AN EVALUATION OF CUBA'S WATER AND WASTEWATER INFRASTRUCTURE

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FIU Cuban Research Institute

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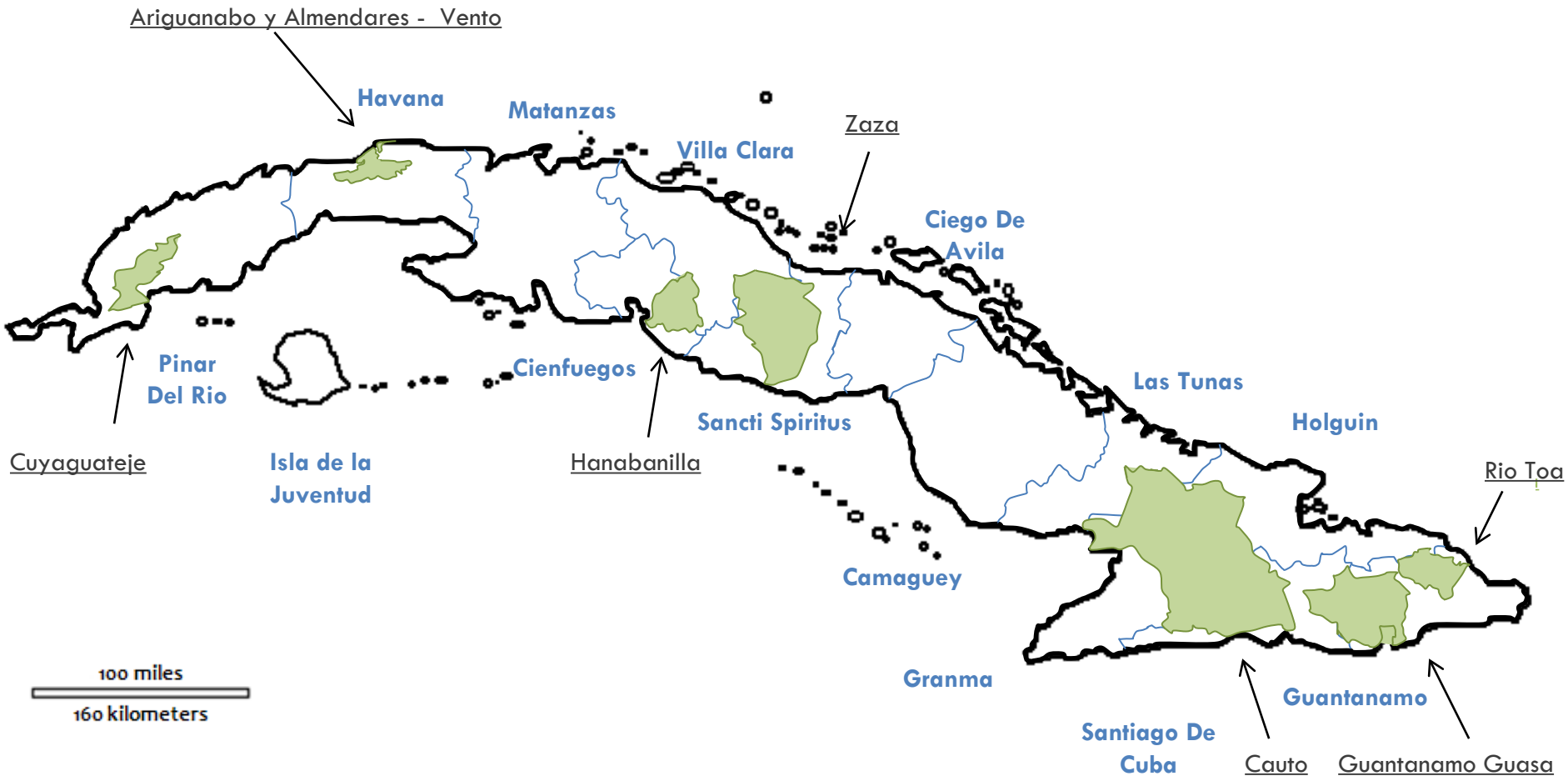
OVERVIEW

- Water
  - Sources
  - Current Infrastructure
  - Demand vs. Capacity
  - Improvements & Costs
- Wastewater
  - Overview
  - Current Infrastructure
  - Demand vs. Capacity
  - Improvements & Costs
- Conclusions

WATER SOURCES

- Surface Water
  - Accounts for 65% of Cuba's Available Water Supply
  - 8 Priority Watersheds
    - Serve 40% of Population
    - Cuyaguateje, Ariguanabo, Almendares-Vento, Hanabanilla, Zaza, Cauto, Guantanamo-Guasa and Toa
- Ground Water
  - 35% of Cuba's Available Water Supply
  - Specific Regions where Ground Water Predominates:
    - La Habana, Matanzas, Ciego de Avila, and Camaguey

