Green Border Cities:
Stormwater Management Alternative for Ambos Nogales

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Motivation

Approach

Vision + Objectives

Activities

Training

Research

Planning

Lessons

Next Steps

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Nogales Wash Watershed

Arizona

Sonora
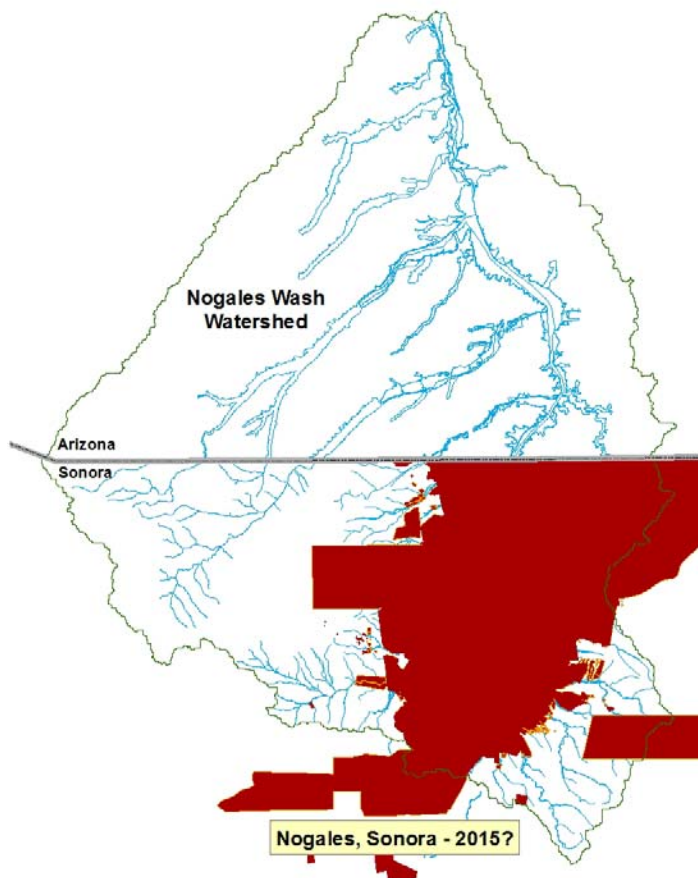
Nogales, Sonora - 2015?

Basic Facts

- Nogales Wash Watershed
  - Total area: 204.8 km2 (79 sq. miles)
  - 52% in Arizona
  - 48% in Sonora
  - 39% urbanized (61% underdeveloped)

- Nogales, AZ, has a shrinking population of 20,000 people. Nogales' urban development has been relocated to Rio Rico, where most of the affordable housing options are.

- Nogales, Sonora, has a growing population of around 250,000 people. Growth is being directed south with important development project to east and west of the city.

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Ambos Nogales - 2000

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Motivation

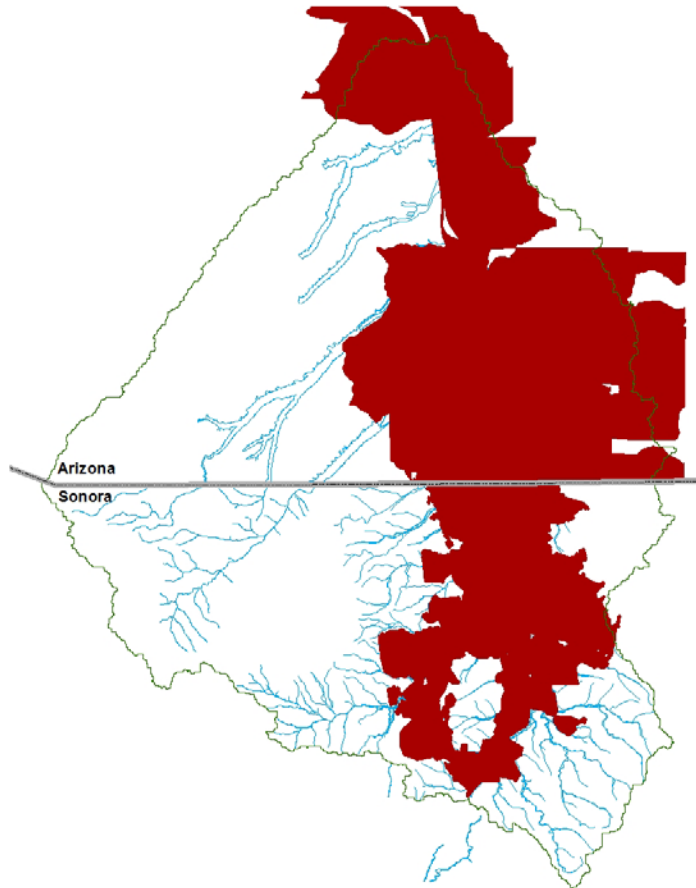Approach
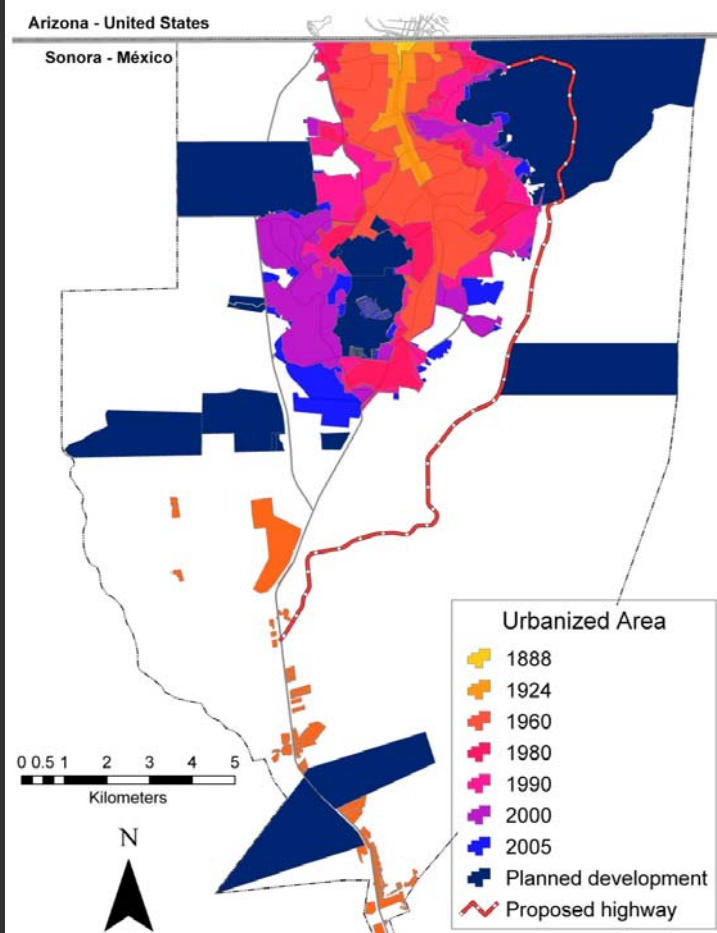
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01

