Towards Sustainable Urban Drainage Systems Planning - Experiences from Bogotá (Colombia)

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INTRODUCTION

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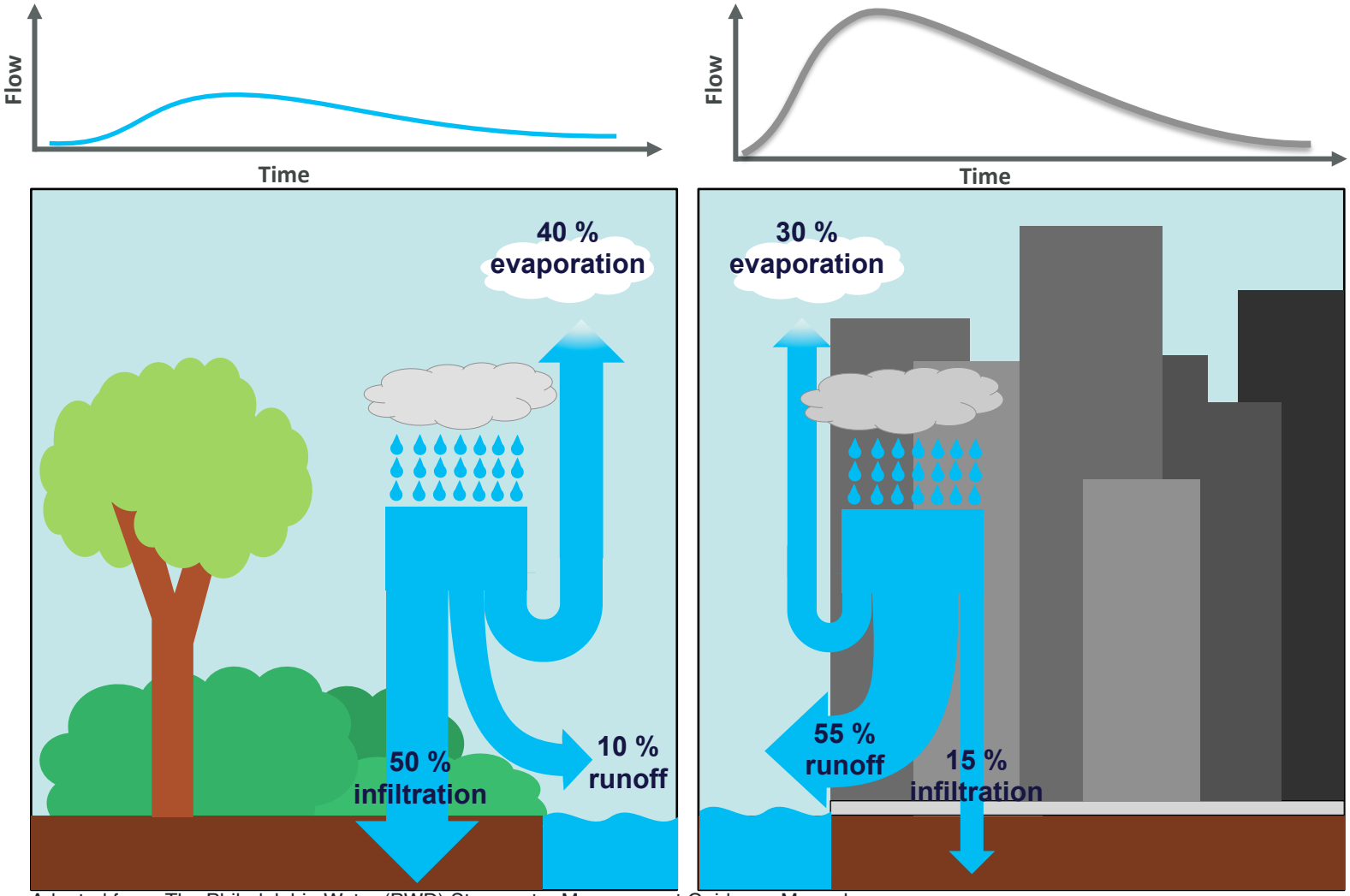
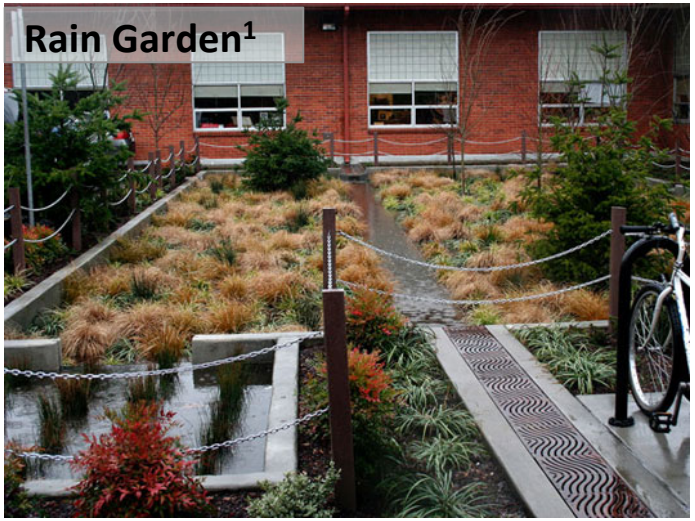


Adapted from: The Philadelphia Water (PWD) Stormwater Management Guidance Manual

Reduction of the pervious natural soils.
Increase of runoff generated.

SUSTAINABLE URBAN DRAINAGE SYSTEMS

Rain Garden[1]

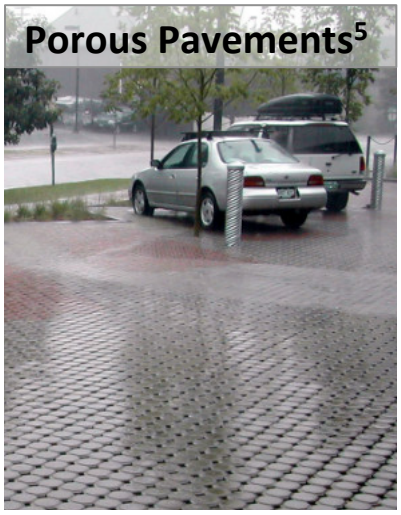


Tree pit[2]

Grassed Swale[3]

Infiltration Trench[4]

Porous Pavements[5]



Dry Detention Basin[6]

[1]The Mount Tabor Middle School, Portland, EE.UU; [2] The North Scituate village, Rhode Island, EE.UU; [3]Blanco River watershed, Texas, EE.UU; [4]Montgomery County, Maryland, EE.UU; [5]Scandinavia VTT Technical Research Centre, Finland; [6]Lamb Drove, Cambourne, UK

SUSTAINABLE URBAN DRAINAGE SYSTEMS?

