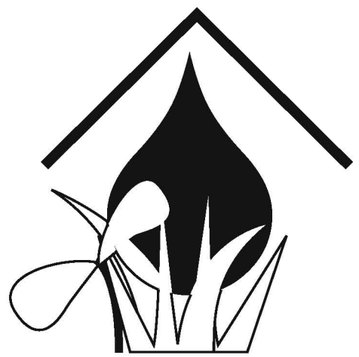
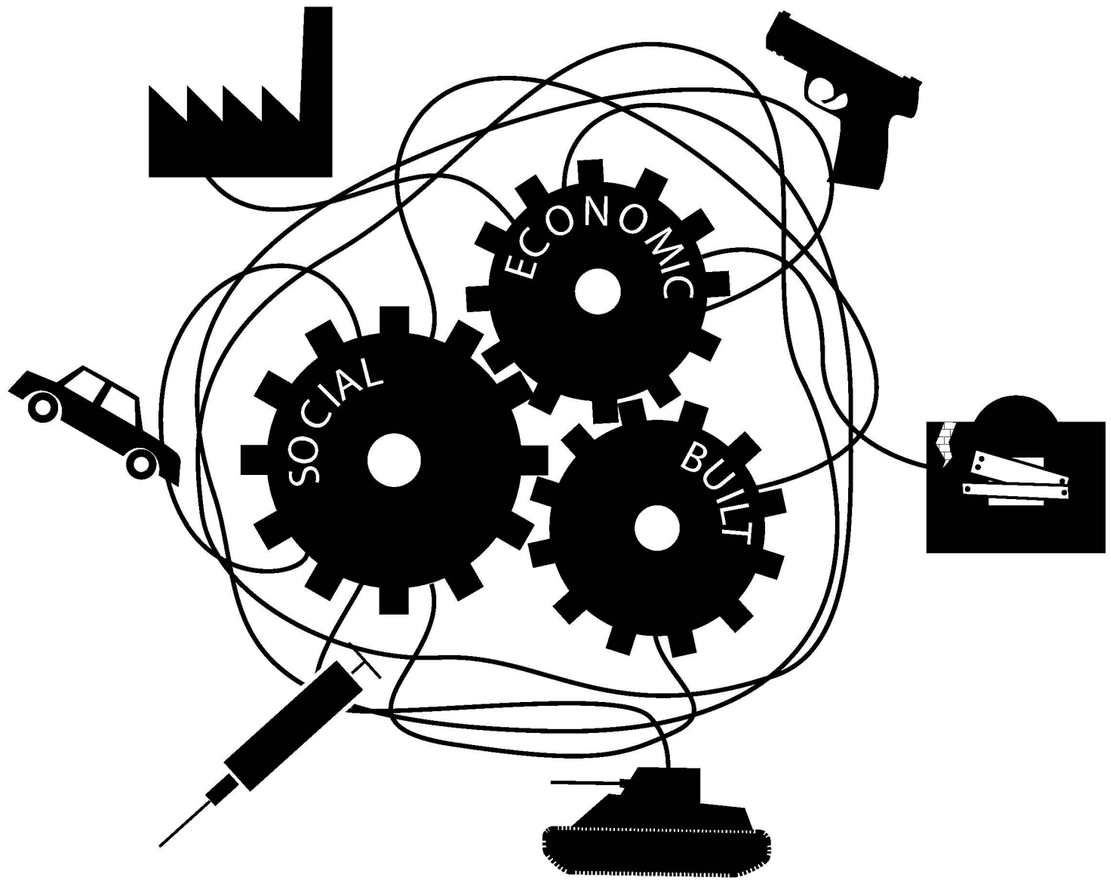
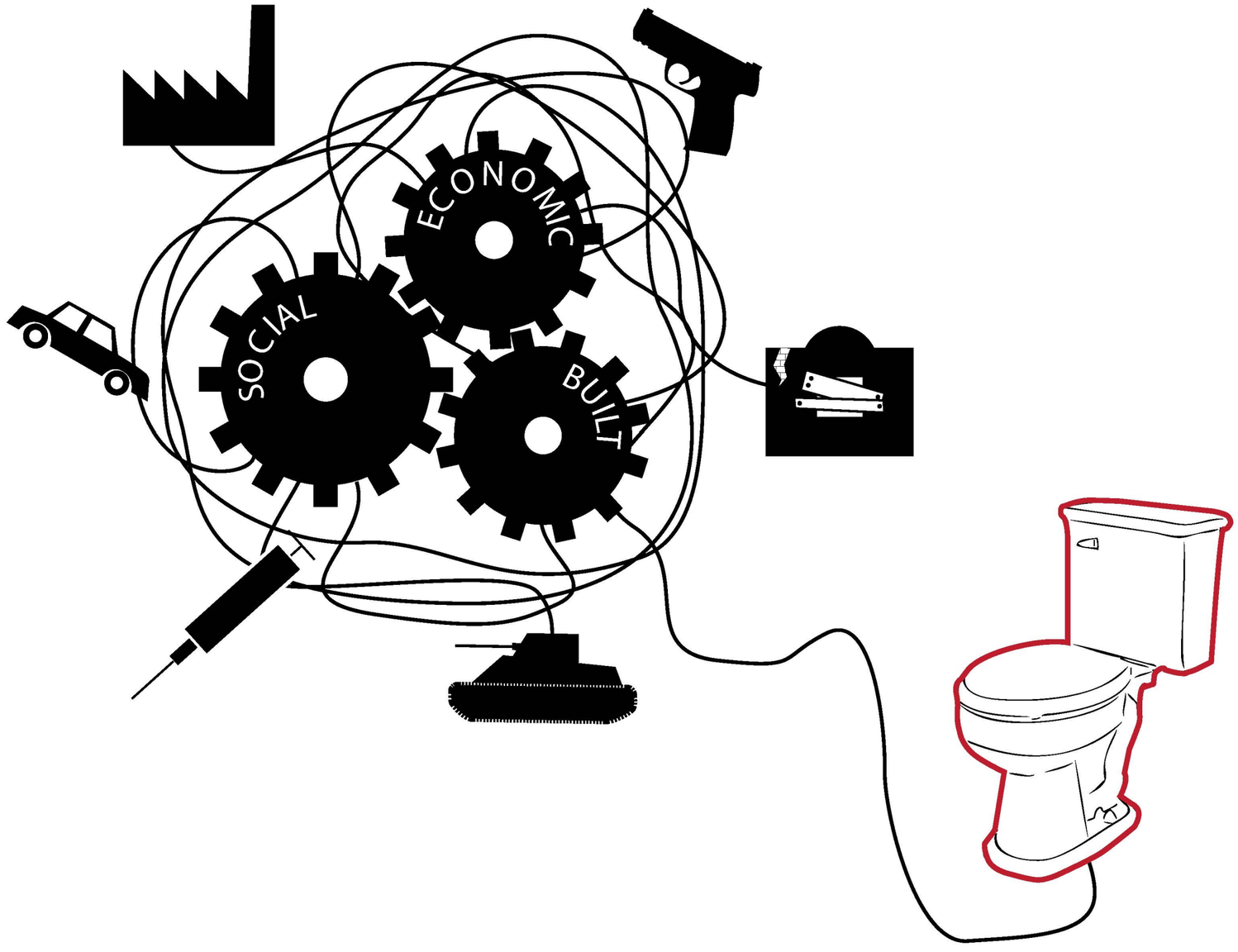
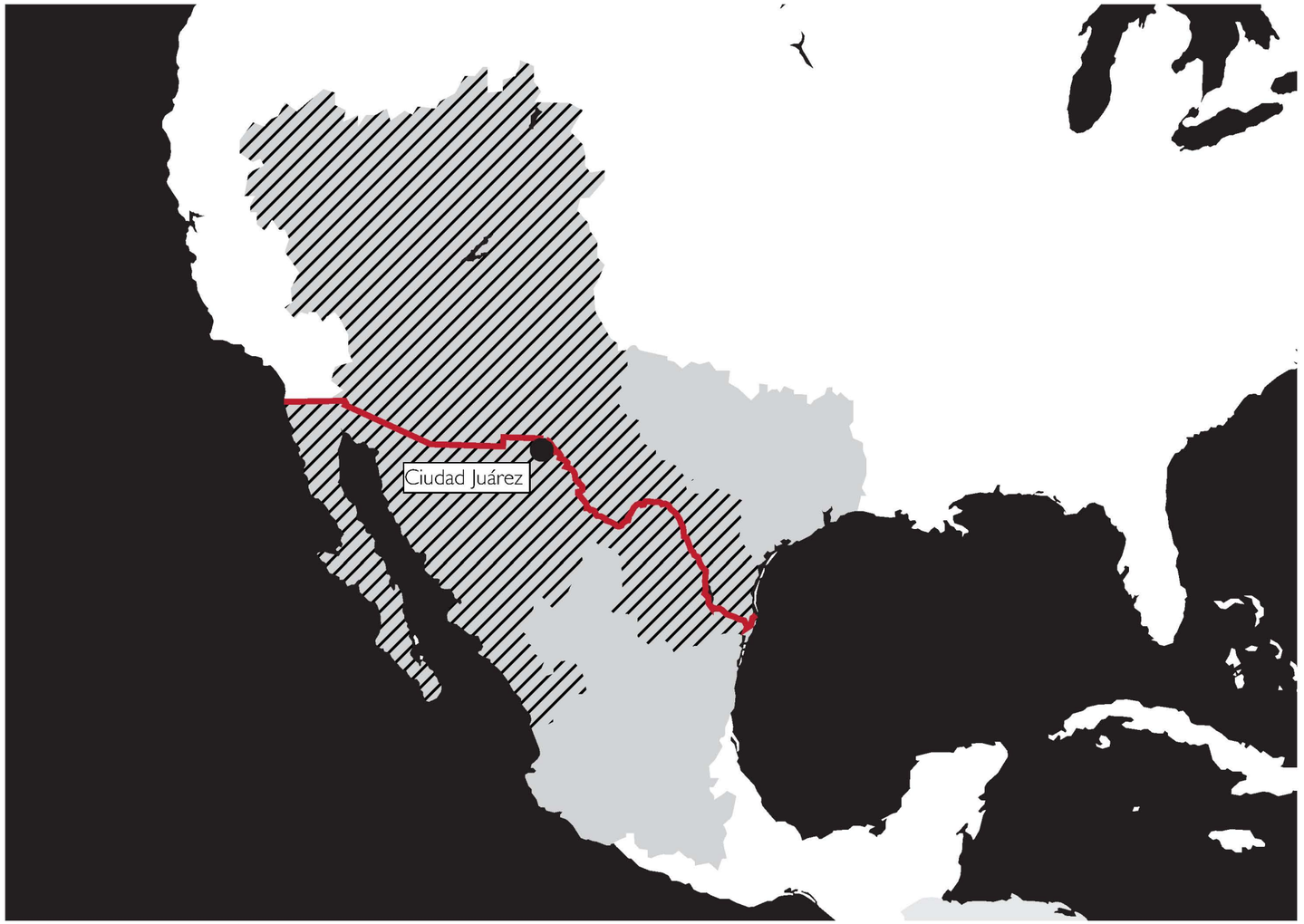