Arizona - United States

Sonora - México

Urbanized Area
- 1888
- 1924
- 1960
- 1980
- 1990
- 2000
- 2005
- Planned development
- Proposed highway

0 0.5 1 2 3 4 5
Kilometers

N

Year	Urban Area	Growth	Ave. Growth
1980	1,923.6	543.7	27.2
1990	2,594.2	670.6	67.1
2000	3,369.6	775.4	77.5
2015*	8,298.5	4,539.5	454.0

ISSUES:

1.Urban decline and fragmentation
- Rapid and disjointed physical expansion of the city
- Decline of the old urban core
- Disconnected peri-urban islands
- Destruction of fragile landscapes

2.Quality of life/livability concerns
- Increased reliance on automobile travel
- Higher social segregation
- Unequal access to jobs, services and amenities

3.Open space/public space chronic deficit
- Limited recreational opportunities
- Encouragement of sedentary lifestyles
- Lack of community cohesion

Morley Ave., Nogales, AZ

Calle Elias, Nogales, Son.

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ISSUES:

4. Water resources degradation
   - Water quality concern
   - Reduced infiltration rate

5. Flooding hazard and vulnerability
   - Occupation of floodplains
   - Construction of steep mountain sides
   - Invasion of waterways
   - Increasingly erratic and intense rainfall
   - Land cover change

6. Growing economic burden
   - Higher cost of provision of urban infrastructure
   - Dislocation of economics activities
   - Disruption of daily life
   - Effect on investment opportunities to keep current economic base and diversify local economy

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Green Infrastructure Tools

Green Network Urban Strategy

Landscape Network View

"Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies" (EPA: http://cfpub.epa.gov/).

"an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife." (Benedict and McMahom, 2006_

"Greenways are networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural, aesthetic or other purposes compatibles with the concept of sustainable land use" (Hellmud and Somers, 2006)

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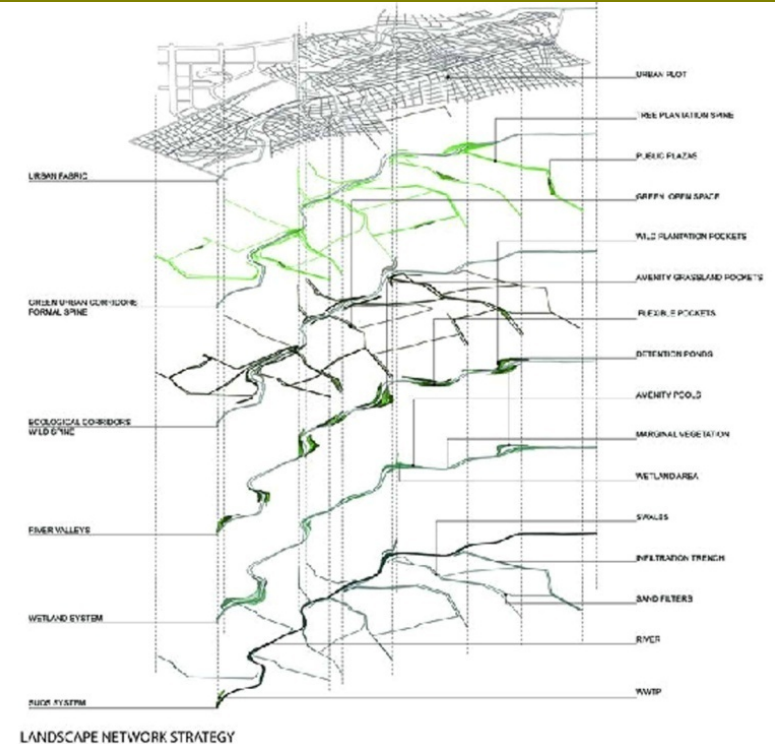
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04

Benefits of green network approach:

- **Multifunctional**

- **Strategic**

- **Flexible**

- **Opportunistic/interstitial**

- **Cost-effective**

- **Multi-scale**

A green urban network strategy is not antidevelopment or no growth, yet it can be the backbone of smart growth

LANDSCAPE NETWORK STRATEGY

A green urban network can be designed to shape urban form and provide a framework for growth