SUSTAINABLE URBAN DRAINAGE SYSTEMS

Planning → Design → Implementation

CHALLENGES

- Institutional
- Technical
- Financial

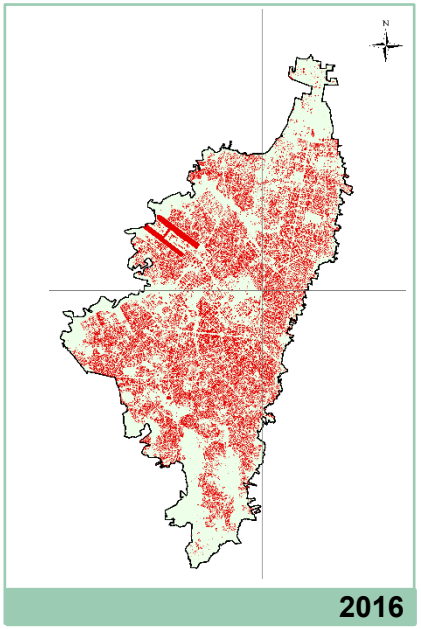
METHODOLOGY

Citywide	Step 1	Definition of objectives, planning framework and local normative
	Step 2	Conduct spatial analyses to identify candidate sub-catchments
Local	Step 3	Identify candidate SUDS areas, feasibility and potential restrictions
Micro	Step 4	Selection of SUDS typologies proposed for a candidate area
	Step 5	Generate initial designs by pre-sizing SCMs
	Step 6	Optimization of proposed alternatives
	Step 7	Construction and monitoring

acueducto
AGUA, ALCANTARILLADO Y ASEO DE BOGOTÁ

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
SECRETARÍA DISTRITAL DE AMBIENTE

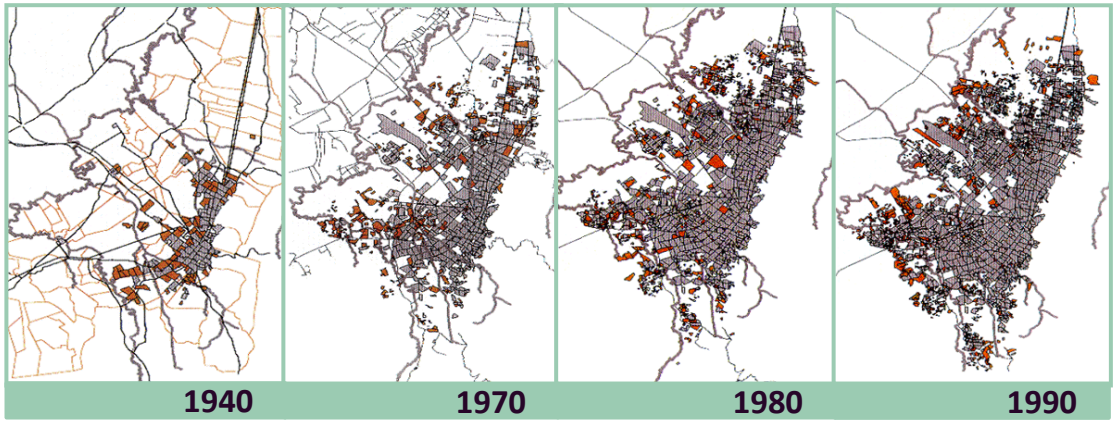
CASE STUDY: BOGOTÁ



7’800,000 hab

400 Km^2

260 hab/ha

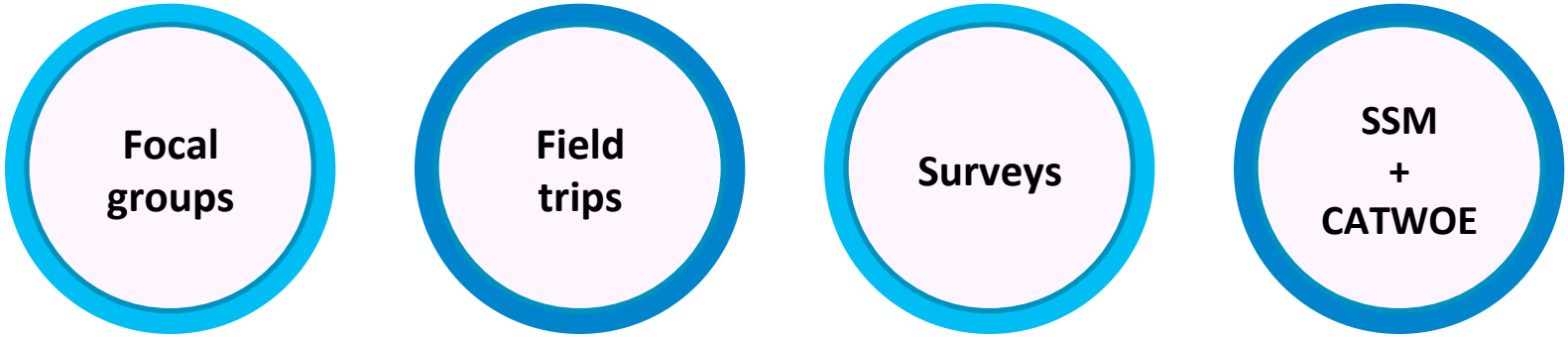


(Instituto de estudios urbanos, s.f.)

STEP 1: DEFINITION OF OBJECTIVES

Workshops and meetings

Water and sewer utility	**EAB**
The city environmental agency	**SDA**
The city urban planning and development agency	**IDU**
Risk management agency for climate change	**IDIGER**
Researchers from public and private universities	**PUJ/UNAL**