CORREDOR DE AGUA URBANO

Sara Navrady


ECONOMIC
SOCIAL
BUILT

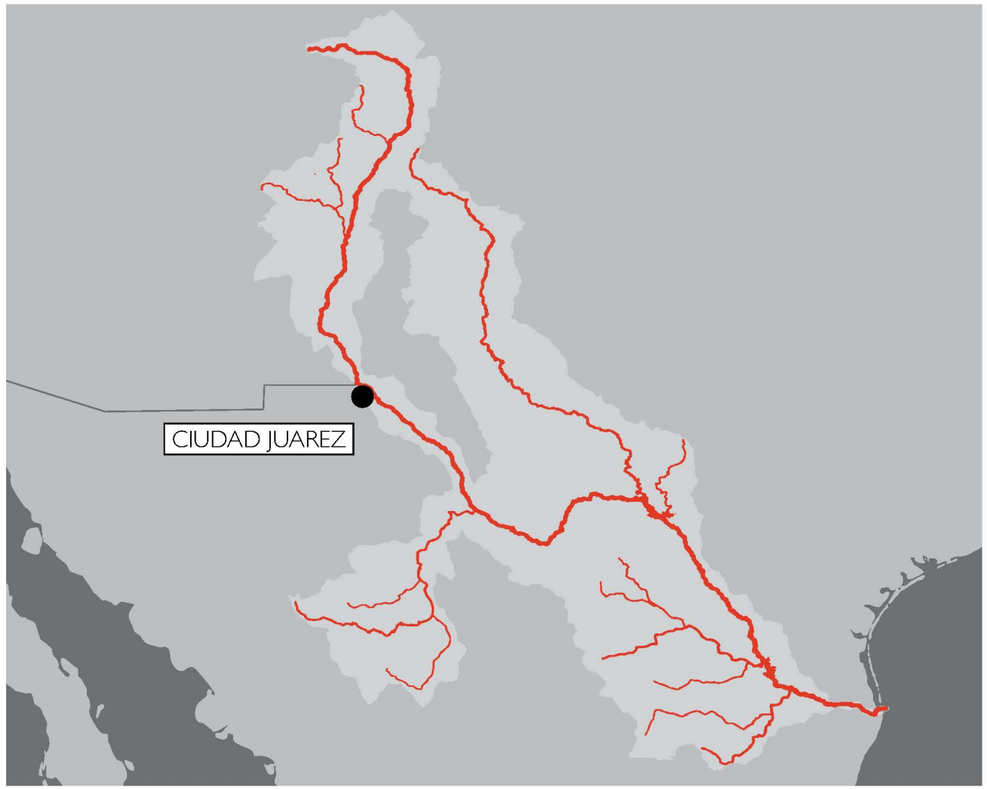

ECONOMIC
SOCIAL
BUILT



Data from the International Water Management Institute

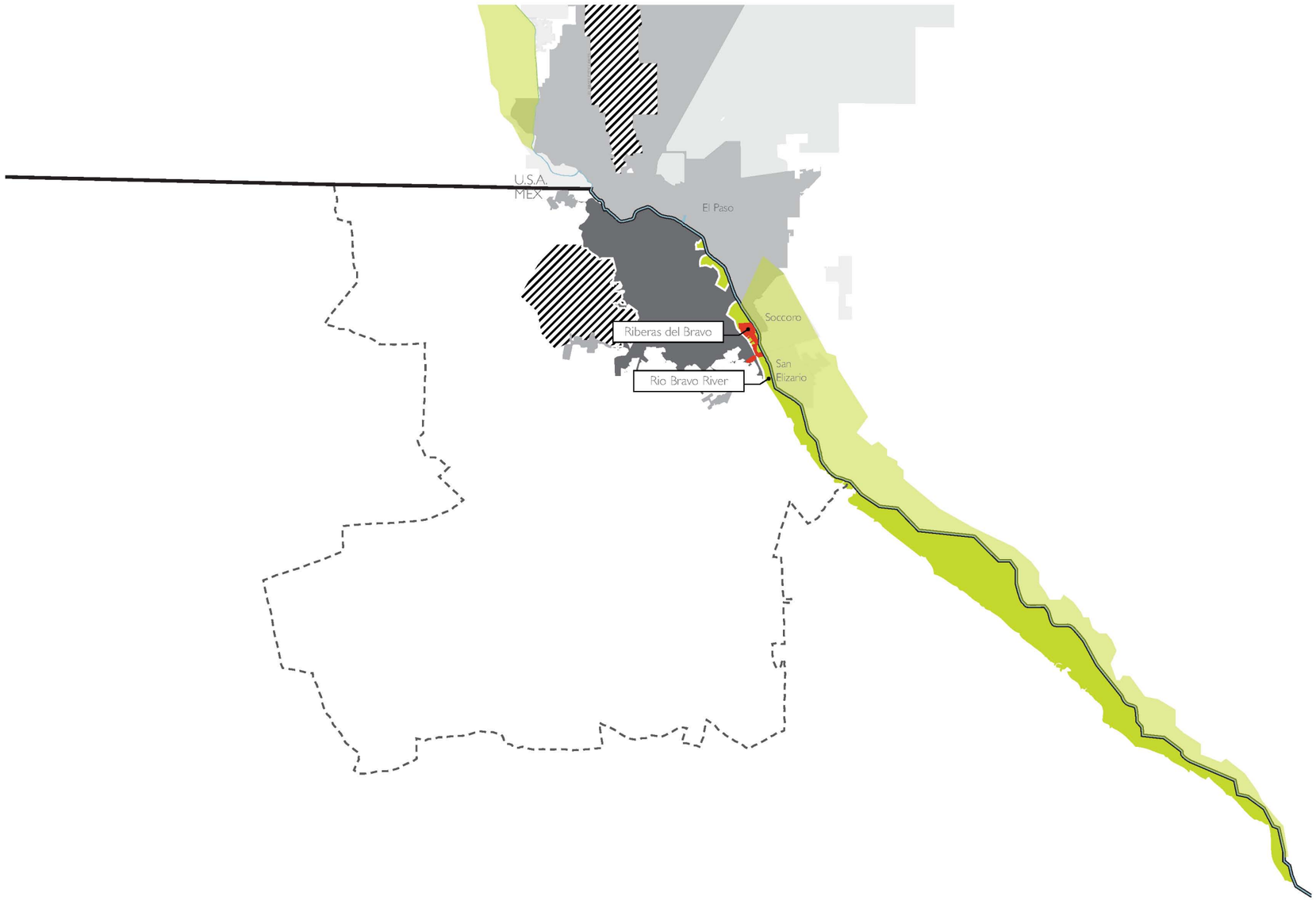
PHYSICAL WATER SCARCITY
More than 75% of river flows allocated to agriculture or urban use

APPROACHING WATER SCARCITY
More than 60% of river flows allocated to agriculture or urban use

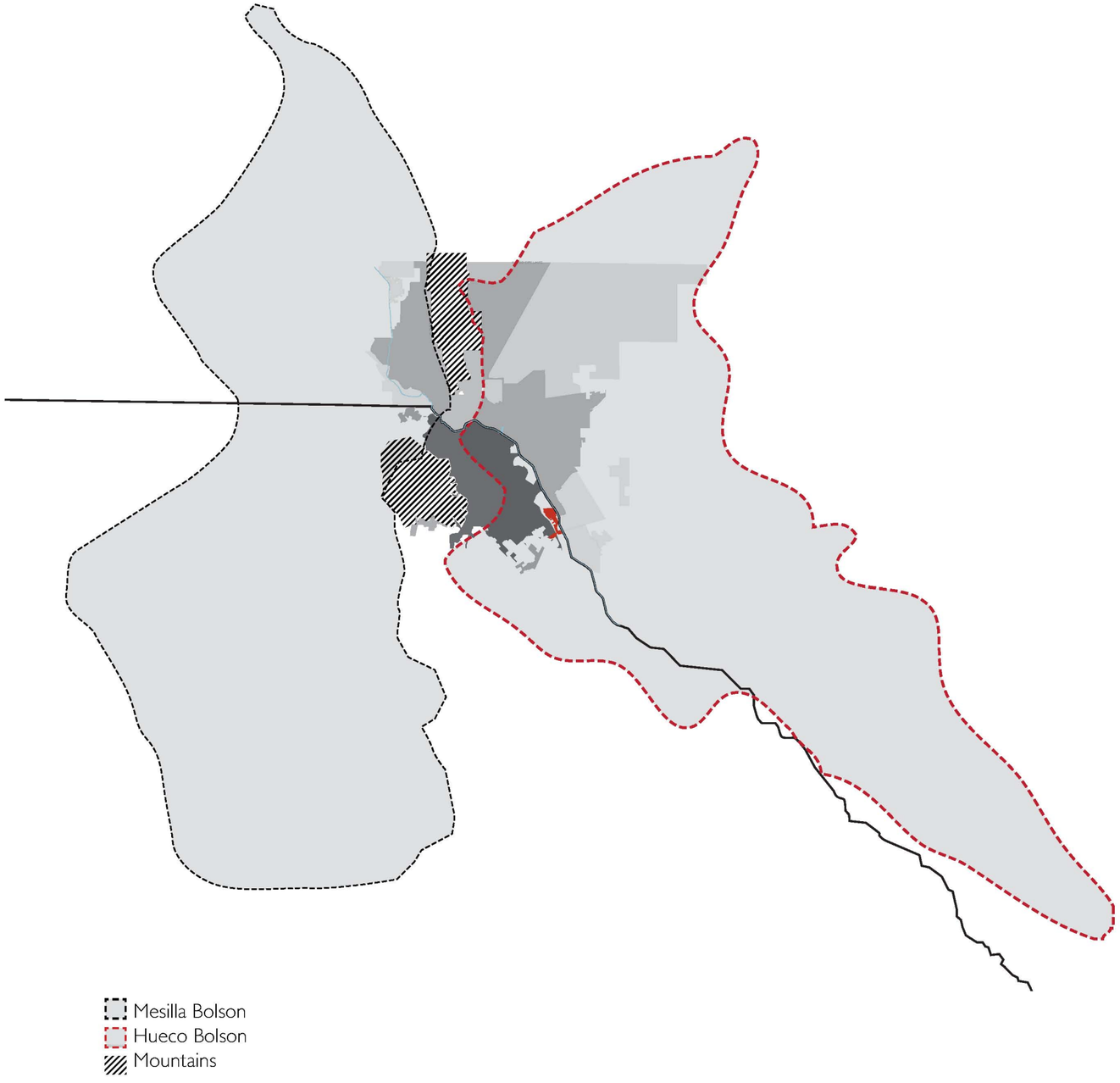


74 MILLION M³ /YEAR

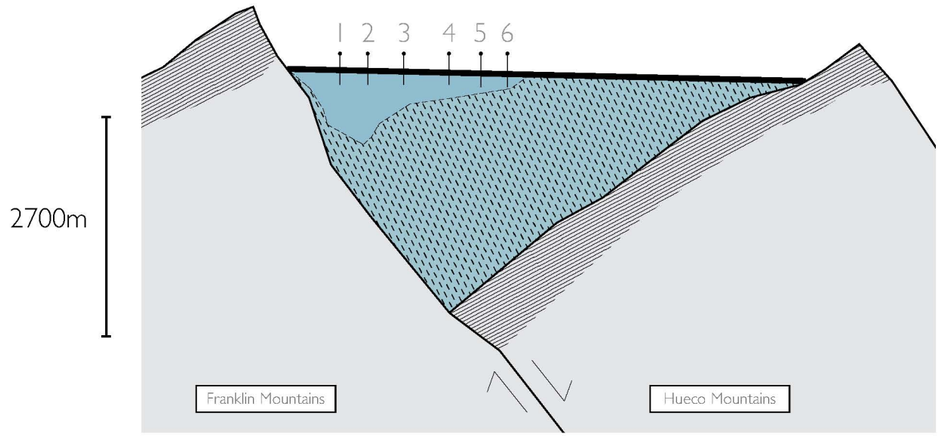
72 MILLION M³ /YEAR



U.S. Agriculture
Irrigation District Valle Juarez 009
Mountains



GEOLOGIC CROSS SECTION THROUGH HUECO BOLSON



WITHDRAWAL ESTIMATES FROM HUECO BOLSON (MILLION M^3)

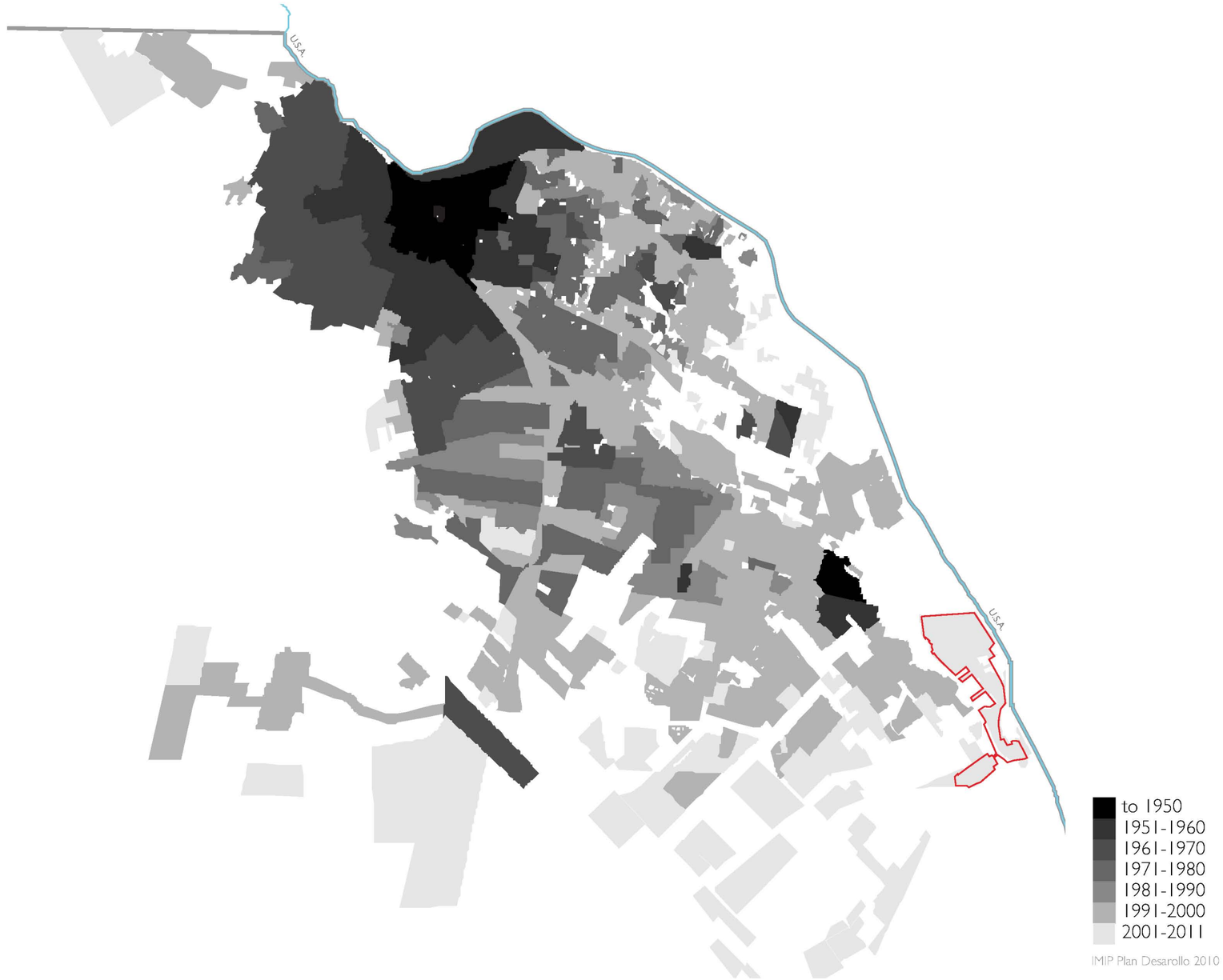
1 Chapparal, NM,	1.33
2 Industrial & Public Supply, TX	16.04
3 City of El Paso, TX	62.21
4 Fort Bliss Military Base, TX	5.81
5 Ciudad Juárez, MX	155
6 District 009, MX	71.83

