. **Refine water fund strategy to maximize ROI**
2. **Ensure sufficient payment/incentives to landowners**
3. **Develop a broader watershed plan (e.g. flood control, water flows, other services)**
4. **Develop blended finance model and engage multiple beneficiaries**

PHOTO: REPRESA ATIBAINHA (FABRICIO MACEDO/ WIKIMEDIA)

THANK YOU!

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Coming up, more Green Gray Assessments:

- *Natural Infrastructure in **Rio de Janeiro**'s Guandu Basin*
- *Natural Infrastructure Aquifer Recharge Calculator (for **Monterrey, MX**)*
- *Natural Infrastructure in **Espirito Santo**'s Jucu Basin*

And Guidance:

- *Green-Gray Assessment: How to Assess Costs and Benefits of Green Infrastructure for Water*
- *Integrating Green and Gray: Creating Next Generation Infrastructure* (with the World Bank)

PHOTO: ERIK LOPES/ TNC