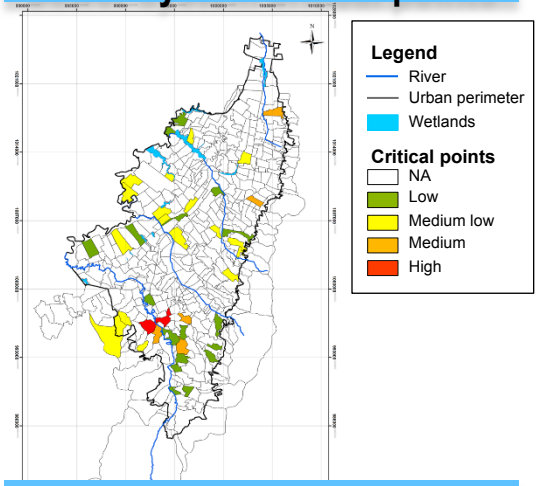


Objectives

- Runoff control
- Minimize degradation of receiving water bodies

STEP 2: RUNOFF CONTROL ANALYSIS

Sewer system critical points

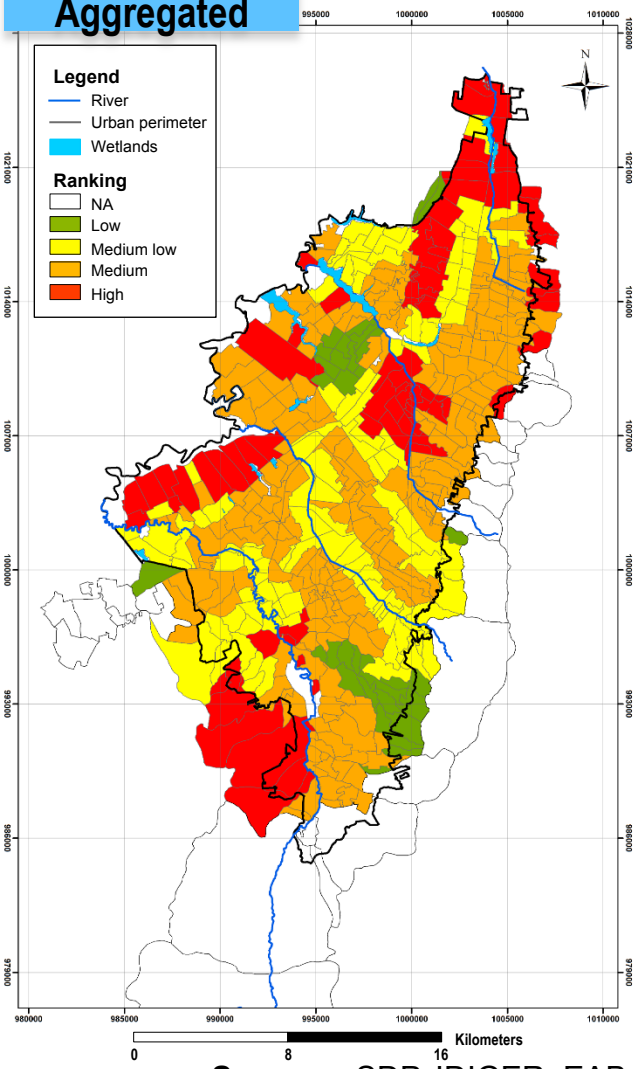


River flood areas

Drainage system capacity

Ponding areas

Aggregated



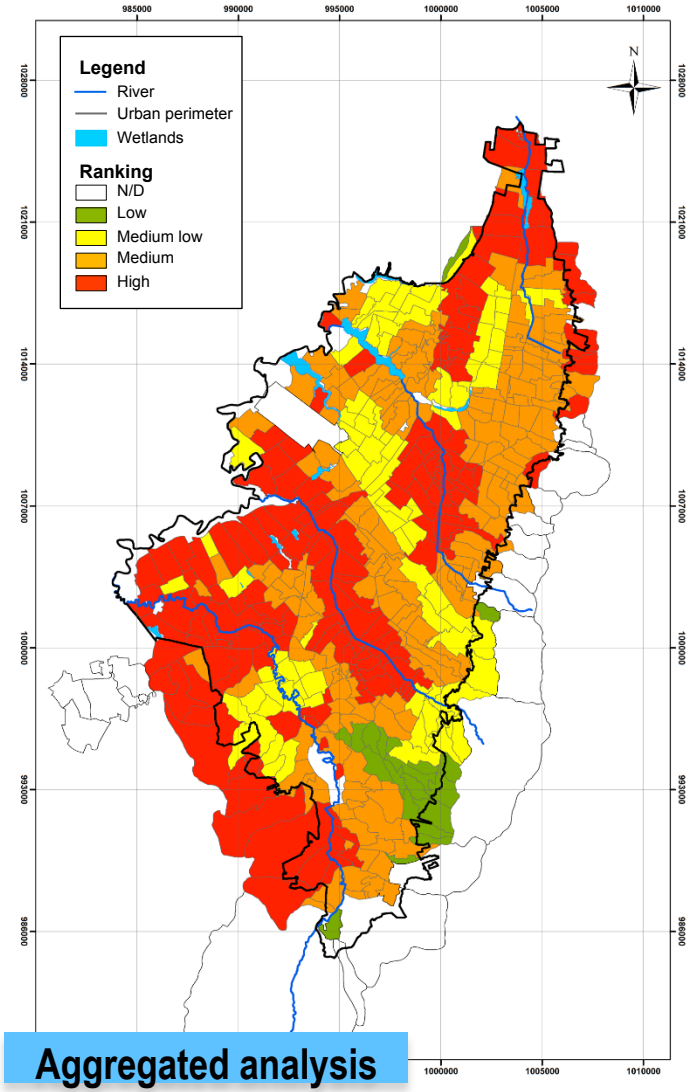
Sources: SDP, IDIGER, EAB

STEP 2: WATER QUALITY ANALYSIS

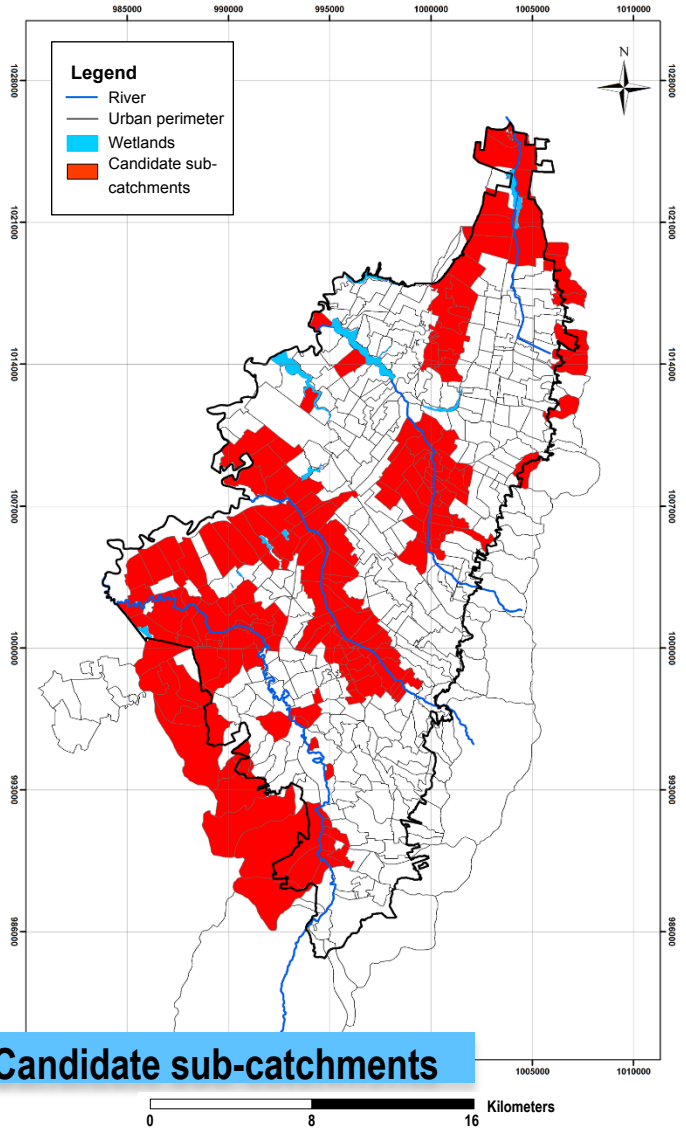
Rivers + **Wetlands** = **Aggregated**

Sources: Universidad de los Andes, SDA, EAB.