TOTAL: 312.22 million m^3

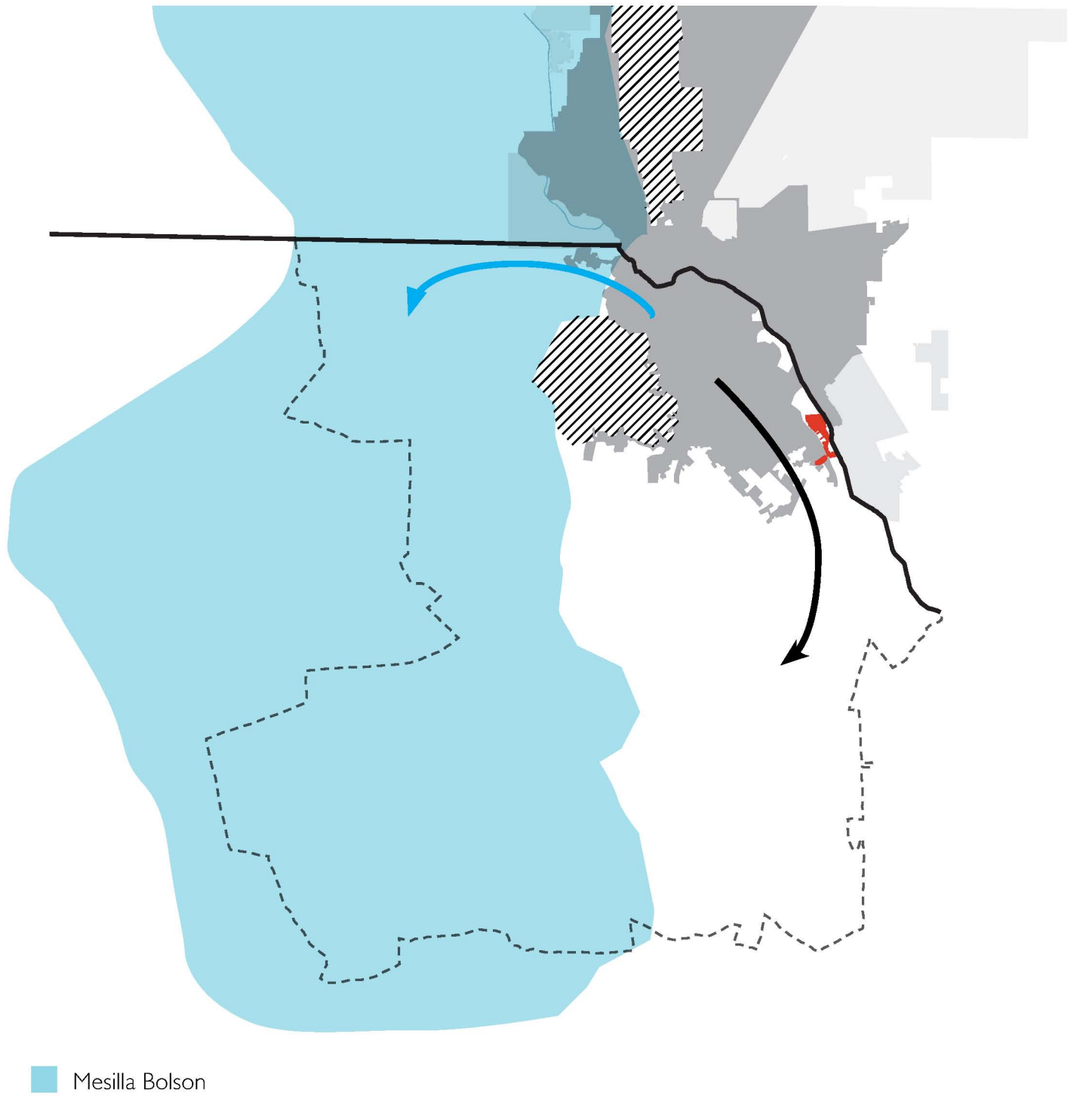
Sheng, Z. & Devere, J. 2005

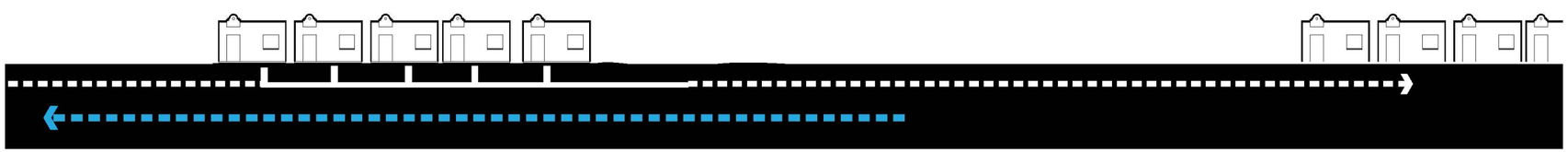
HUECO BOLSON
RATE OF EXTRACTION: RATE OF RECHARGE

5:1



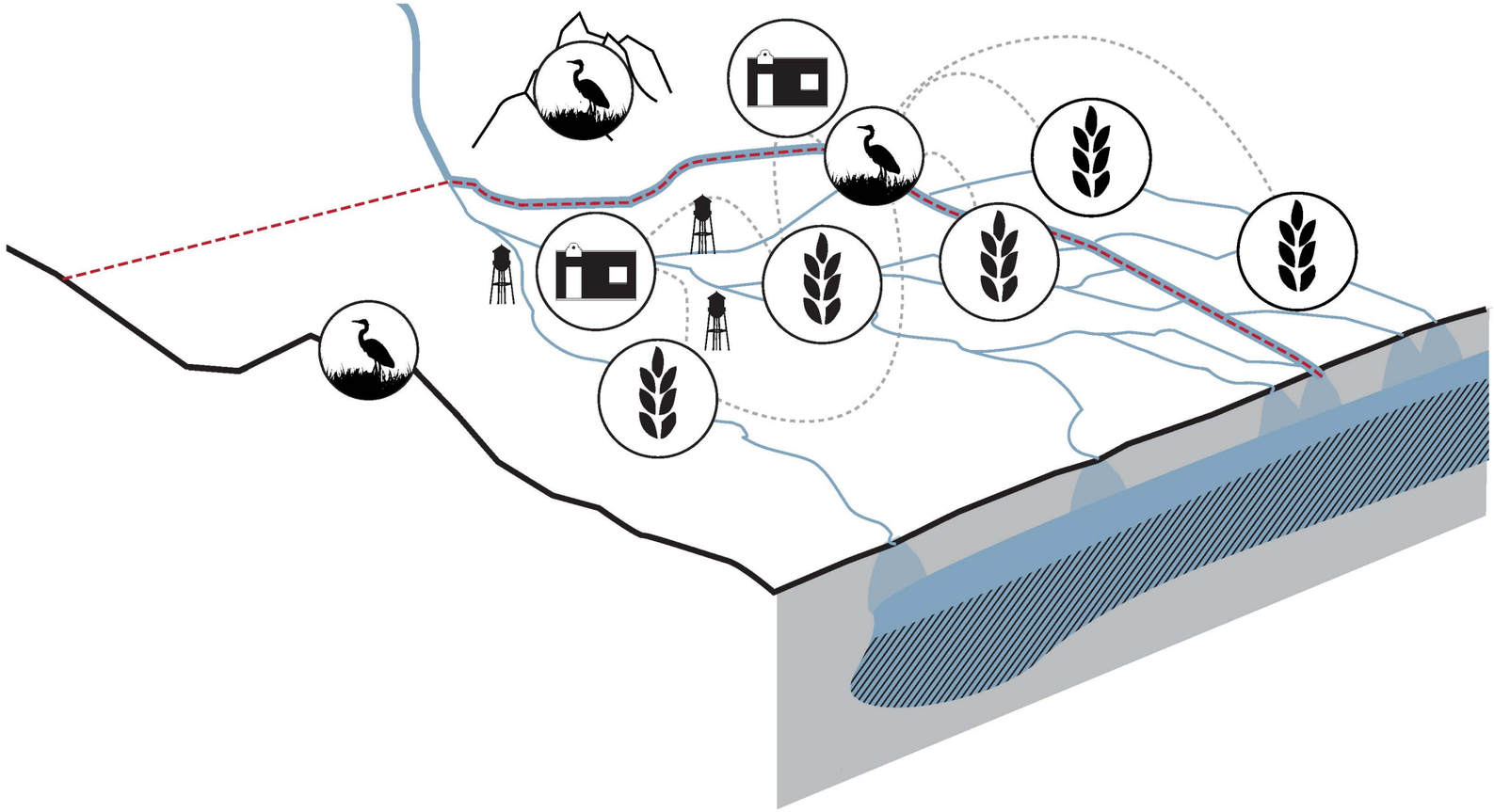
IMIP Plan Desarollo 2010


Mesilla Bolson

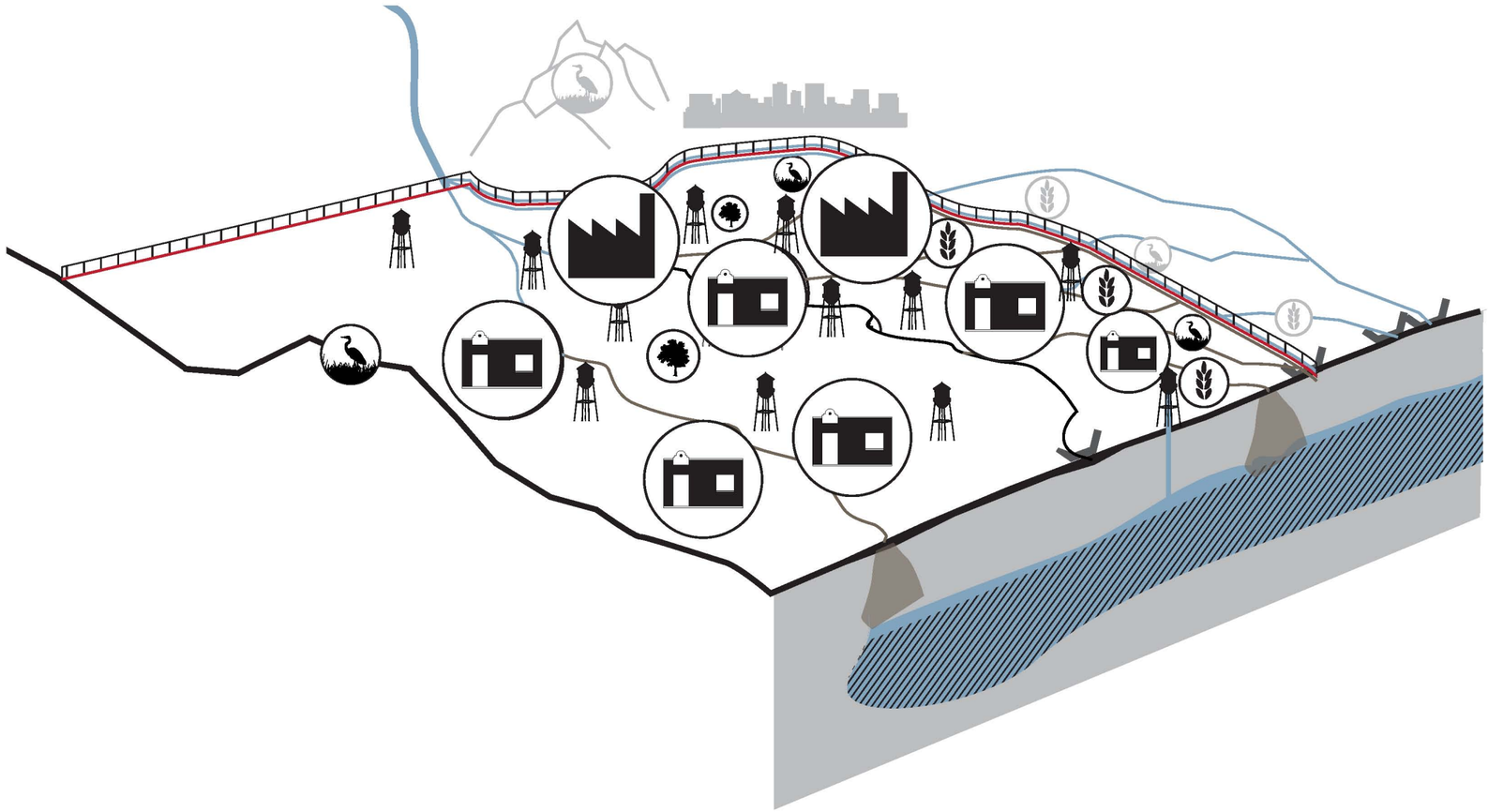


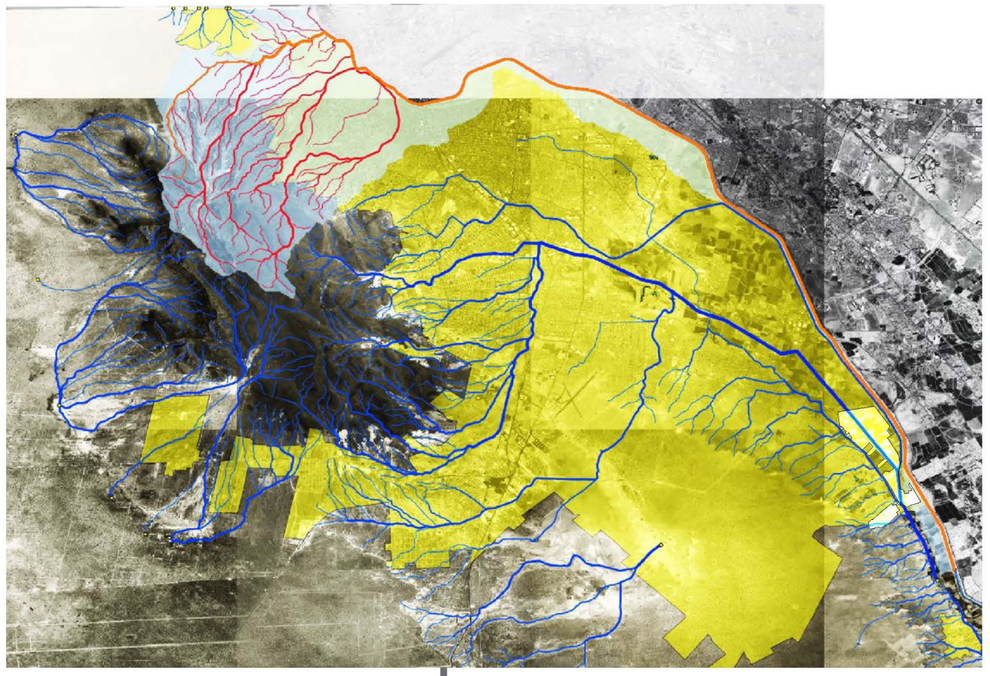
http://www.alcontacto.com.mx/imagenes/2012-08-01/2-24-27-pm.jpg

SINCE IT OPENED IN 2009 THE CONEJOS MEDANOS AQUIFER HAS RUPTURED 10 TIMES, COSTING 6 MILLION MXP IN REPAIRS AND SPILLING POTABLE WATER INTO RESIDENTIAL AREAS