PRIORITY WATERSHEDS

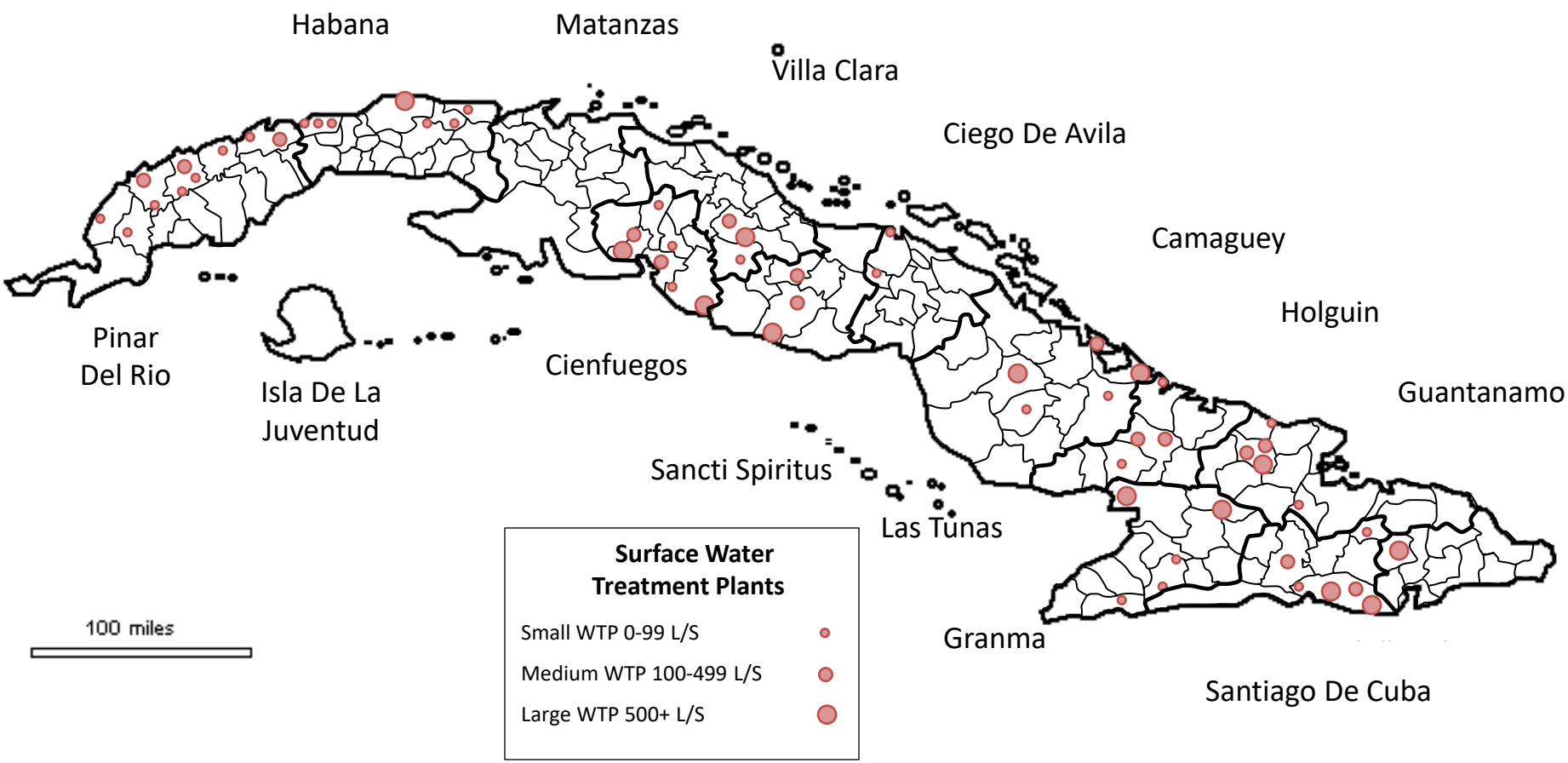


Source : (Perez et al. 2009)