STEP 2: CANDIDATE SUB-CATCHMENTS



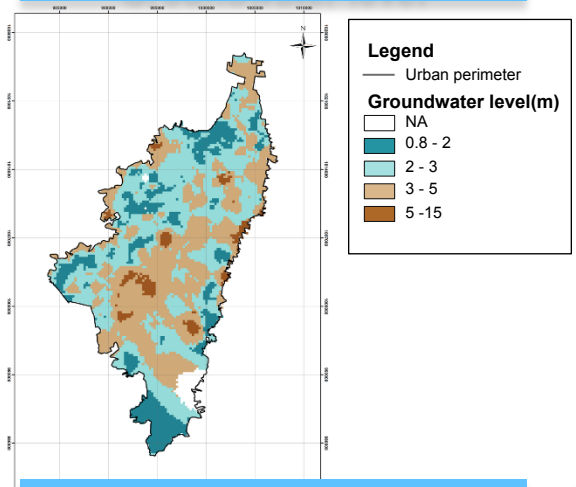
Aggregated analysis



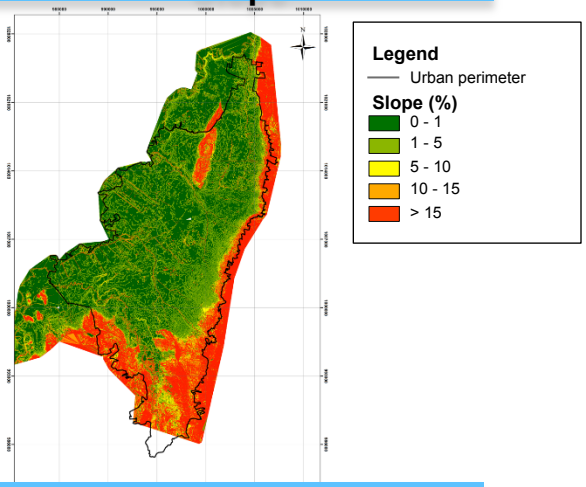
Candidate sub-catchments

STEP 3: CANDIDATE AREAS

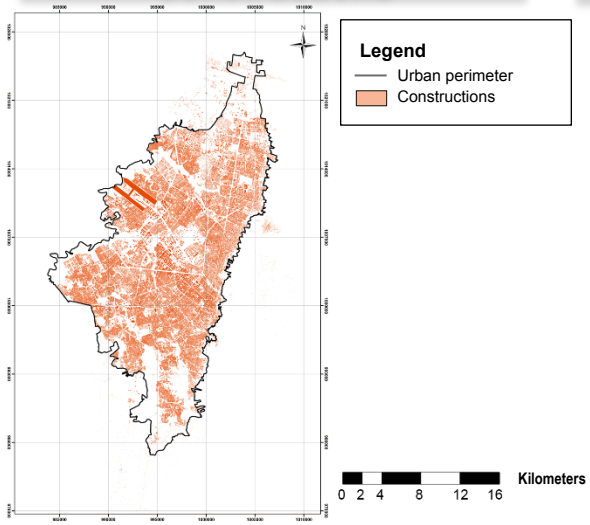
Groundwater level



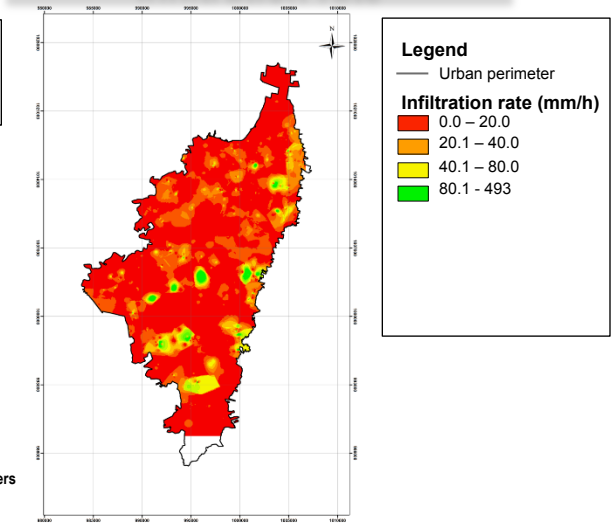
Slope