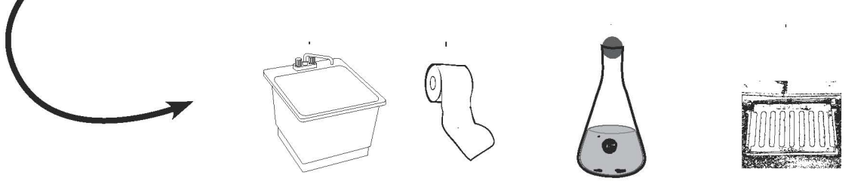
http://texashistory.unt.edu

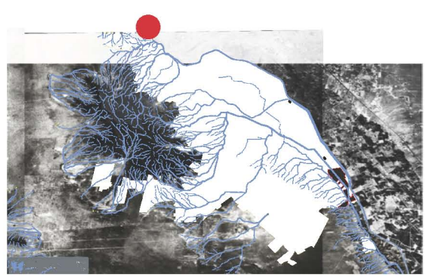


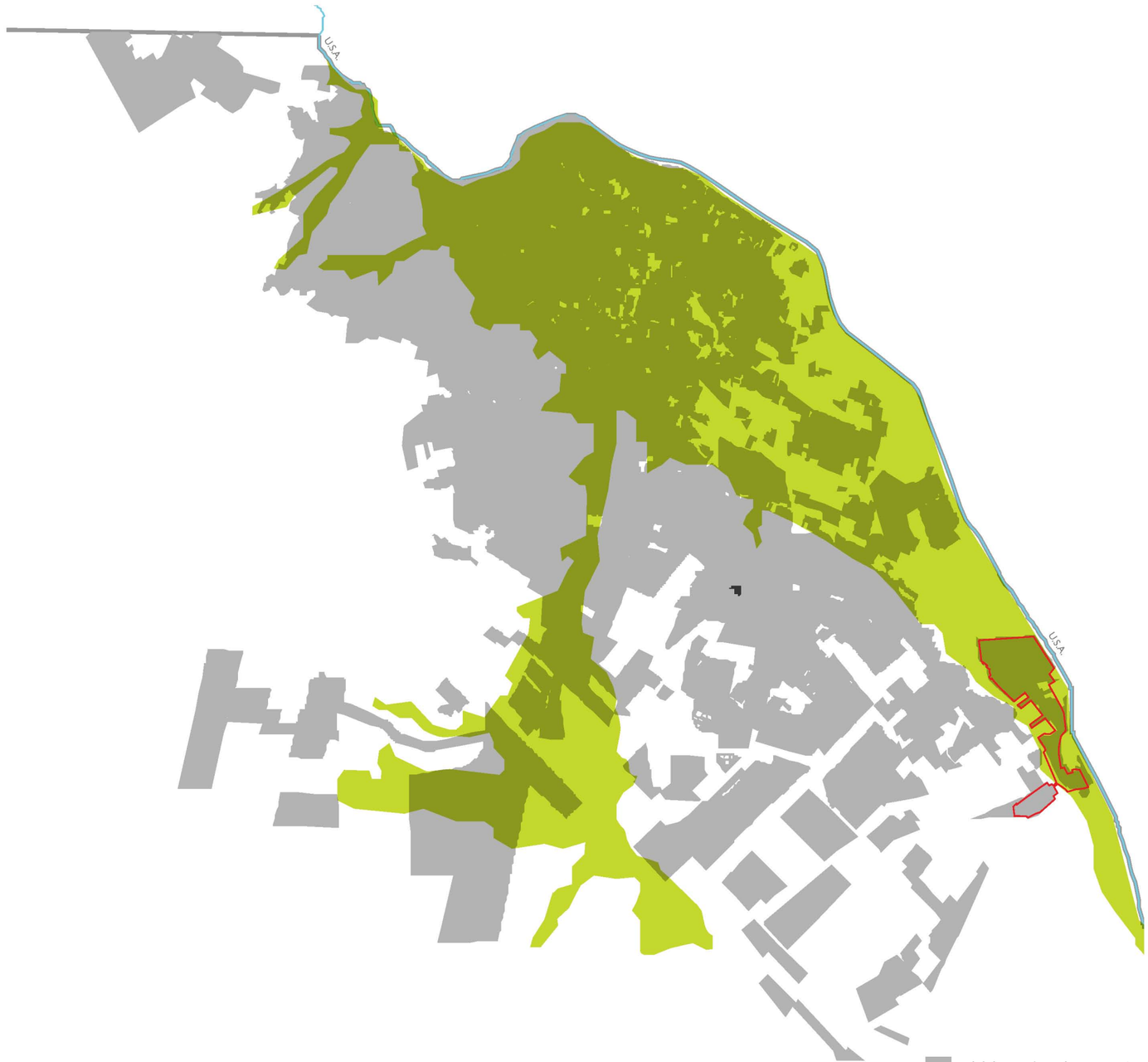


INEGI (2012)

www.googlemaps.com



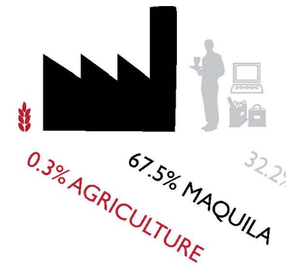


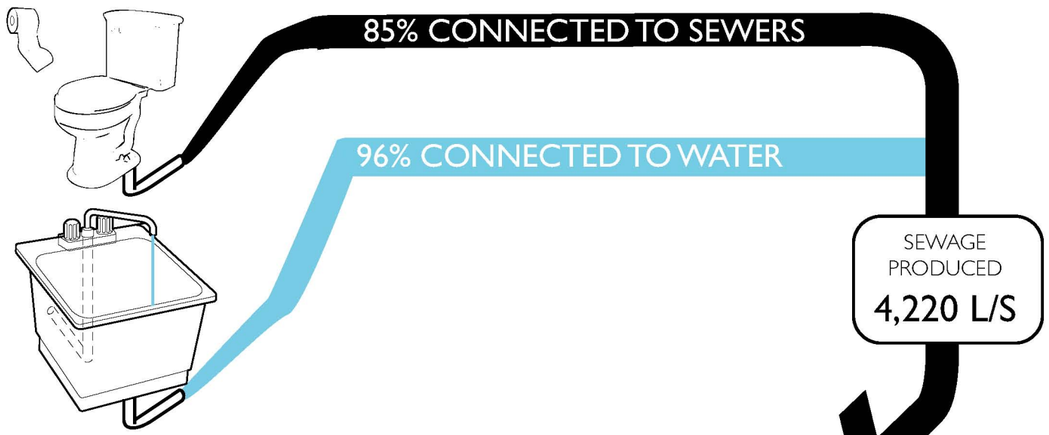


Data from Plan Desarollo 2011

JUAREZ

$ =

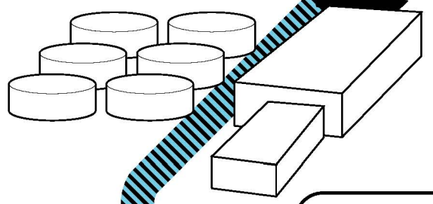




85% CONNECTED TO SEWERS

96% CONNECTED TO WATER

SEWAGE PRODUCED
4,220 L/S



AVERAGE SEWAGE TREATED
2800 L/S (66%)

1420 L/S SEWAGE RETURNED TO IRRIGATION CANAL

NO CONSUMABLE CROPS

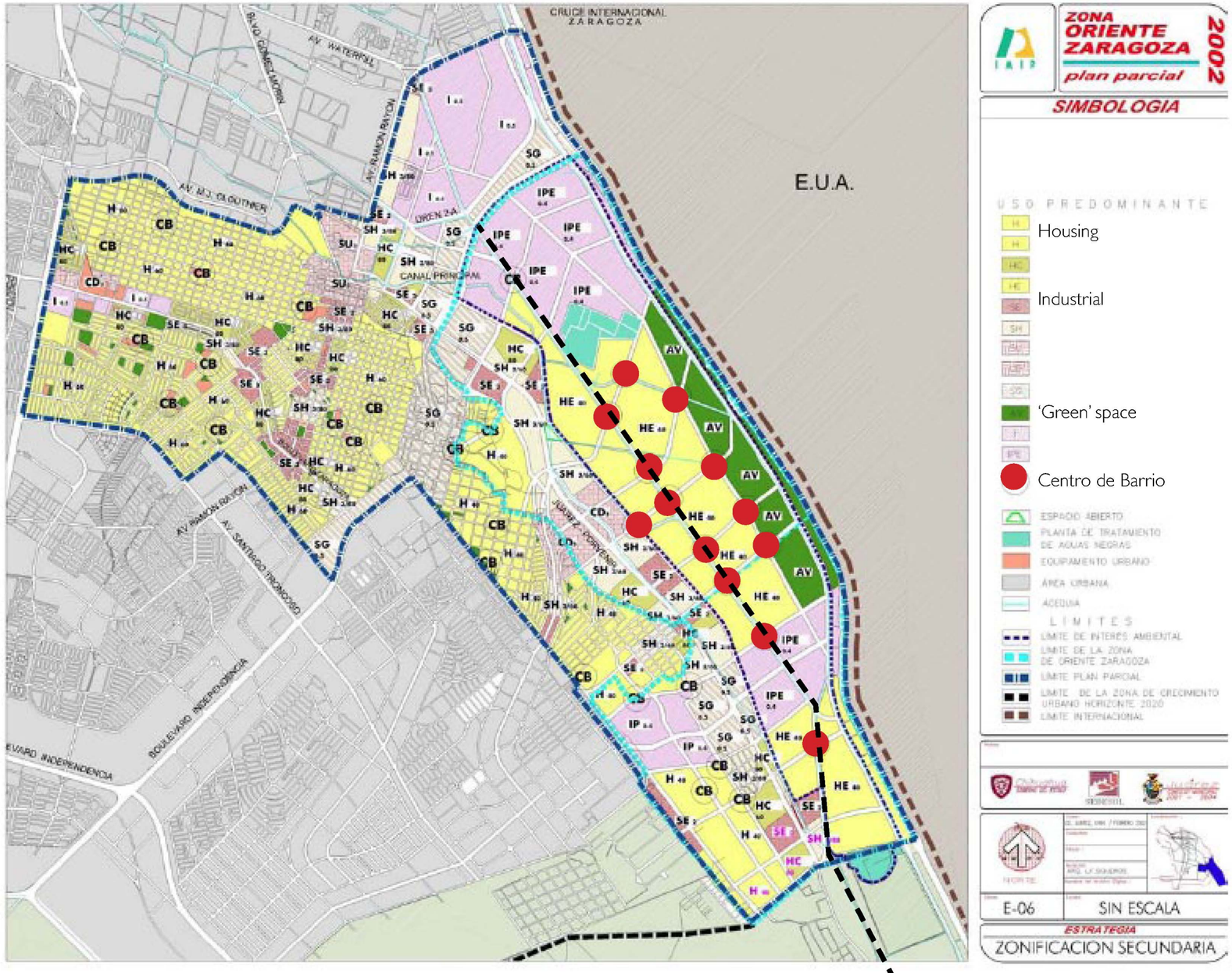
NORTH WATER TREATMENT PLANT 1997

SOUTH WATER TREATMENT PLANT 1997

DSD Urban Asymmetries P5- Sara Navrady

Since the 1980s El Paso has been recharging the Hueco Bolson with treated wastewater. In 1993 El Paso's Roberto Bustamante WWTP started directing treated water through the newly established 1.5km^2 Rio Bosque Wetlands Park during the off-peak irrigation periods. The park now hosts a variety of native plants and animals that have returned to the habitat. The border fence has limited the parks expansion.

image from http://research.utep.edu



IMIP Zona Oriente Zaragoza Plan Parcial 2002

www.googlemaps.com

CASE STUDY ISSUES

MONO FUNCTIONALITY

NO CONNECTIVITY WITH THE REST OF THE CITY
PUBLIC TRANSPORT

BAD ACCESS TO HEALTH AND EDUCATION
POOR QUALITY OF PUBLIC AND GREEN SPACES

VAST OPEN UNDEFINED SPACES

SAME TYPOLOGY OF HOUSINGS

ANY DIFFERENCE BASED ONLY ON SIZE DEPENDING ON INCOME

INCOMPLETENESS OF THE INITIAL PLANNING

STATE PROVIDED SECURITY NOT ENOUGH
EXTORTION AS A SIDE EFFECT OF IT

CONCENTRATION OF ACTIVITIES IN ONE SPECIFIC AREA

BAD INFRASTRUCTURE

ROADS UNFINISHED

OPEN SEWAGE CROSSING THE NEIGHBORHOOD

LOW BUILT DENSITY

LOW INCOME

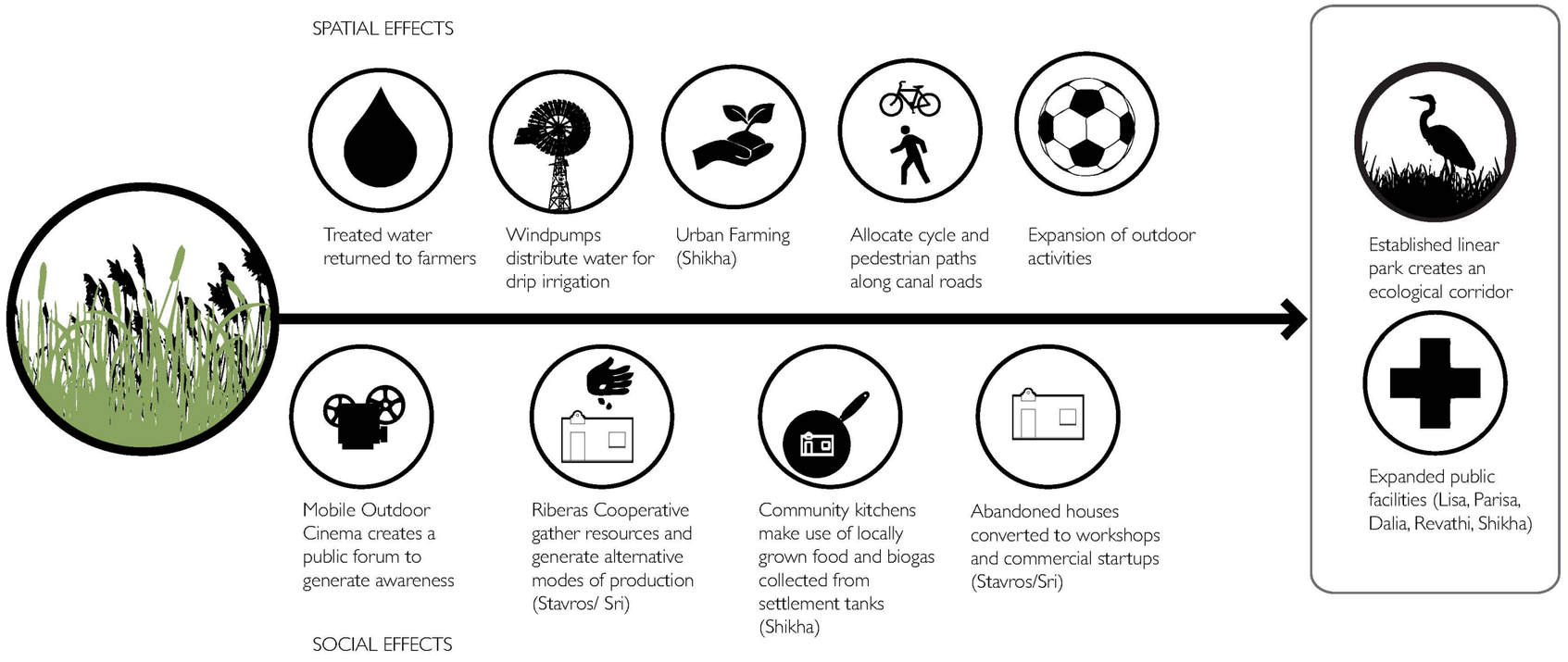
RIVERAS BUILT IN ALLUVIAL SOIL, WASTING FERTILE AGRICULTURAL LAND

FLOODING

LACK OF LOCAL ECONOMY

LACK OF PARTICIPATORY STRUCTURE FOR THE REPRESENA TION OF THE INHABITANTS

NO DIVERSITY IN INCOME GROUPS



KEY PLAYERS

RESIDENTS OF RIBERAS DEL BRAVO

KNOWLEDGE BASE
El Colegio de la Frontera Norte
UACJ- Universidad Autonomica de Ciudad Juarez
GIZ-ecosan constructed wetlands