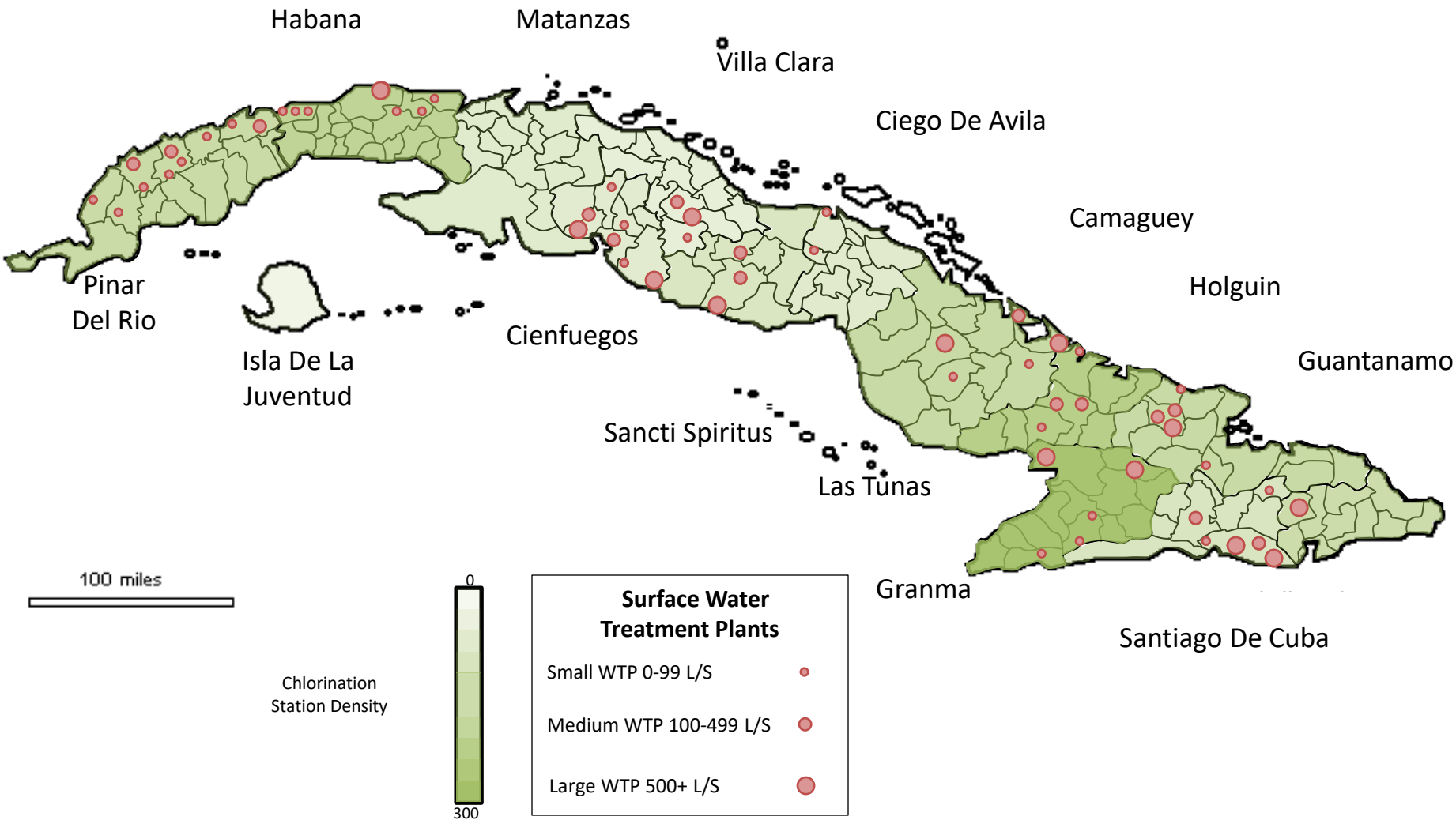
WATER TREATMENT INFRASTRUCTURE

- Surface Water
  - 59 Surface Water Treatment Plants
    - Shortage of Chemicals and Chemical Dosing Equipment
    - Poor Equipment Reliability (pumps, instrumentation, etc.)
    - Quantity and Quality of Filter Media
- Ground Water
  - 2,000 Ground Water Chlorination Stations
    - Primary Disinfectant: Chlorine Gas
    - Current Challenges
      - Shortage of Chlorine

WATER TREATMENT PLANT ATLAS



CHLORINATION STATION DENSITY



WATER TREATMENT DEMAND & CAPACITY

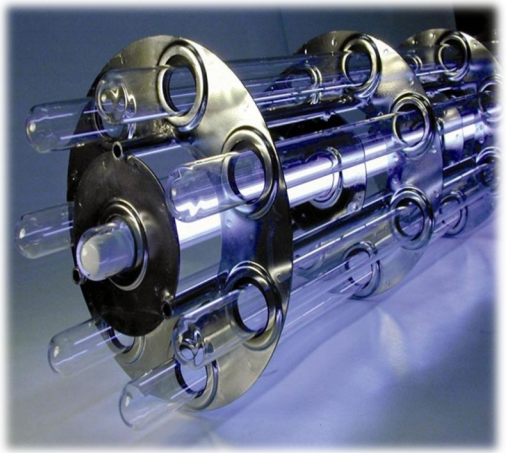
- Demand
  - Population: 11.25 Million
  - Overall Demand: 1.77 m^3/person/day
    - Demand Breakdown:
      - 12% Industrial
      - 19% Domestic: *0.34 m^3/day/capita*
      - 69% Agricultural
- Capacity
  - Overall Treatment Capacity: *0.36 m^3/person/day*
    - Capacity Breakdown by Source:
      - Surface Water: (28%)
      - Ground Water: (72%)