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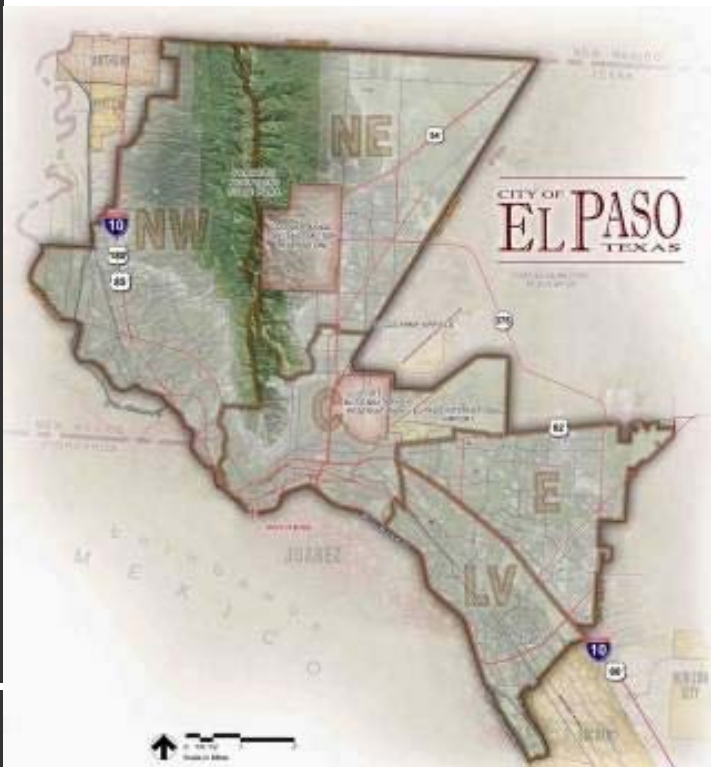
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Green Infrastructure Planning in other border cities

"The mountains, the desert, the river…El Paso wouldn't be the same without them. Yet as our city grows, the special places our families remember are disappearing one by one"

Towards A Bright Future: A Green Infrastructure Plan for El Paso, Texas

"This type of plan is sometimes called a Green Infrastructure Plan. The idea is to look at all the open-spaces, parks, trails, greenways, and natural undeveloped land, not as individual, discrete items, but rather to integrate them into an organized system. Thinking this way helps us to deal with open spaces as an interconnected system, recognizing that each component can affect other parts or the system itself. Just as a network of roadways, utilities, buildings and parking lots forms the urban or "gray" infrastructure of a community, the green infrastructure network weaves together a web of recreational and nature areas that add to our quality of life. It also aids in the land-development process by proactively identifying areas that should be left undisturbed or used as open space, and also identifying areas for development"

El Paso City Council adopted the plan on March 13, 2007

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Important Facts:

Green Infrastructure contributes to increased property values (Warthon):
- 9% with three plantings
- 28% with improvement in streetscapes

Green Infrastructure can help reduce violence (University of California)
- Change in perception of neighborhood
- Increase neighborhood stability
- Reduce violence and crime

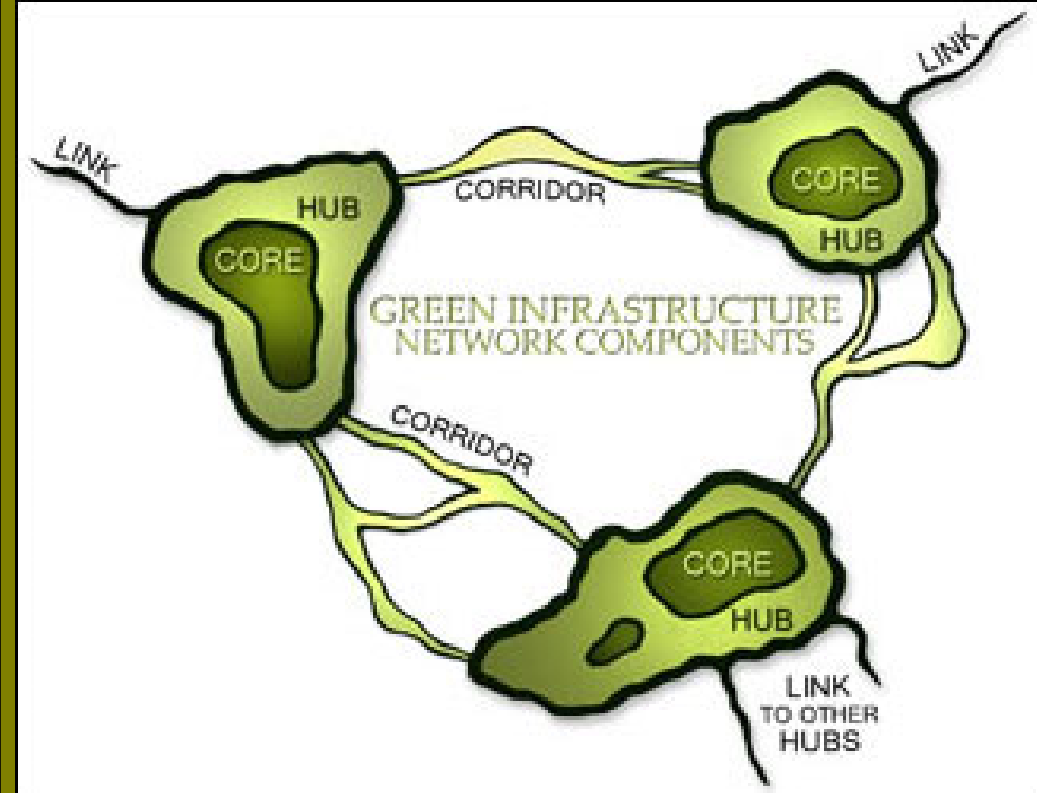Green Infrastructure can reduce infrastructure costs:
- Total GI capital costs can be lower than conventional methods, with savings ranging from 15 to 80% (EPA 2007).
- A stormwater control system using bio-retention areas, grass channels and storm water basin can save a developer approximately 72% of the stormwater construction costs (Blue Land, Water and Infrastructure, 2000).

Green infrastructure contribute to the ecology of the city:
- the reduction of peak flows; the removal of pollutants, the promotion of runoff infiltration, and restore habitats.