INTERNATIONAL AGENCIES
Inter American Development Bank

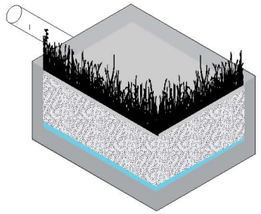
US AGENCIES
USAID
EPA-Environmental Protection Agency

NATIONAL & STATE AGENCIES
SEMARNAT- Secretariat of the Environment and Natural Resources
CONAGUA- National Water Commission
CMAS- State Board of Water and Sanitation
Gobierno de Chihuahua
INFONAVIT- Institute for Workers Housing

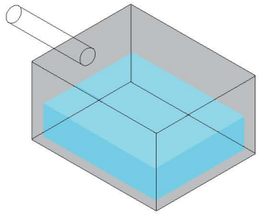
TRANS-BORDER AGENCIES
IBWC- International Boundary and Water Comission
BECC- Border Environment Cooperation Comission
NADB- North American Development Bank

LOCAL AGENCIES
Gobierno de Cludad Juarez
JMAS- Municipal Board of Water and Sanitation

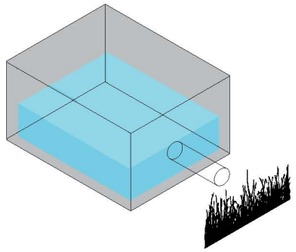
INFRASTRUCTURE



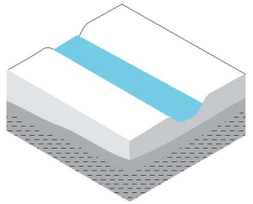
TREATMENT



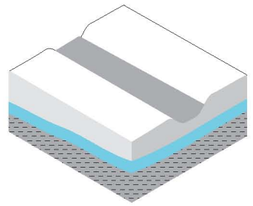
ACTIVE RAINWATER STORAGE



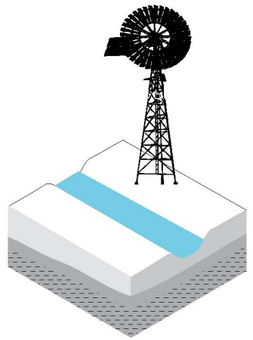
RE-USE



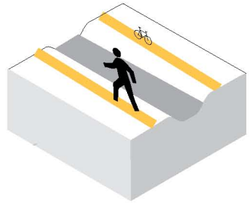
TREATED CANAL WATER



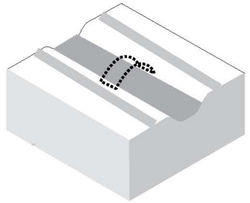
GROUNDWATER REGHARGE



IRRIGATION

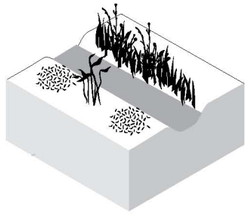


PEDESTRIAN ORIENTED CIRCULATION

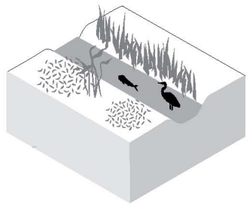


IMPROVED CONNECTIVITY

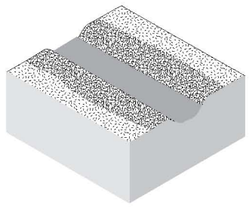
ECOLOGICAL



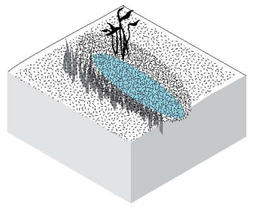
REMEDIATED AND ENHANCED VEGETATION



ECOLOGICAL CORRIDOR



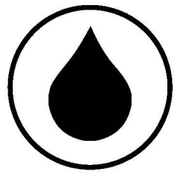
SELECTIVE GROUND COVER TO MINIMIZE EROSION



PASSIVE RAINWATER STORAGE

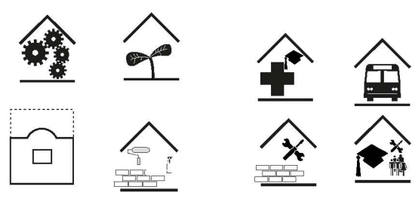
PUBLIC SPACE

RIBERAS CO-OPERATIVE

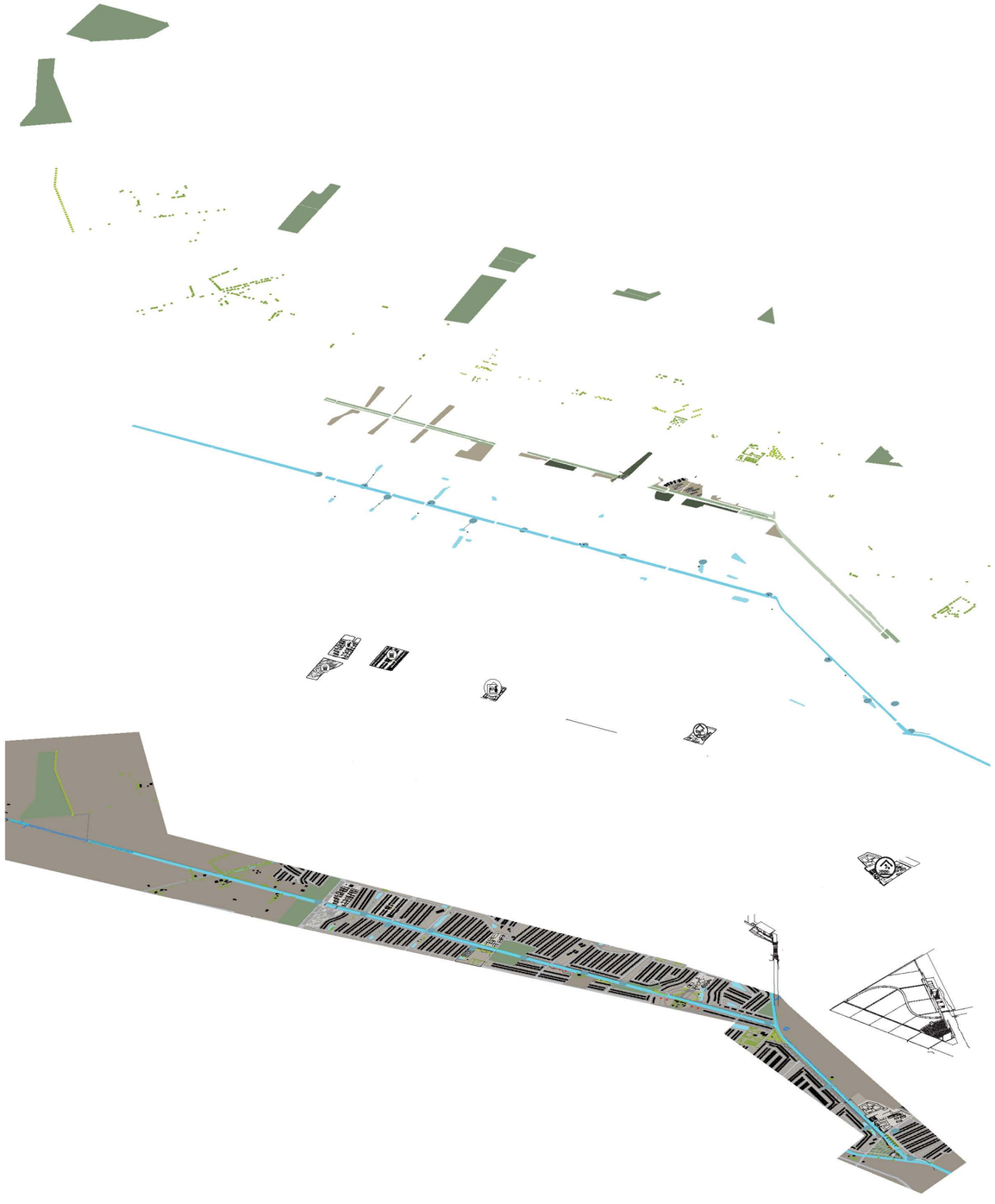


WATER EDUCATION

SPORTS AND RECREATION



PUBLIC SERVICES



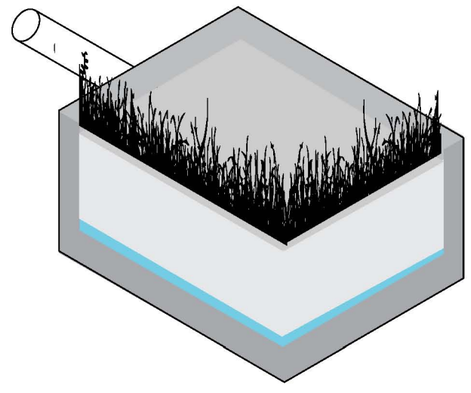
Constructed wetlands

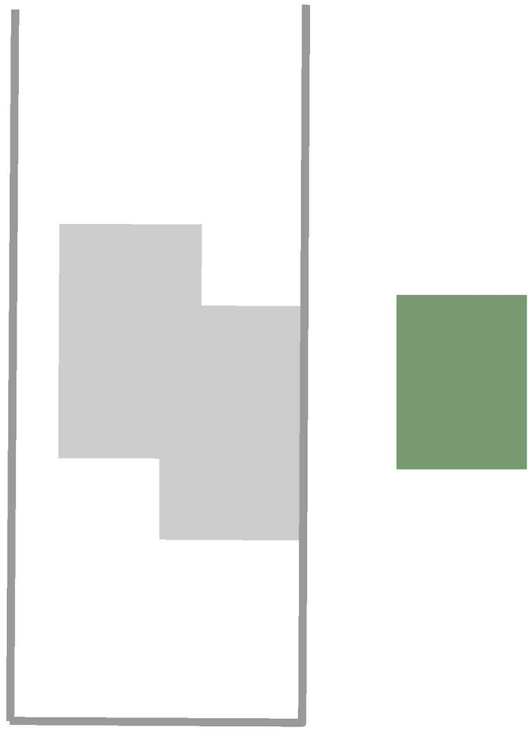
Landscape

Water

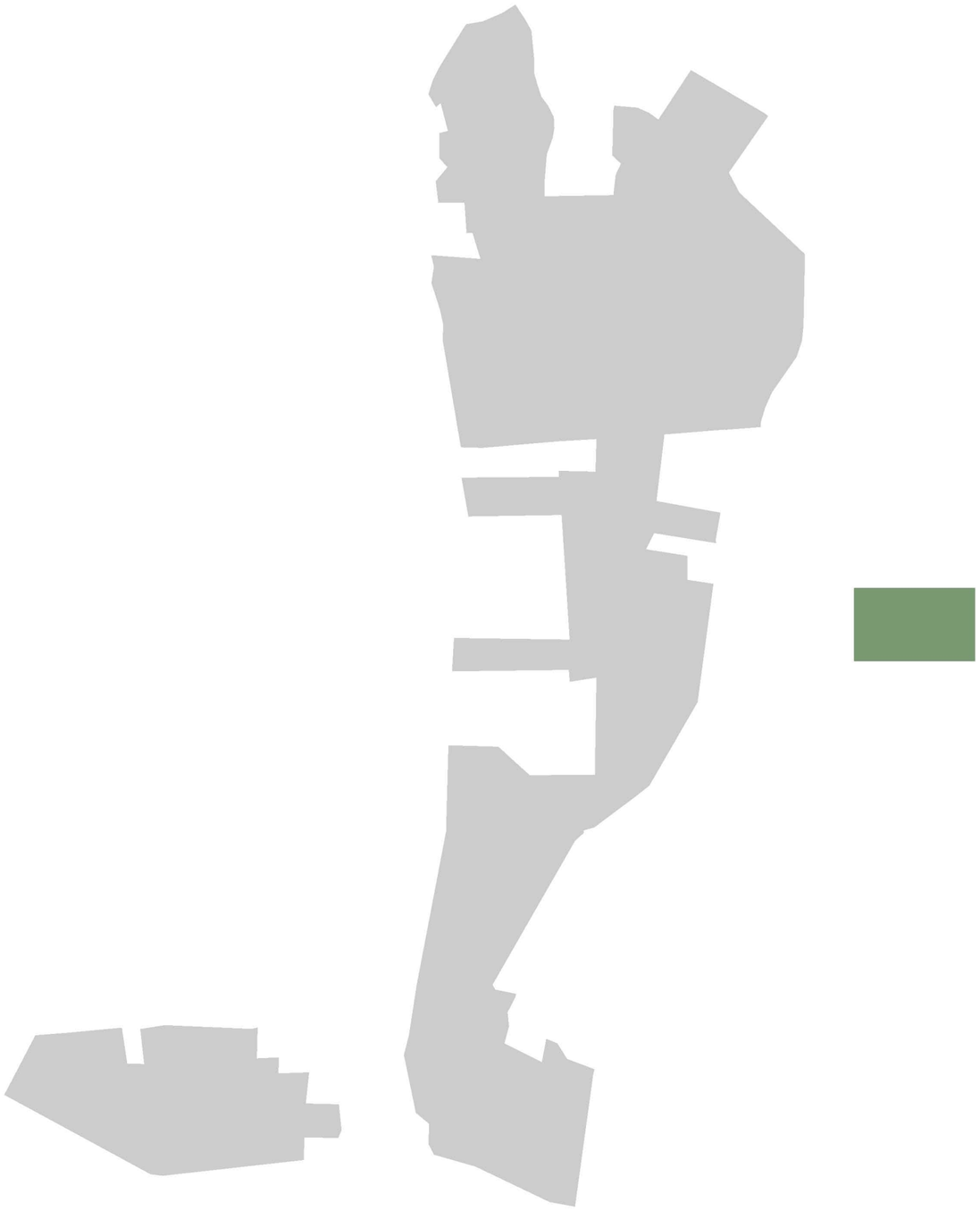
Public amenities

What is required is a new mindset that might see the design of infrastructure not as simply performing to minimum engineering standards, but as capable of triggering complex and unpredictable urban effects in excess of its designed capacity. - Stan Allen