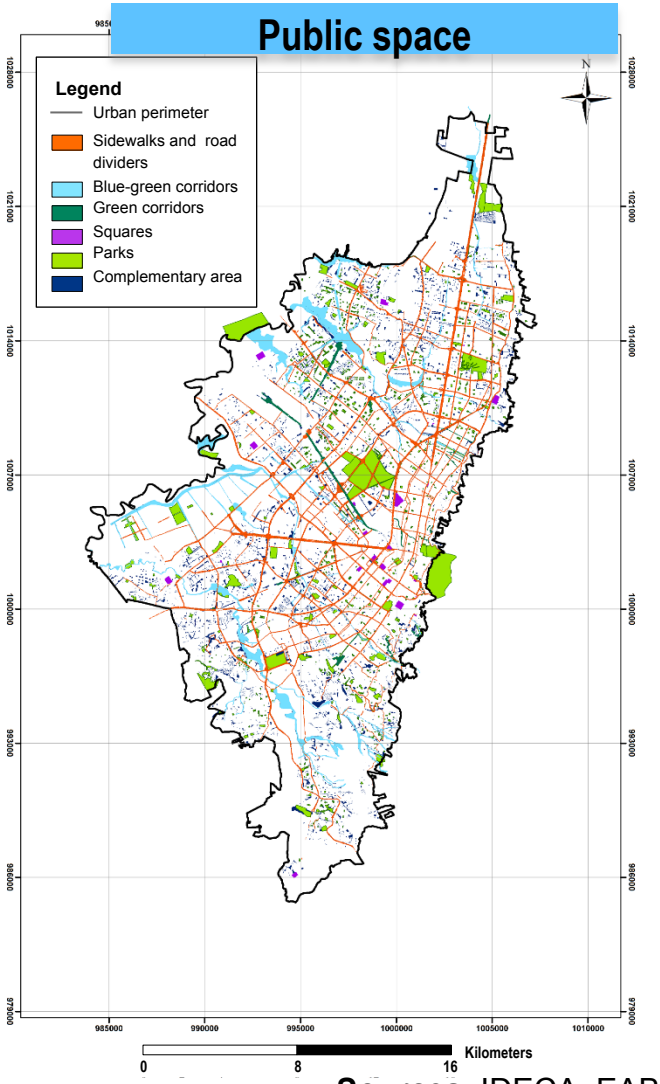
Constructions



Infiltration rate

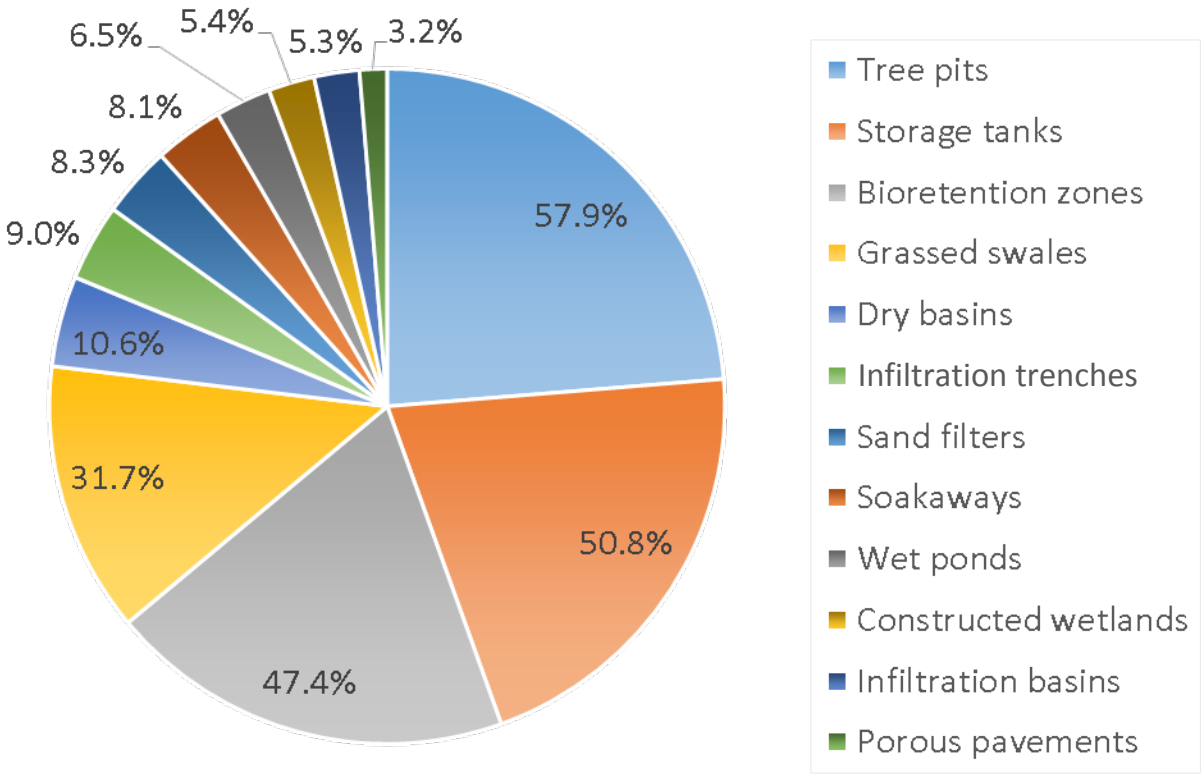


Public space



Sources: IDECA, EAB

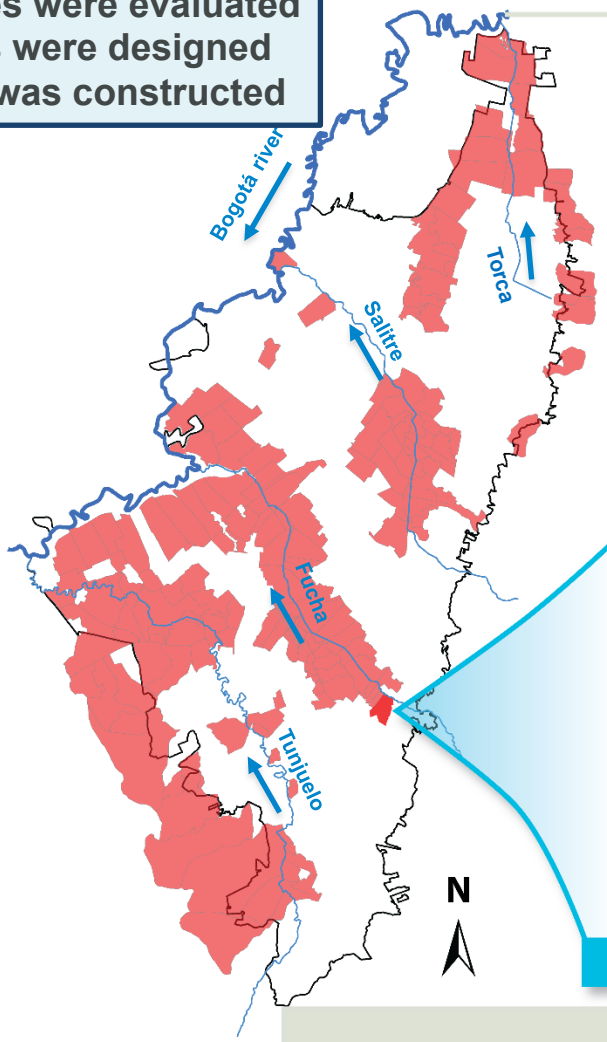
STEP 3: CANDIDATE AREAS - RANKING



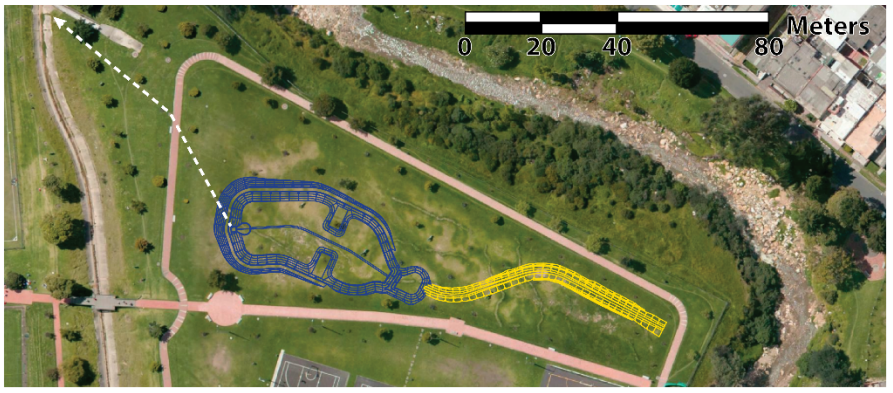
Percentage of areas for SUDS implementation