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Five stages of the network design:

1. Identify goals & develop a vision
2. Define the extent of the planning area
3. Select nodes and links
4. Select alternative designs
5. Implement and manage

GREEN INFRASTRUCTURE NETWORK COMPONENTS

http://www.greeninfrastructure.net/content/definition-green-infrastructure

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A. Water and ecology

B. Land use and land cover

C. Humane-nature interaction
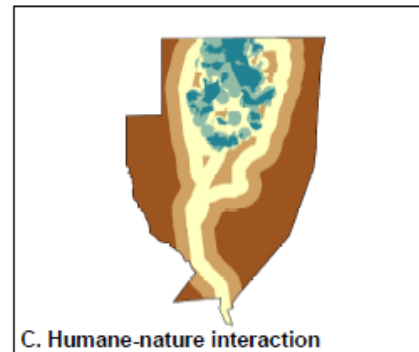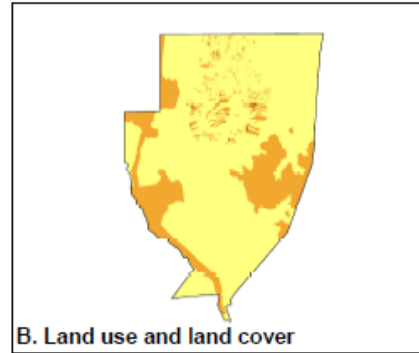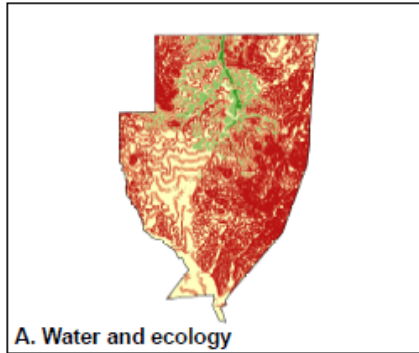
Land Suitability Analysis

ENVIRONMENT & ECOLOGY
Proximity to streams, distance to floodplain, slope.

HUMAN-NATURE INTERACTION
Proximity to arterial streets, population density and proximity to schools.

LAND USE
Plant cover, land use availability and land ownership.

1. Select a land use type for analysis;
2. Select factors to be considered and attribute values of each factor;
3. Determine a score for each factor attribute
4. Weigh the factor;
5. Calculate a composite score from the attribute values and weight it for each factor;
6. Rank the combined scores to establish suitability levels;
7. Identify available land based on existing land uses;

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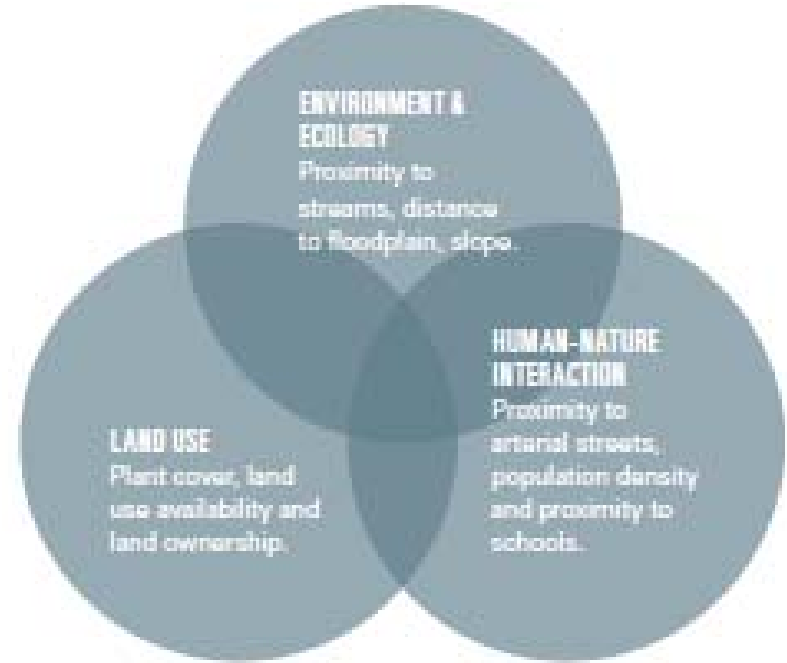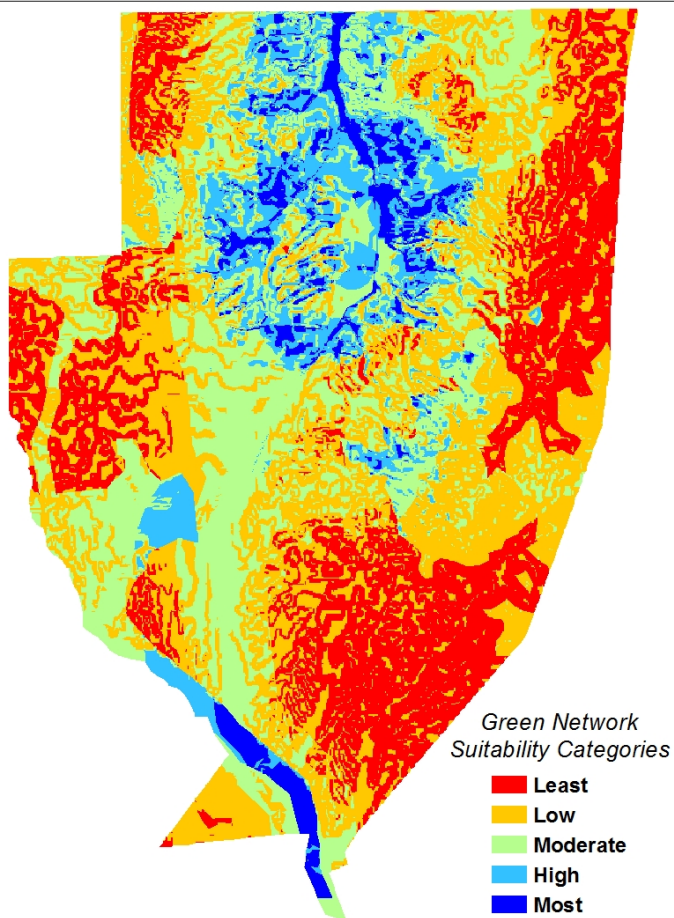
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Green Network Suitability Categories