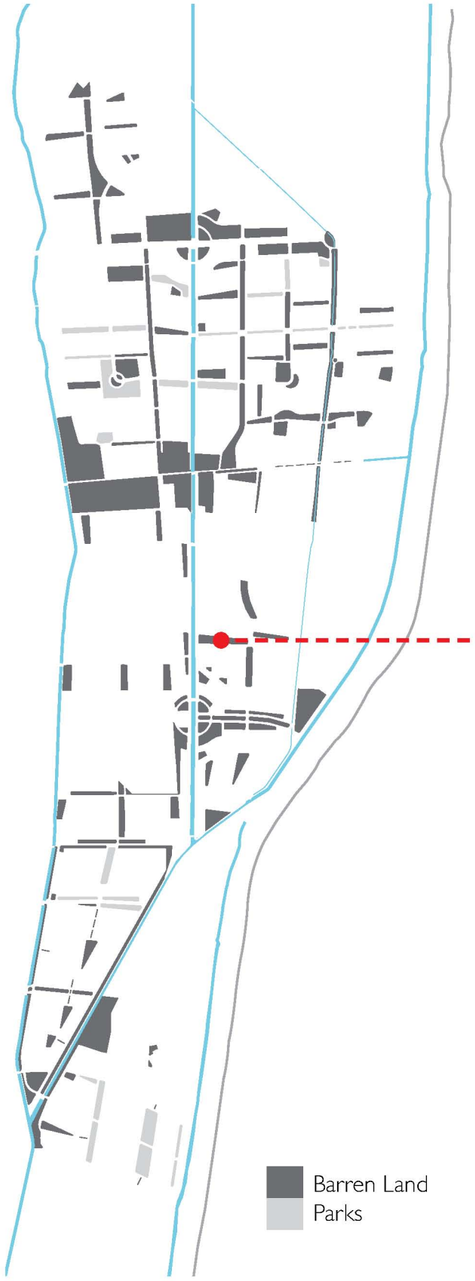




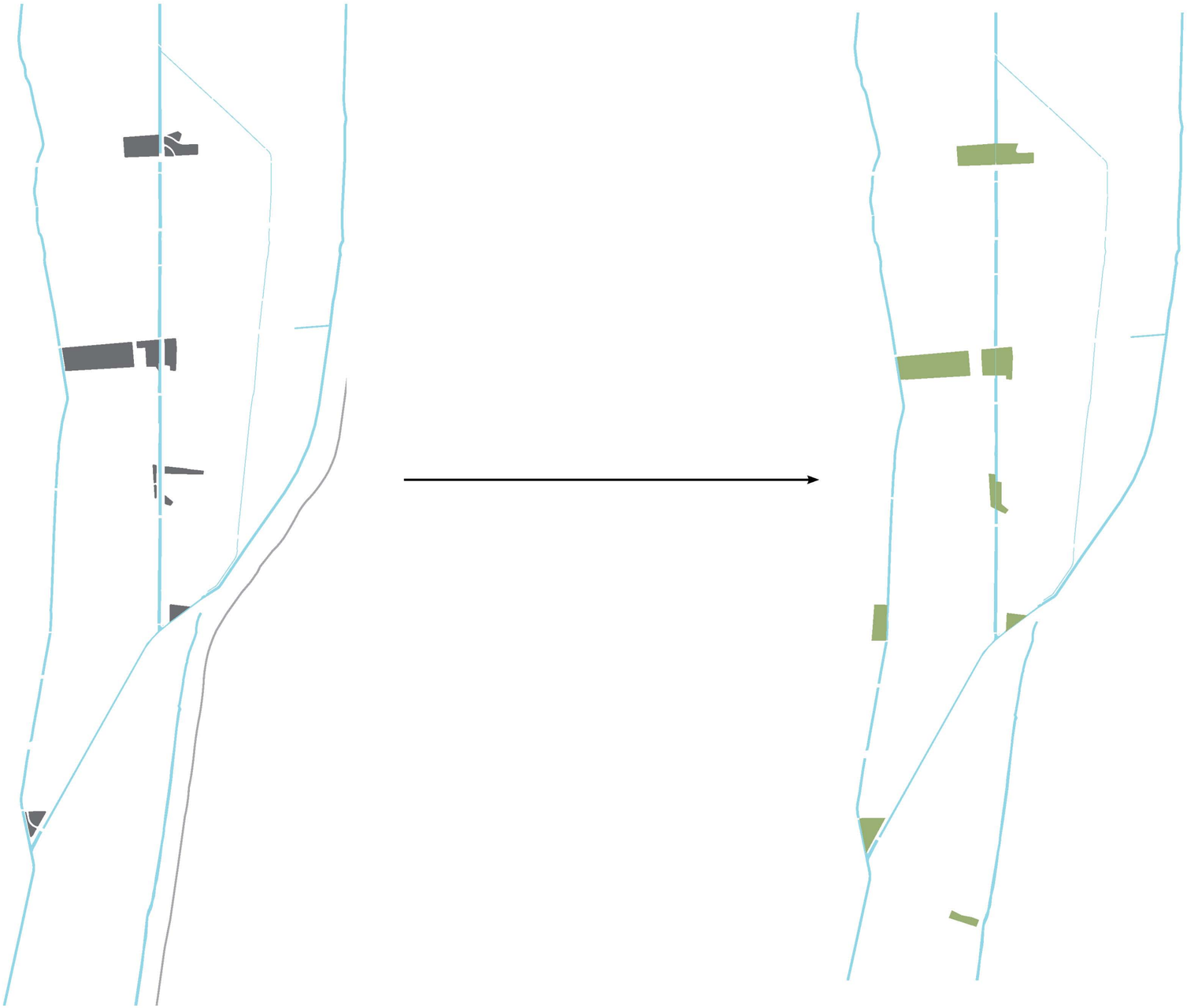
1 HOUSEHOLD = 12M^2 OF VERTICAL FLOW CONSTRUCTED WETLANDS

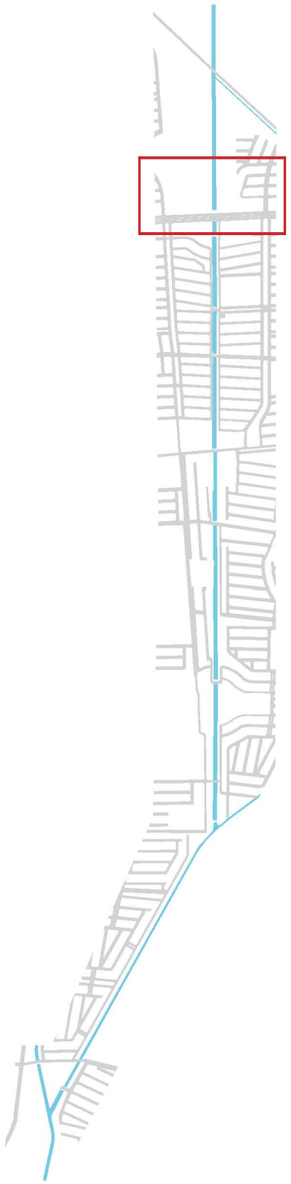


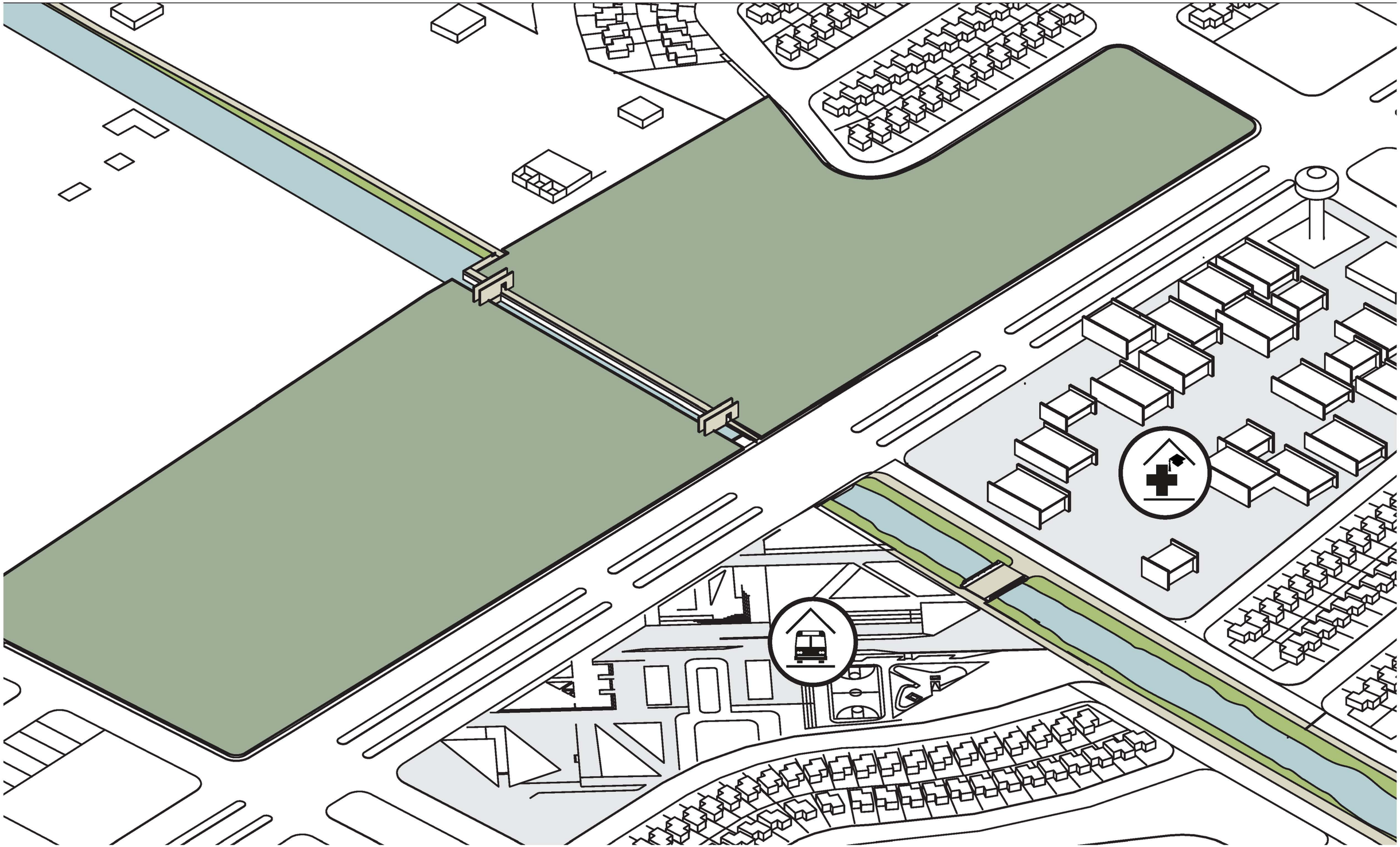
RIBERAS DEL BRAVO = 150 000 M^2 OF CONSTRUCTED WETLANDS

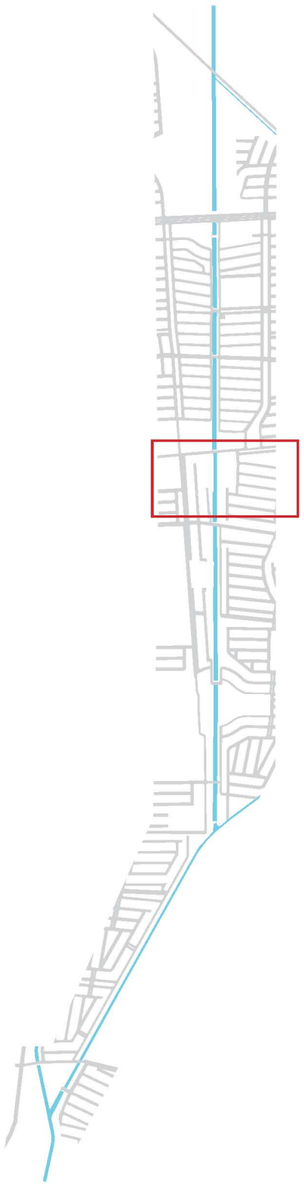


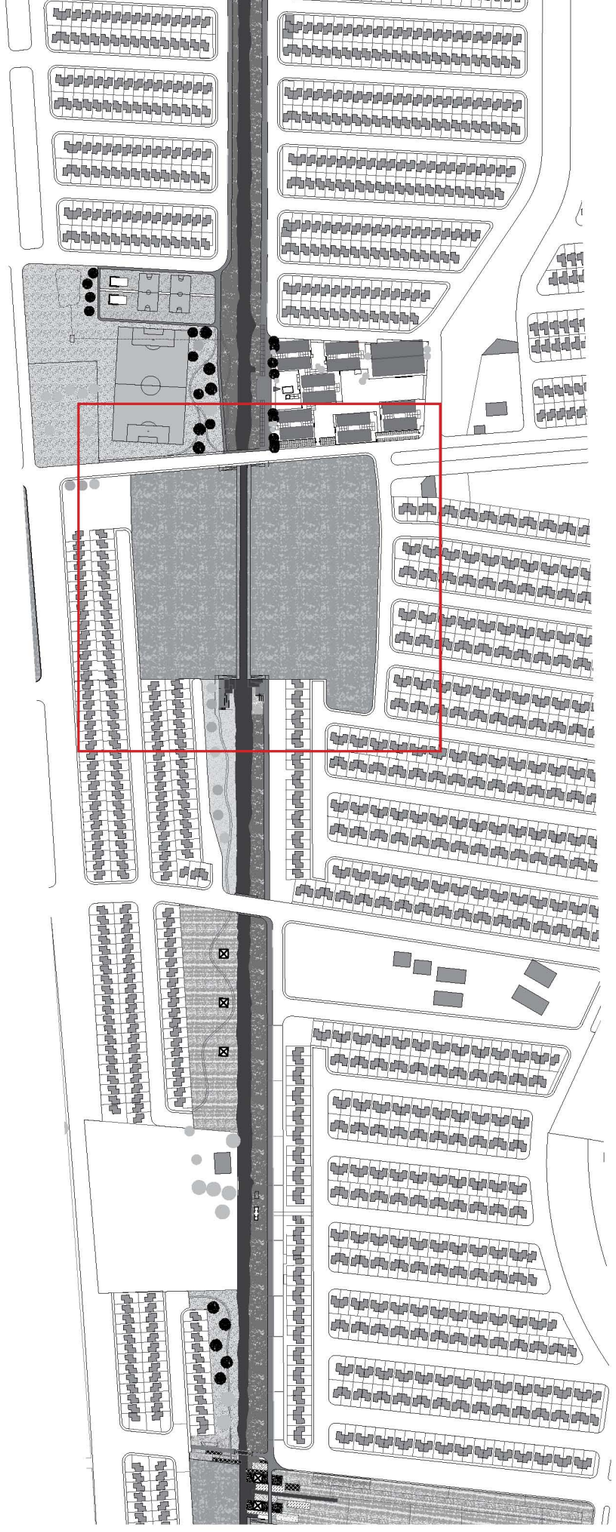
47% of 'parks' are undefined dirt patches