STEP 4: SELECTION OF CANDIDATE AREA

20 sites were evaluated
2 sites were designed
1 site was constructed



Microscale



SUDS Typologies

- Bioretention zone
- Infiltration trench
- Permeable pavement
- Swale
- Detention basin
- Tree pits
- Storage tank

Local scale

Citywide (Bogotá, Colombia)

Priority areas | Rivers | Bogotá river | Urban perimeter

STEP 4: SELECTION OF SUDS TYPOLOGIES

Ver "Tipologías SUDS"

Escoja las tipologías preseleccionadas de la siguiente lista despegable, la lista se desplegará al posicionarse en cada celda:

A	CUNETAS VERDES
B	ZONAS DE BIO-RETENCIÓN
C	ALCORQUES INUNDABLES
D	Tipología de SUDS n
E	Tipología de SUDS n
F	Tipología de SUDS n
G	Tipología de SUDS n

1 Siguiente: Asignar pesos

Volver a "Inicio"

	Procesos
A	Transporte (T)
B	Almacenamiento / Detención (A)
C	Almacenamiento / Detención (A)
D	Proceso n
E	Proceso n

Número de tipologías	
Número de tipologías	2

3 Siguiente: Asignar procesos

CRITERIOS DE SELECCIÓN	PESO
Mejoramiento de calidad de agua	20%
Control de volúmenes	20%
Amenidad y conflictos de uso	20%
Mantenimiento	20%
Costos	20%
Suma (100%)	100%

Asigne un peso para cada criterio de selección. La suma de los pesos debe ser igual a 100%.

2 Evaluar tipologías

Tabla 1. Matriz final de selección de tipologías

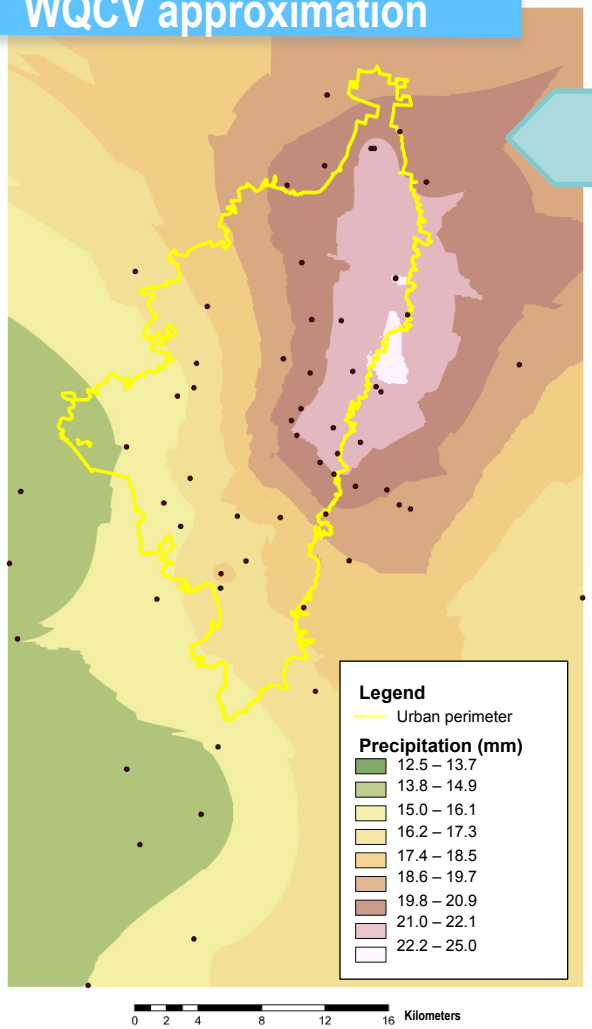
CRITERIOS DE SELECCIÓN \ TIPOLOGÍA	CUNETAS VERDES	ZONAS DE BIO-RETENCIÓN	ALCORQUES INUNDABLES				
Mejoramiento de calidad de agua	2	2	2				
Control de volúmenes	1	2	1				
Amenidad y conflictos de uso	2	2	3				
Mantenimiento							
Costos	3	2	2				
TOTAL (máximo 5 puntos)							

OPCIONES \ TIPOLOGÍAS	CUNETAS VERDES	ZONAS DE BIO-RETENCIÓN	ALCORQUES INUNDABLES					CALIFICACIÓN (máximo 5 puntos)
Opción 1	T	A						
Opción 2	T		A					
Opción 3		T	A					
Opción 4	T	I						
Opción 5	T		I					
Opción 6	T	I						
Opción 7	T		I					
Opción 8	T	A						
Opción 9	T		A					
Opción 10								
Opción 11								
Opción 12								
Opción 13								
Opción 14								
Opción 15								
Opción 16								
Opción 17								
Opción 18								
Opción 19								