- 🟥 Least
- 🟧 Low
- 🟩 Moderate
- 🟦 High
- 🟦 Most

Factors	Capability categories				
	Least	Low	Moderate	High	Most
Proximity to streams (meters)	<250		250-50		>50m
Proximity to floodplain	Outside				Inside
Slope (%)	>25%	15-25	10-15	5-10	2-5%
Forest or grassland	Inside				Outside
Land ownership	Private		State/ Federal		Municipal
Open public space (100 m buffer)	Inside				Outside
Prox. to arterial streets (km)	<2	2-1.5	1.5-1	1-0.5	>0.5
Pop. density (persons/hectare)	Lowest	Low	Average	High	Highest
Proximity to schools (km)	<2	2-1.5	1.5-1	1-0.5	>0.5

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Edge Nodes – Watershed scale

•4 nodes – 2200 has
•Connect the city with the outer regional space
•Define and edge/transitional zone
•Location for larger stormwater control structures

Inner Nodes – City Scale

•15 inner nodes – 285 has.
•Potential green space/park space
•Runoff and flooding hazard mitigation
•Define planning districts incorporating land use controls and green infrastructure techniques
•Groundwater filtration and recharge

Residential Nodes – Neighborhood scale

•20 Nodes – close to 180 has
•Secondary streams or interstitial space
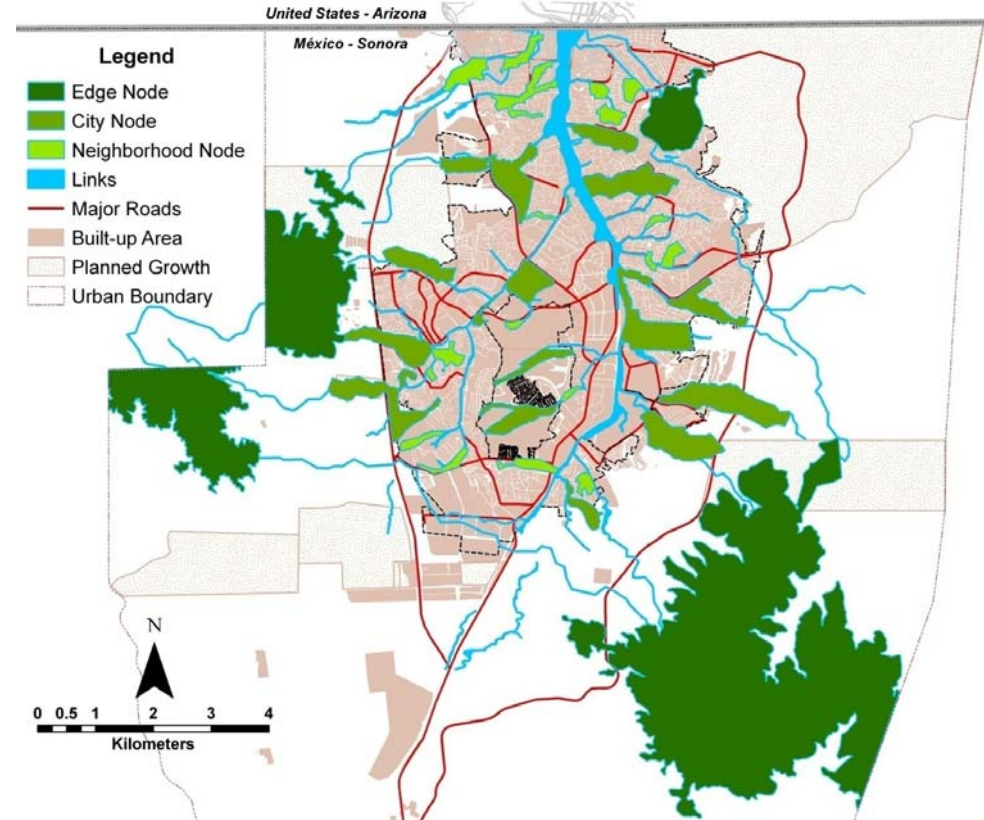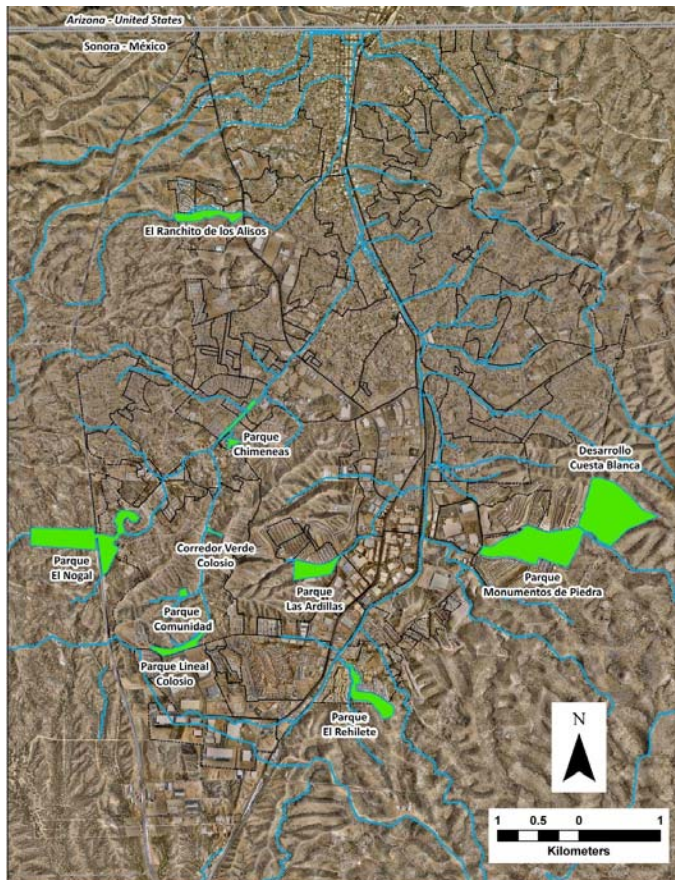
Inventory of Green Space in Nogales and Potential Scenarios