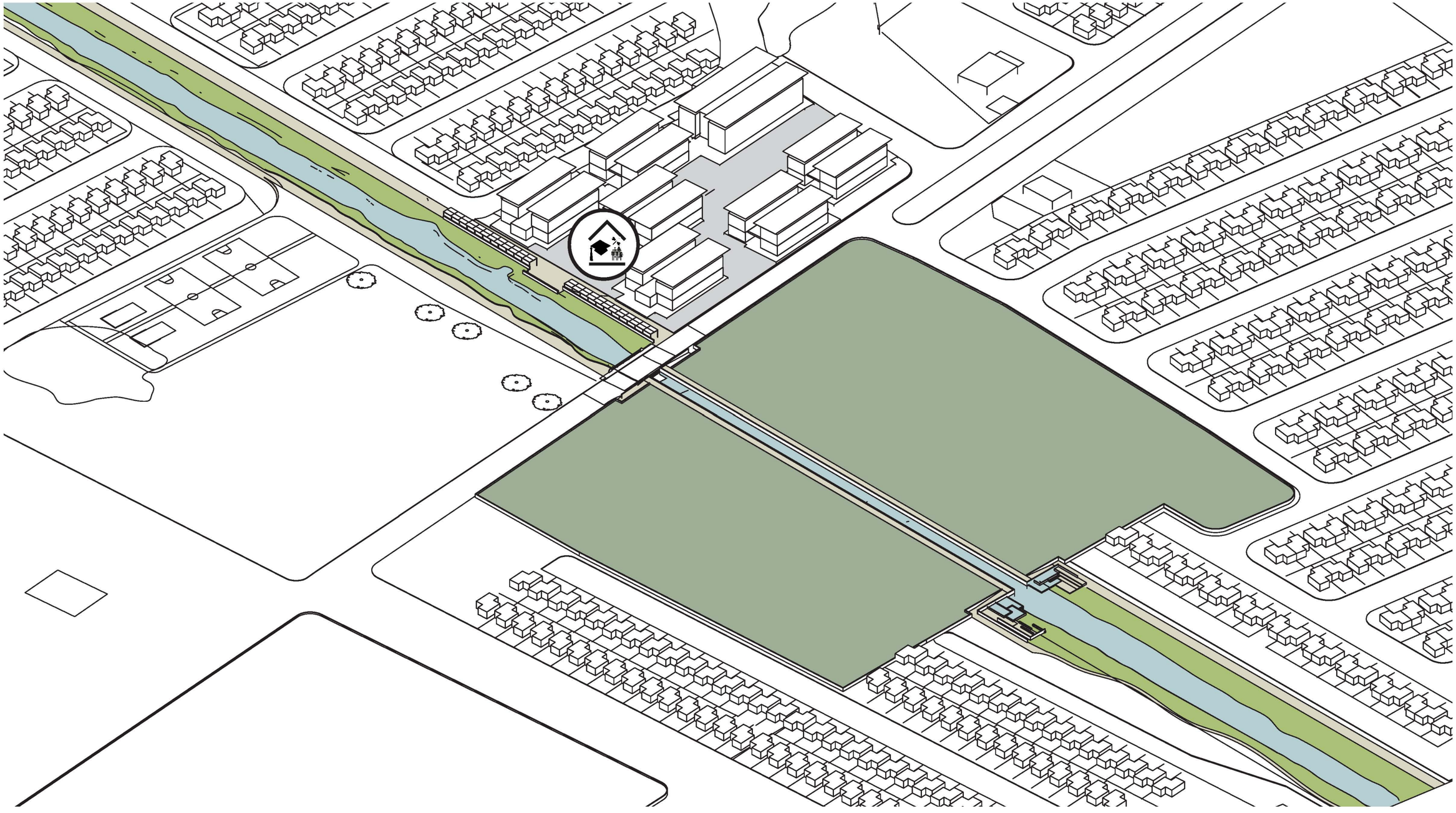












CATTAILS
Typha domingensis

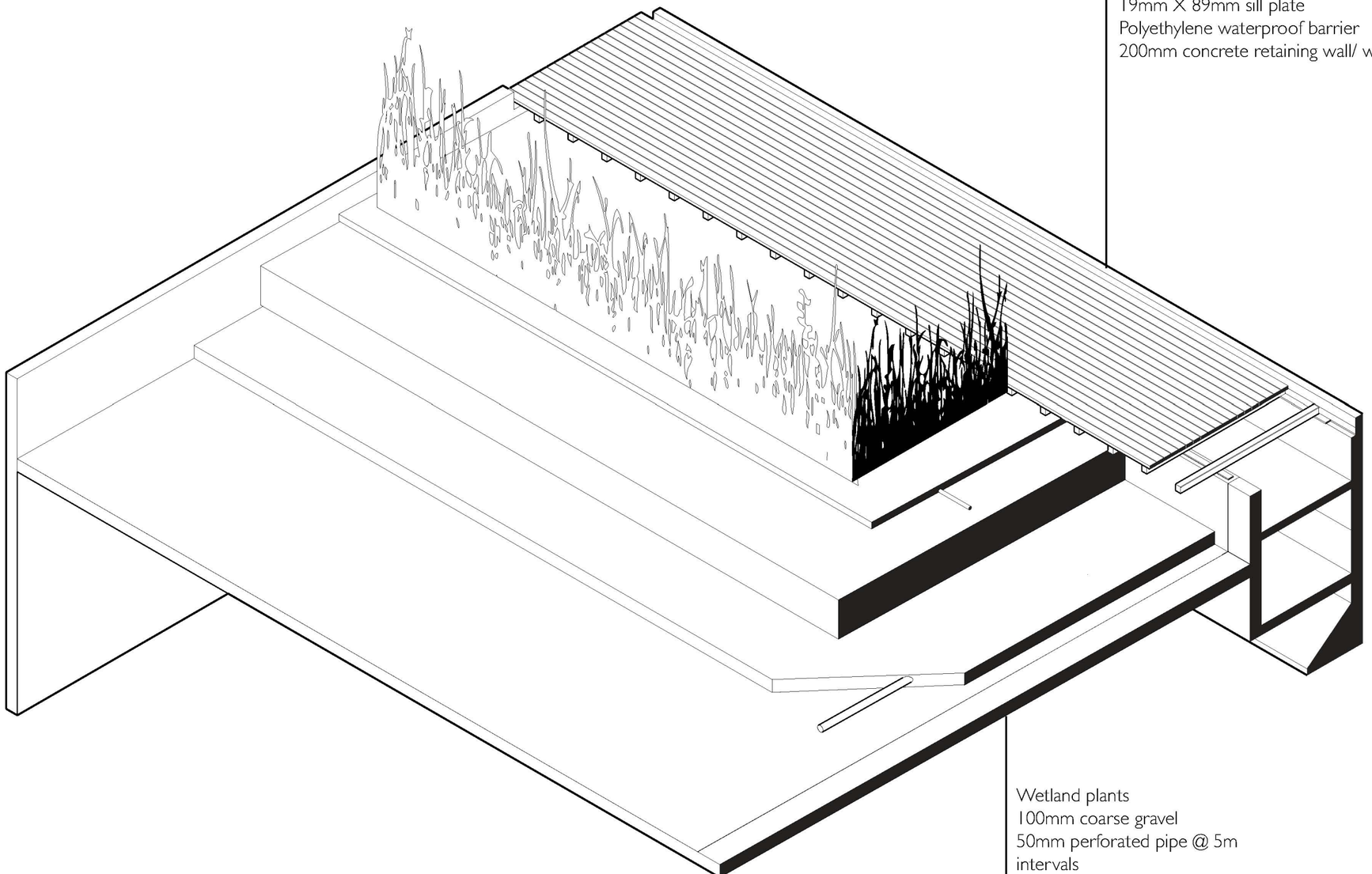
YERBA MANSA *
Anemopsis californica

SCOURING RUSH
Equisetum hyemale

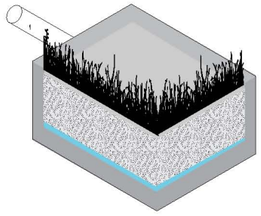
FRANK'S SEDGE
Carex frankii

SALTMEADOW CORDGRASS *
Spartina patens

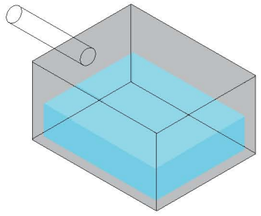
REEDS
Phagmites communis


Wood decking with 10mm spacing
Polyethylene cap
90 X 90mm timber joists spaced @ 600mm
19mm X 89mm sill plate
Polyethylene waterproof barrier
200mm concrete retaining wall/ water trough
Wetland plants
100mm coarse gravel
50mm perforated pipe @ 5m intervals
600mm sand
200mm coarse gravel
100mm french drain piping
polyethylene waterproofing
100mm concrete floor

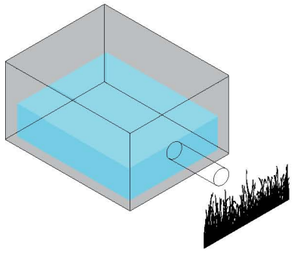
INFRASTRUCTURE



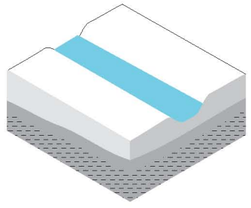
TREATMENT



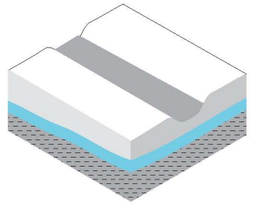
ACTIVE RAINWATER STORAGE



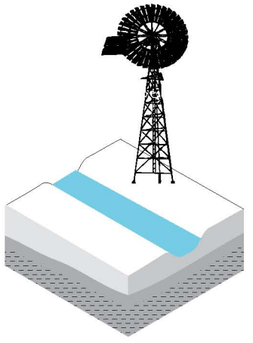
RE-USE



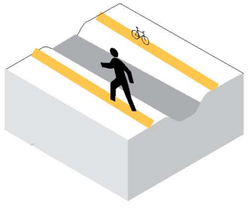
TREATED CANAL WATER



GROUNDWATER REGHARGE

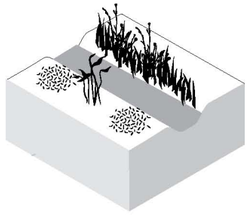


IRRIGATION

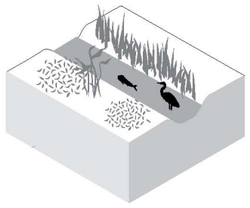


PEDESTRIAN ORIENTED CIRCULATION

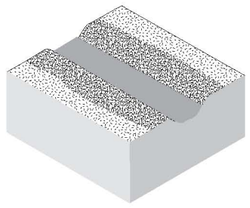
ECOLOGICAL



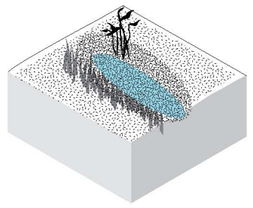
REMEDIATED AND ENHANCED VEGETATION



ECOLOGICAL CORRIDOR

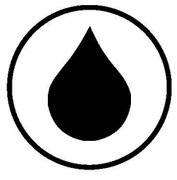


SELECTIVE GROUND COVER TO MINIMIZE EROSION



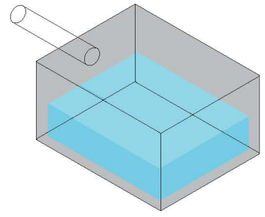
PASSIVE RAINWATER STORAGE

PUBLIC SPACE

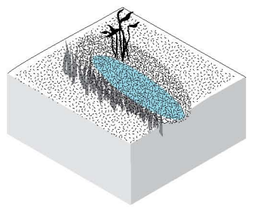


WATER EDUCATION

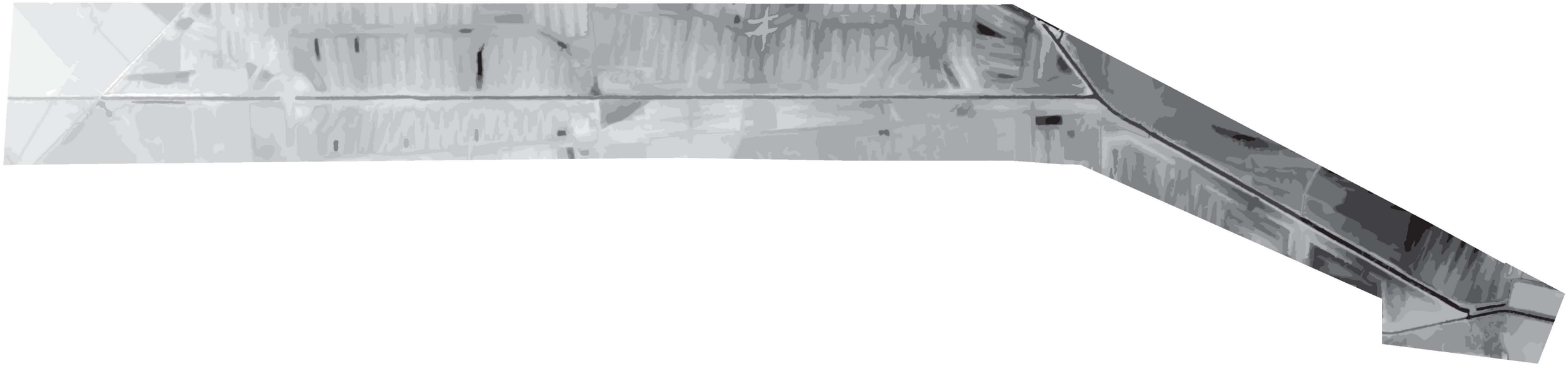
SPORTS AND RECREATION



ACTIVE RAINWATER
STORAGE

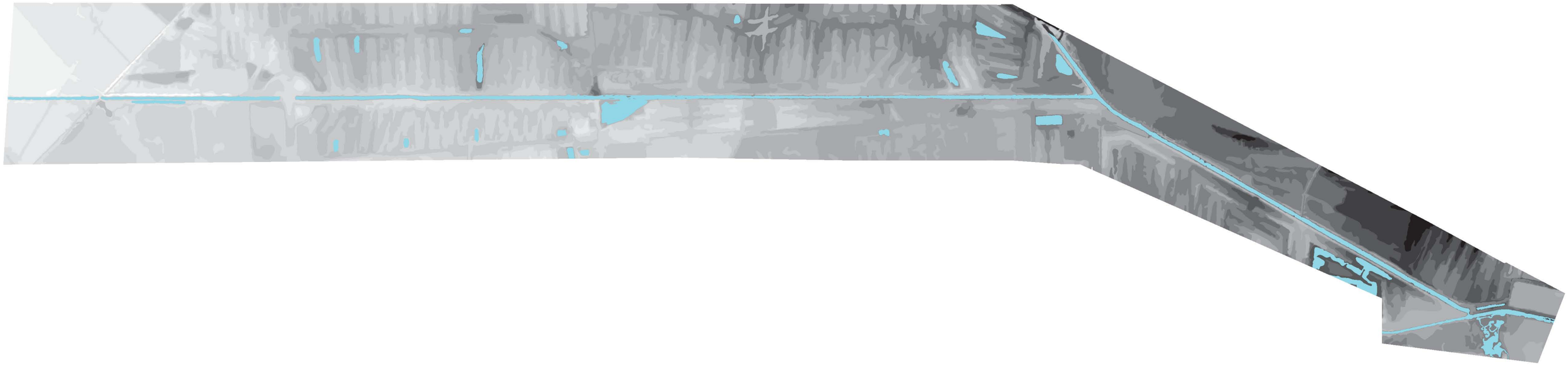


PASSIVE RAINWATER STORAGE



+4.27m (+15 ft)