4 Definir trenes

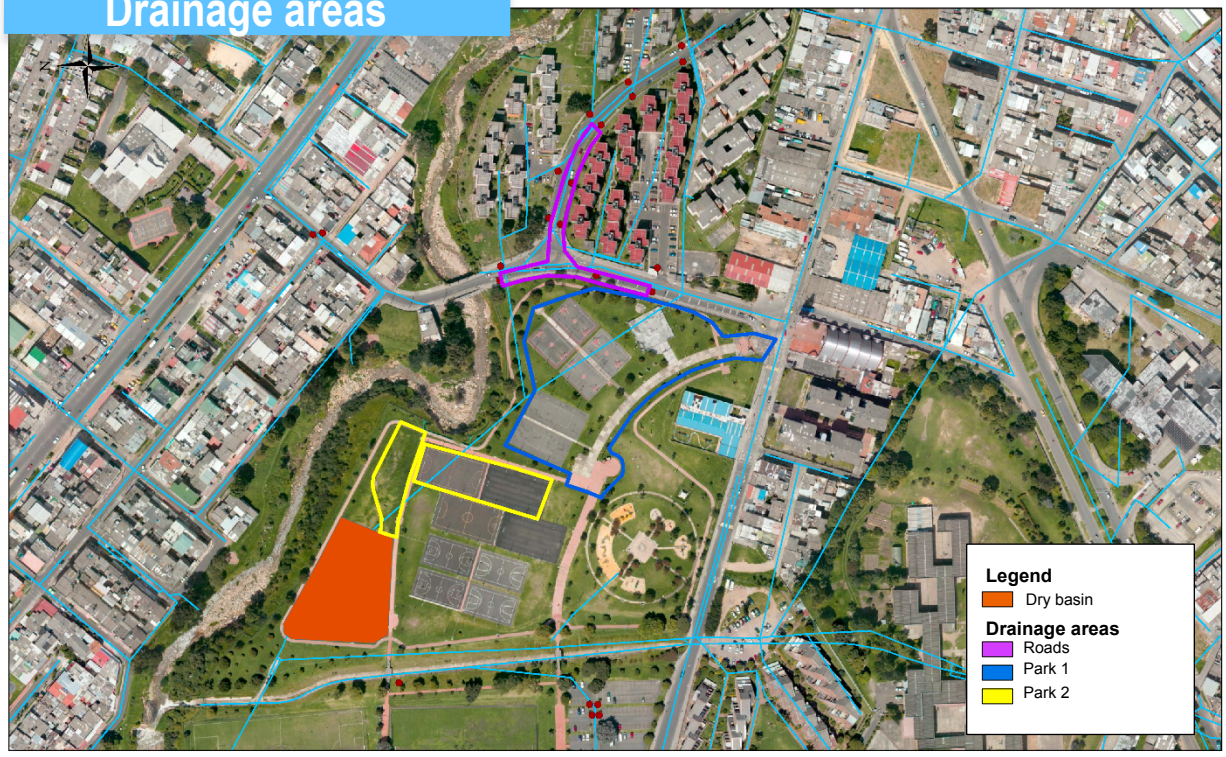
STEP 5: PRE-SIZING

WQCV approximation



Rainfall depth
Limited hourly rainfall records
Use of **daily information**

Drainage areas

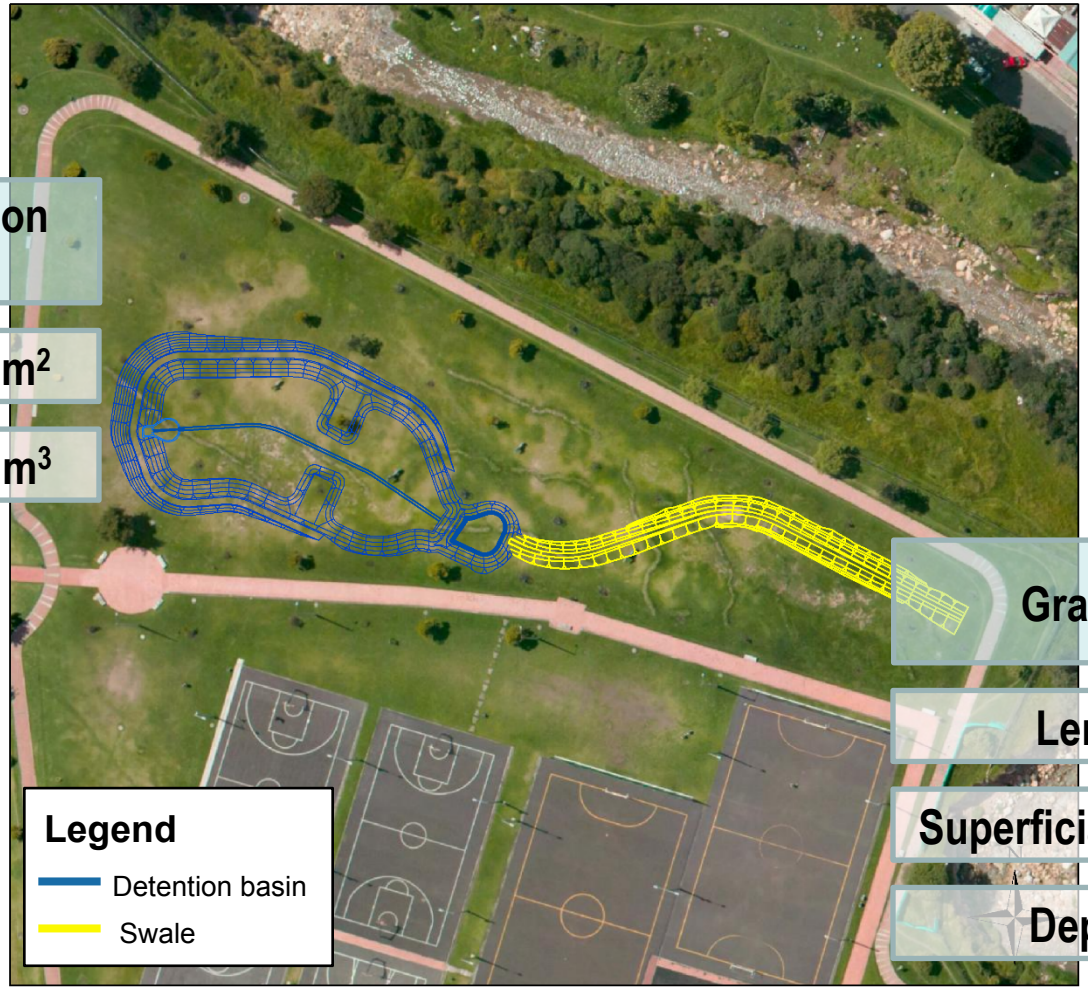


STEP 5: PRE-SIZING

Dry extended detention basin

Superficial area: 850 m^2

Storage volume: 195 m^3



Grassed swale

Length: 70 m

Superficial top width: 4 m

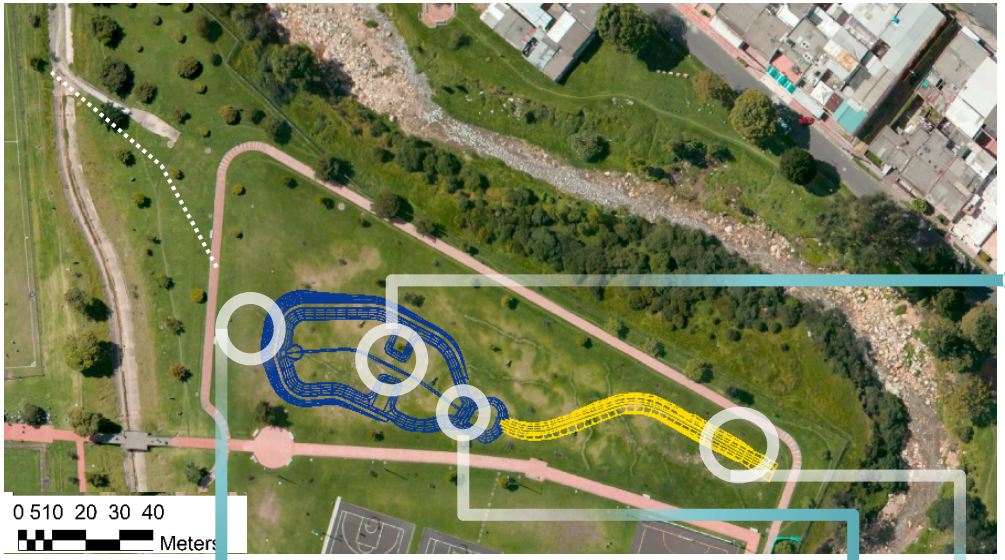
Depth: 0.45 m

STEP 6: DESIGN OPTIMIZATION

- Identification of stakeholders
- Surveys
- Social mapping
- Informative workshops