Available green space		
Green areas	Area (Hectares)	8.14
	No. de sites	186
Gardens	Area (Hectares)	6.22
	No. de sites	28
Neighborhood Parks	Area (Hectares)	6.69
	No. de sites	11
Potential green space under a network scenario		
Green Nodes	Area (Hectareas)	63.4
	No. de sites	34
Service gap		
Current	Area total	21.05
	m²/habitant	1.11
	Deficit (%)	87.66
Green network potential	Area total	84.45
	m²/habitant	4.46
	Deficit (%)	50.48

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Site Plan at Ridge Scale
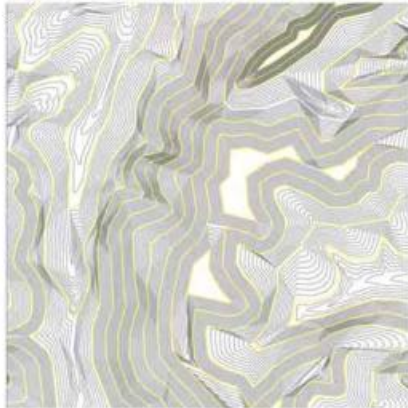
Contours

Microbasins

Conditions Analysis

Project by Eduardo Santamaria, Hugo Castorena, and Taylor Hawkings

Water Dependent Plants .... Vegetation Gradient Diagram .... Xeric Plants

Concrete Filter Basin

Gabion Filter Basin

High Density Small Scale .... Filtration Gradient Diagram .... Low Density Large Scale

Site Section

0   5ᴍ   10ᴍ   20ᴍ

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Project by Eduardo Santamaria, Hugo Castorena, and Taylor Hawkings

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Project by Arq. Romina Castaño and Ing. Agustín Varela

Nuevo Nogales

Villa Sonora

El Rehilete

100   50   0   100

Meters

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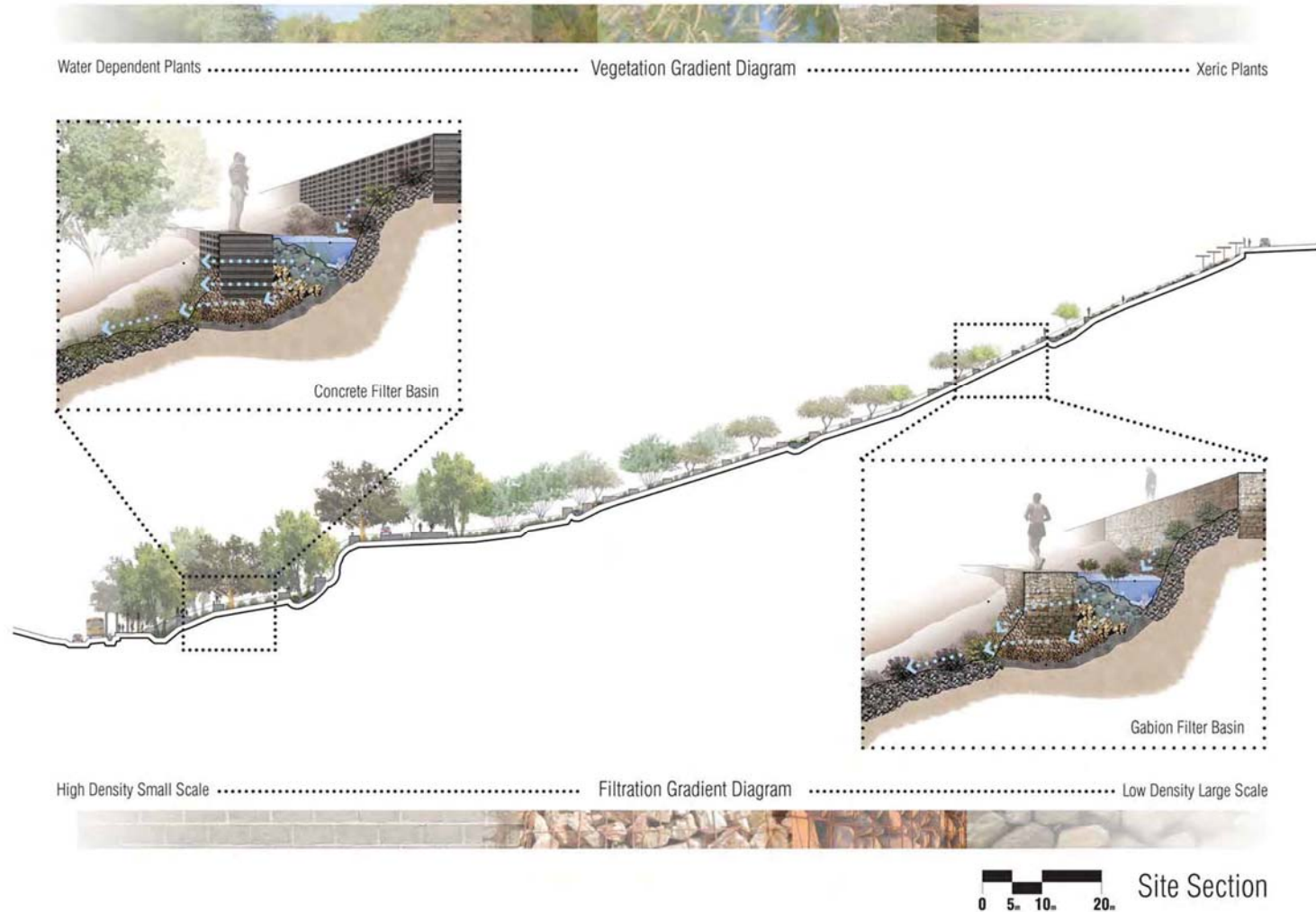Next Steps