WATER DISTRIBUTION

- Overview of System
  - 19,000 km of Pipe Network
  - 2,375 Pump Stations
- Current Challenges
  - Deteriorated Piping
  - Unreliable Pump Stations
- Result:
  - **Available Potable Water is Not Equal to Potable Water Demand**

HIGH PRIORITY IMPROVEMENTS

- Water Distribution System
  - Repair Piping
- Pump Stations
  - Rehabilitate & Upgrade Pump Stations
    - Ensure conveyance of potable water throughout system
- Disinfection
  - Increase Chlorine Production
    - Disinfection of the water supply.



COST ESTIMATE FOR DRINKING WATER SERVICE (CONTINUED)

- Overall Cost of Water System Improvements

Upgrade of Existing Potable Water Pump Stations (Million USD)	$1,100
Repair of Distribution System (Million USD)	$2,400
Sodium Hypochlorite Generation (Million USD)	$20
Total	**$3,520**

WASTEWATER TREATMENT
OVERVIEW

- Sanitary Coverage estimated at 94% (PAHO 2000)
  - 38% Connections to Wastewater Collection Systems
  - 56% In-Situ Wastewater Systems
  - 6% Without Service
- In 2007, estimated 4% of wastewater collected was treated (Belt and Velazquez, 2007)
- Stabilization Lagoons used predominantly for industrial wastewater.

WASTEWATER TREATMENT PLANTS
EXISTING PLANTS

- **11** Existing Wastewater Treatment Plants
  - Within the City of La Habana
    - **3** WWTPs
  - Outside of the City of La Habana
    - **8** Plants mostly in Tourist Areas
      - Varadero, Villa Clara, Cayo Coco
- Only **3** are suspected to be currently operational
  - Maria del Carmen
  - Quibu
  - Solar Aquatic System

WASTEWATER TREATMENT PLANTS
NEW PLANTS

- **6** Future Wastewater Treatment Plants
  - Within the City of Havana
    - 2 Plants on Almendares River Basin
    - 4 Plants by Habana Bay (Luyano & Martin Perez Rivers)
- **3** have begun construction but are delayed
  - El Pitirre (Cotorro)
  - Lower Luyano
  - Upper Luyano
- **3** are in the planning stage

WASTEWATER TREATMENT PLANTS
WITHIN CITY OF LA HABANA

WASTEWATER TREATMENT PLANTS
OUTSIDE CITY OF LA HABANA

Quibu WWTP

Bejucal WWTP

Holguin WWTP

WASTEWATER TREATMENT
DEMAND & CAPACITY

- Demand
  - Population: 11.25 Million
  - Overall Demand: 3.02 mil m^3/d, or 0.27 m^3/person/day
  - Demand Breakdown:
    - Urban 76% (2.30 mil m^3/day)
    - Rural 24% (0.72 mil m^3/day)
- Capacity
  - Only 2 large plants are operational and at 1/3 capacity:
    - **21,600 m^3/day (<1% of existing wastewater flows)**
  - If all existing treatment plants were operational:
    - **107,900 m^3/day**
  - After completion of two plants on Luyano:
    - **246,140 m^3/day**
  - If all delayed and plants in planning were completed:
    - **~400,000 m^3/day (<15% of existing wastewater flows)**

WASTEWATER TREATMENT
HIGH PRIORITY IMPROVEMENTS

- Rehabilitation of existing wastewater infrastructure:
  - Collection System (Sewers)
  - Pump Stations
  - Wastewater Treatment Plants
- Priority should be given to protection of source water quality to ensure public health
- Emphasis on highly populated areas (cities with population > 100,000)

WASTEWATER COST ESTIMATES
OVERALL

Overall Cost of Wastewater Infrastructure Improvements

Wastewater Collection System Improvements (Million USD)	$1200
Wastewater Treatment Plant Improvements (Million USD)	$550
Wastewater Pump Station Improvements (Million USD)	$450
Total (Million USD)	**$2,200**

OVERALL COST OF IMPROVEMENTS

Water Infrastructure Improvements (Billion USD)	$3.52
Wastewater Infrastructure Improvements (Billion USD)	$2.20
TOTAL (Billion USD)	**$5.72**

CONCLUSION

- Current condition of Cuba's water and wastewater system warrants extensive improvements to both systems.
- Final Recommendations:
  - Improvement of Water Distribution System
  - Nationwide On-Site Sodium Hypochlorite Generation
  - Rehabilitation of Existing Wastewater Infrastructure
  - Construction of Priority New Wastewater Infrastructure to meet demand/protect human health.

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