Perception of users

STEP 7: CONSTRUCTION



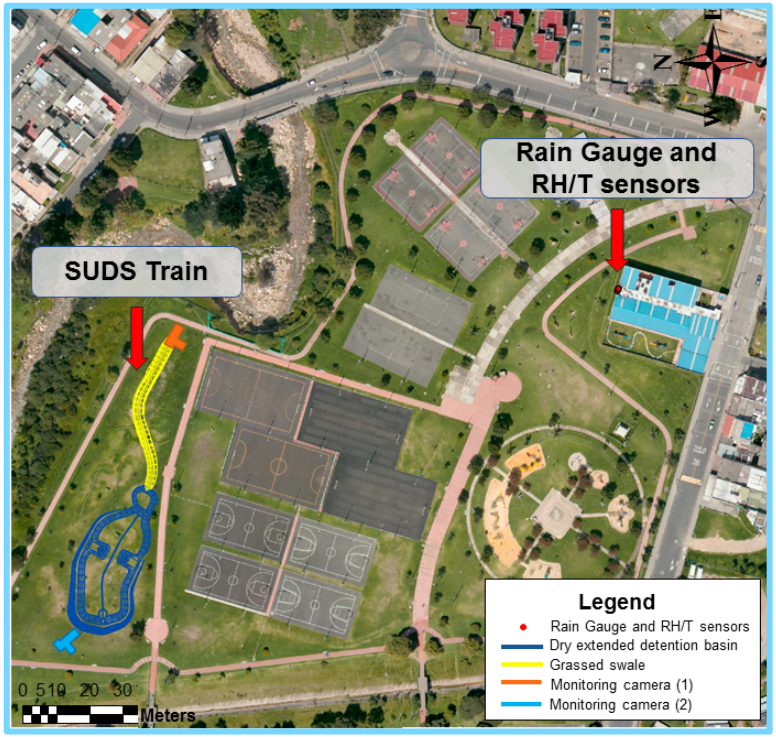
Dry extended detention basin

Monitoring camera

Forebay

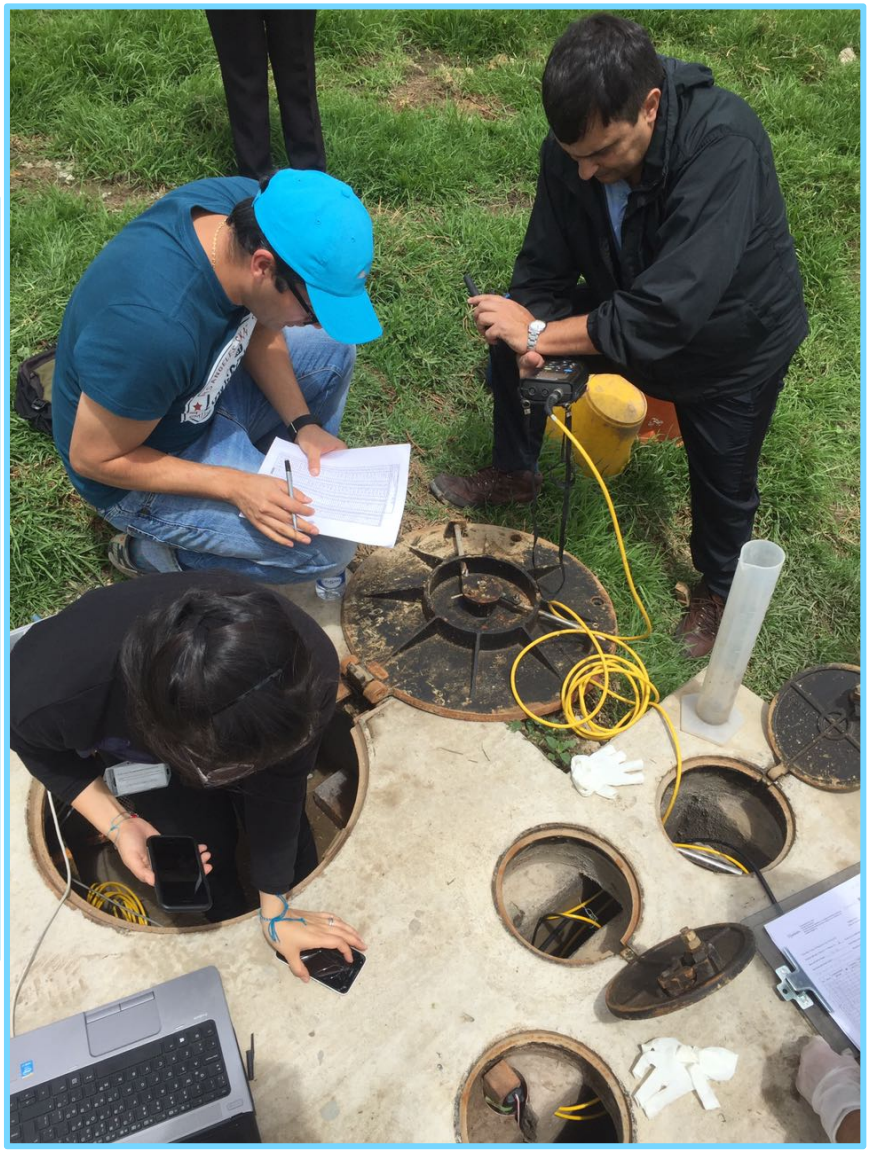
Grassed swale

STEP 7: MONITORING



On-Line	Off-Line
pH	Biochemical Oxigen Demand
Temperature	Total Suspendent Solid
Conductivity	Ammoniacal Nitrogen
Flow (level)	Nitrates
Precipitation	Total Phosphorus
Relative Humidity	Phosphates
Air Temperature	

STEP 7: MONITORING



THANK YOU

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