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Avenida Villa Sonora

Acceso / Gate

Calle de los Buhos

Talleres de artes / Art studios

Muro de escalar /
Rappel wall

Calle Villa Sonora

Acceso / Gate

Calle de los Cisnes

Estanque / Pond

Teatro / Theater

Acceso / Gate

Represo filtrante /
Sedimentation pond

Estacionamiento / Parking

Acceso / Gate

Juegos Infantiles / Playground

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Project by Ing. Claudia Gil and Ing. Francisco Gastelum

El Represo

Tecnologico

Luis Donaldo Colosio

Corredor Fiscal

N

0 125 250

Meters

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EL REPRESO TEAM

TOM BALK
BENEDETTO MARCHIAFAVA
FRANK FARINA
CHELSEA ELWOOD
CHRIS BOCKEY
TROY HANSEN
JAMES GARCIA
CHRIS OLSEN
CRAIG CROWLEY
ADAM NORDFORS
JOHN GOUGH

GEO TECHNICAL EROSION CONTROL BY
BENEDETTO MARCHIAFAVA

PLASTIC BAGE SOIL STABALIZATION BY
TOM BALK

TERRA MESH EROSION CONTROL MAT-
TRESSES BY **CRAIG CROWLEY**

GABION LIVING RETAINING WALLS BY
CRAIG CROWLEY

GABION RETAINING WALLS BY
TROY HANSEN

VEGETATED GABION TERRACACING BY
ADAM NORDFORS

PARK
1 - 50 YEAR
FLOOD ZONE

2 - 20 YEAR
FLOOD ZONE

3 - CONSTANT
WATER ZONE

CHECK DAMS BY **TROY HANSEN**

BOTTLE CHECK DAMS BY **CHELSEA ELWOOD**

DIVERSION BARRIERS BY **CHRIS BOCKEY & FRANK FARINA**

GEO TECHNICAL EROSION CONTROL BY
BENEDETTO MARCHIAFAVA

RE-GRADING BY **CRAIG CROWLEY**

CLOSING RESOURCE LOOPS BY **JOHN GOUGH**

CHECK DAMS BY **TROY HANSEN**

BIO SWALE BY **CHRIS OLSEN**

TIRE RETAINING WALLS BY **JAMES GARCIA**

SITE PLAN

EL REPRESO

Project by Jonathan Scolaro

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Project by Arq. Porfirio Rentería and Ing. Arnoldo García

Real del Arco

Parque Chimeneas

Las Praderas

El Rastro

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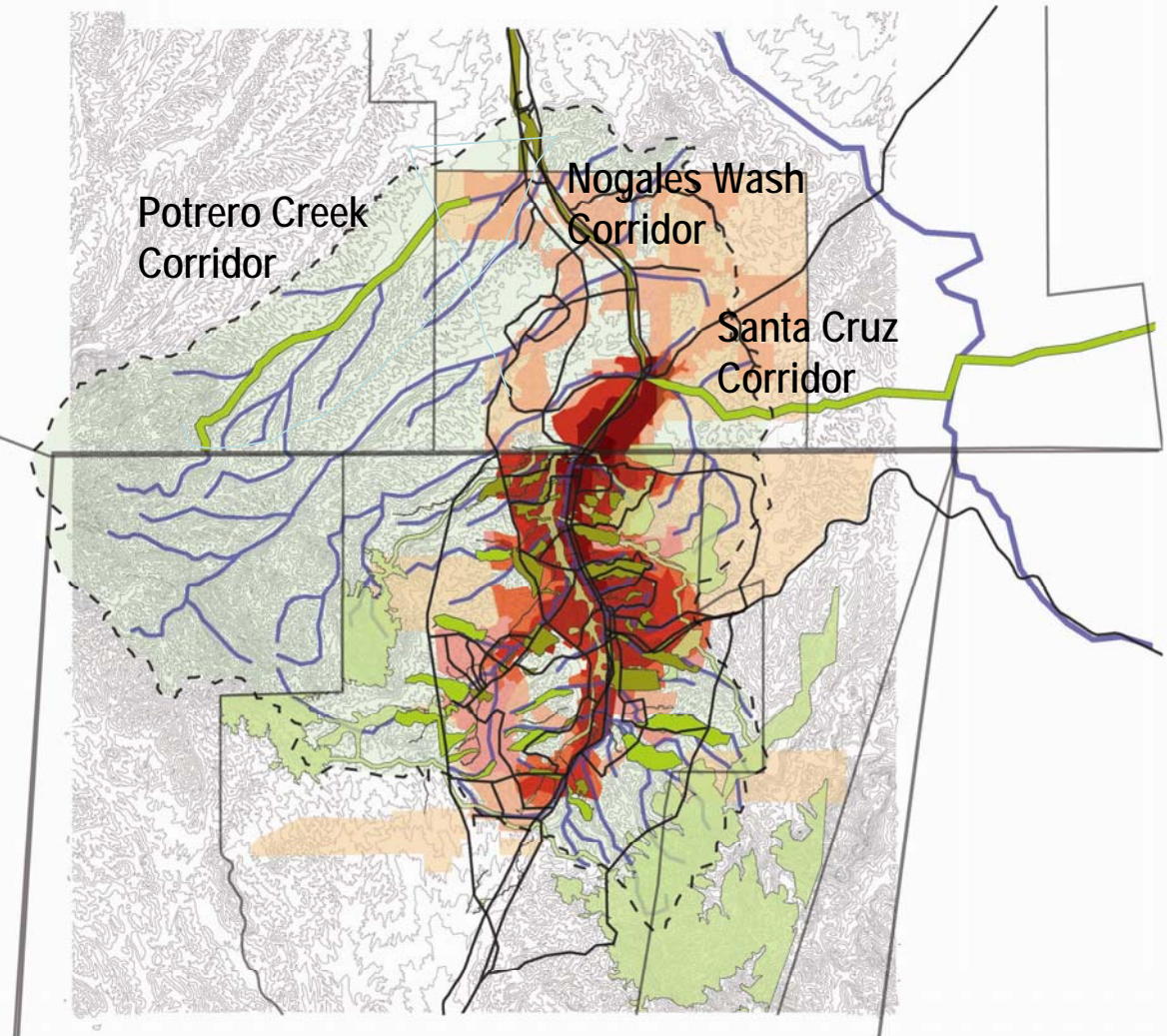
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The new, 2010, general plan for the City of Nogales, AZ, proposes three green corridors: the Nogales Wash, Potrero Creek, and a corridor connecting with the riparian areas of the Santa Cruz River, XX miles to the east.

Potrero Creek Corridor

Nogales Wash Corridor

Santa Cruz Corridor

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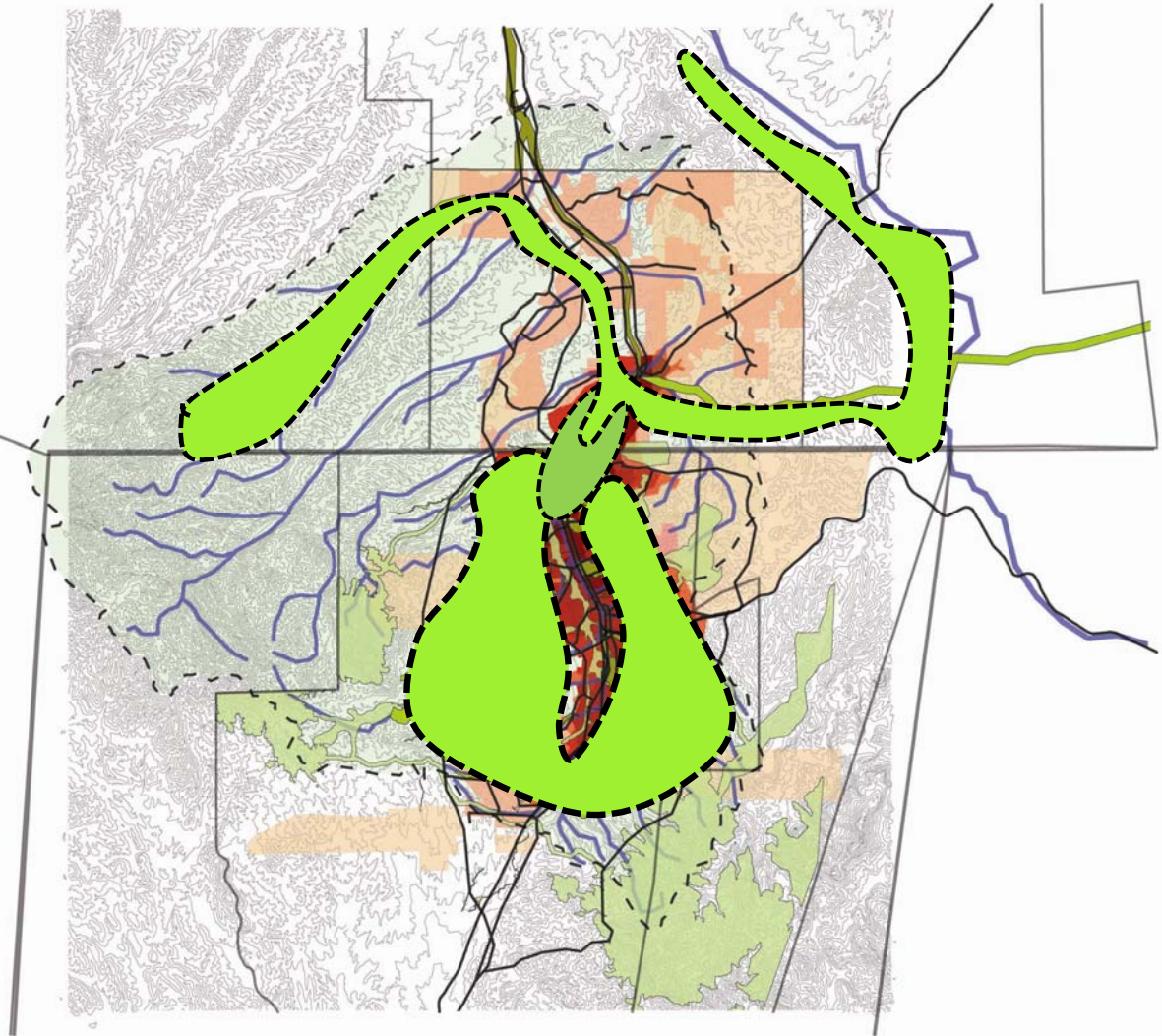
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Resilience/Sustainable Ambos Nogales:
• Bi-national watershed,
• Binational planning institutions and efforts,
• one basin,
• two cities,
• two nations,
• a common future

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Sustainable urban development in border cities requires a vision of change that can be enhanced through:

- Investing in information and knowledge, both in their production and in the means for their communication and distribution;

- Facilitating the creation of a stock of human capital through education and practical training;

- Developing a sustainable development portfolio including a range of viable and credible urban projects;

- Encouraging the development of appropriate institutions promoting evolutionary urban change;

- Enhancing the ability of local decision makers to manage and communicate information.

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