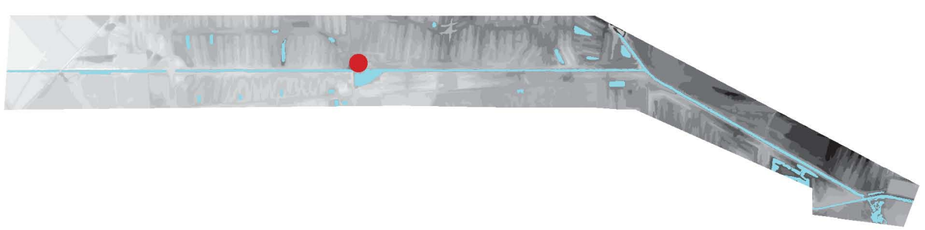
+ 0.0m (0ft)

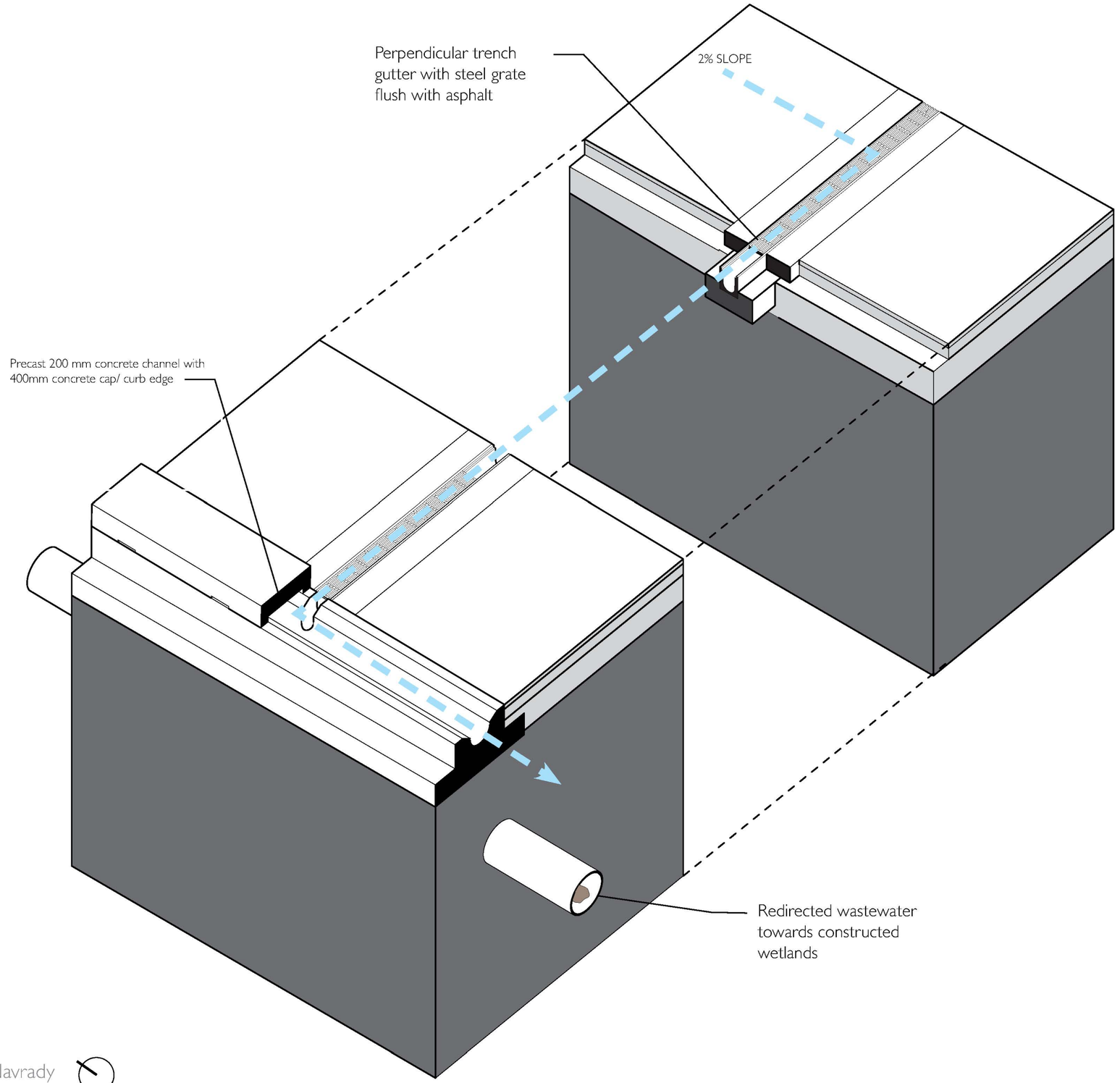


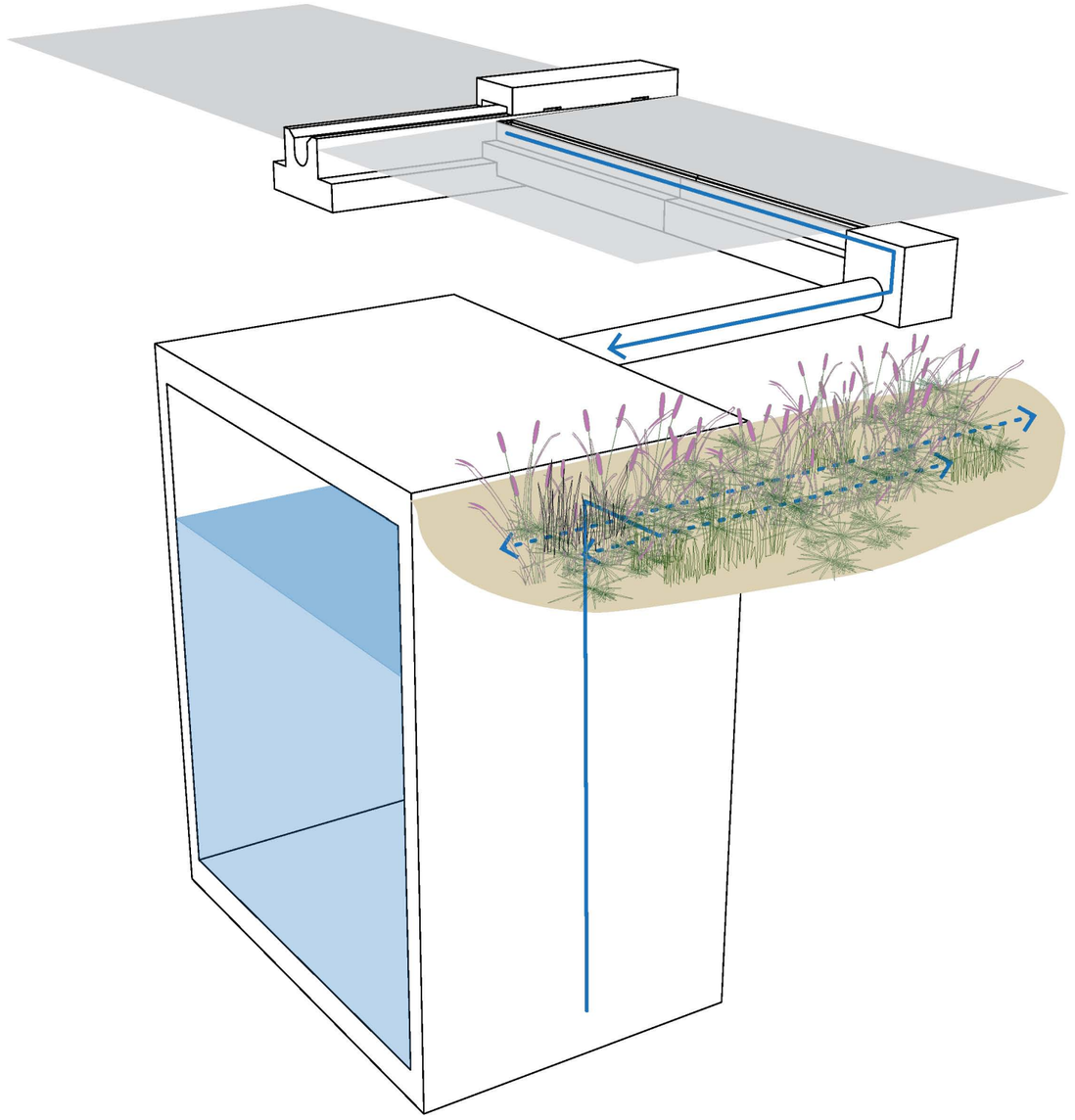
+4.27m (+15 ft)

+ 0.0m (0ft)

www.bing.com/maps




Perpendicular trench
gutter with steel grate
flush with asphalt
2% SLOPE
Precast 200 mm concrete channel with
400mm concrete cap/ curb edge
Redirected wastewater
towards constructed
wetlands



COLLECTING WATER FROM A 100M STRETCH OF STREET WILL GENERATE 257M^3 (or 257 000L) OF RAINWATER PER YEAR

WHITEHORN ACACIA ✱

Acacia constricta

LITTLELEAF ASH

Fraxinus greggii

GOLDENBALL LEADTREE

Leucaena retusa

ESCARPMENT LIVE OAK

Quercus fusiformis

MEXICAN BLUE OAK

Quercus oblongifolia

WHITE SAGE ✱

Artemisia ludoviciana

WOOLLY BUTTERFLYBUSH

Buddleja marrubiifolia

FAIRY DUSTER

Calliandra conferta

OCOTILLO✱

Fouquieria splendens

SILKTASSEL ✱

Garrya wrightii

LITTLELEAF RAIN SAGE ✱

Leucophyllum minus

BROOM DALEA✱

Psorothamnus scoparius

ORANGE ZEXMENIA

Wedelia texana

TUBULAR BLUESTAR ✱

Amsonia longiflora

MAXIMILIAN SUNFLOWER ✱

Helianthus maximiliani

INDIAN RUSHPEA ✱

Hoffmannseggia glauca

SUPERB BEARDTONGUE ✱

Penstemon superbus

SIDEOATS GRAMA ✱

Bouteloua curtipendula

NEW MEXICO FEATHERGRASS ✱

Hesperostipa neomexicana

ALKALI SACATON ✱

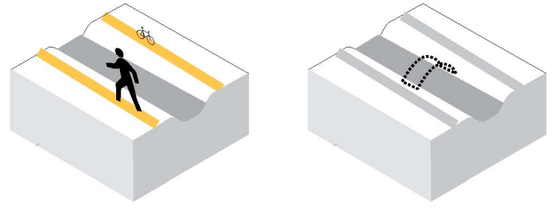
Sporobolus airoides

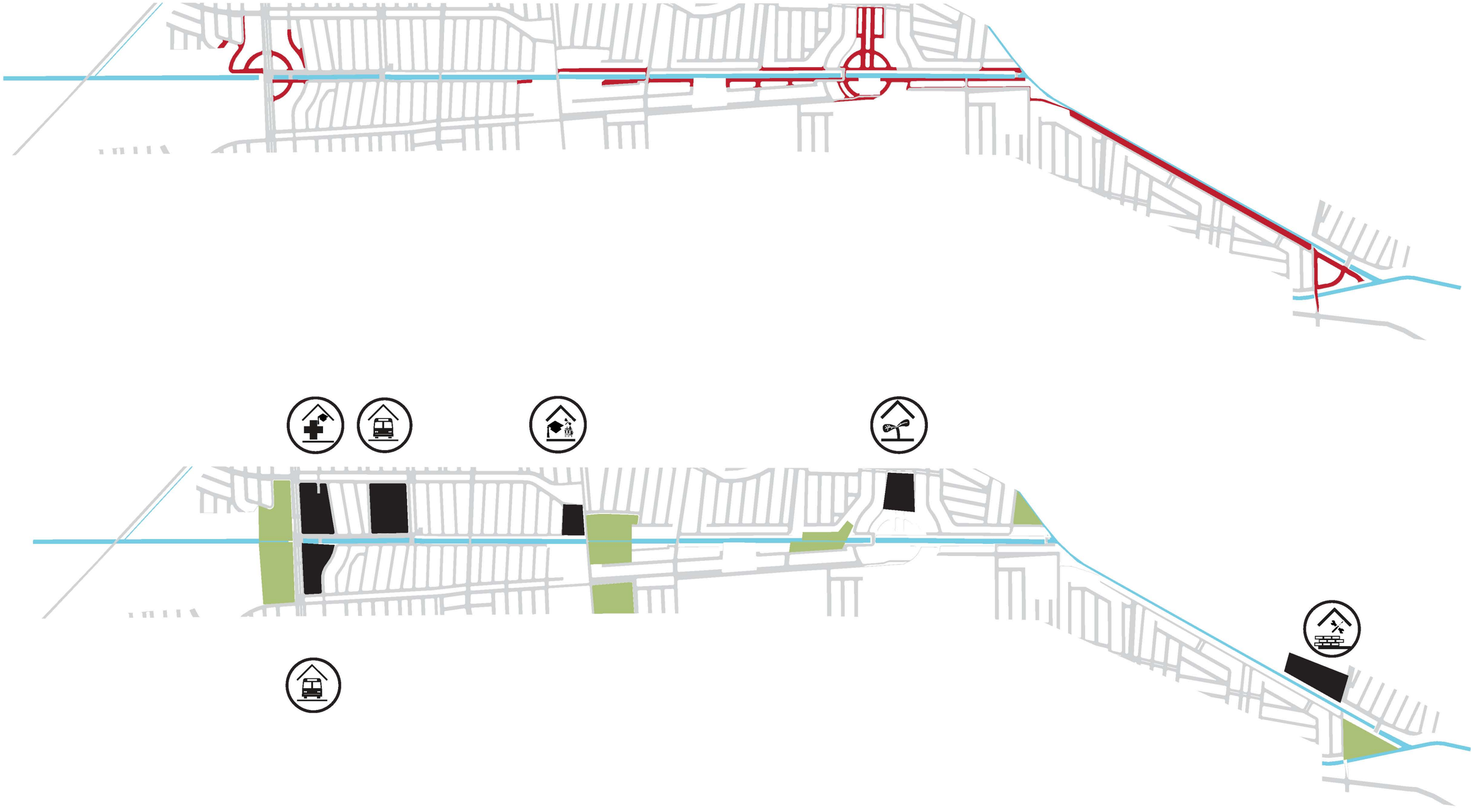
MUHLY GRASS "REGAL MIST"

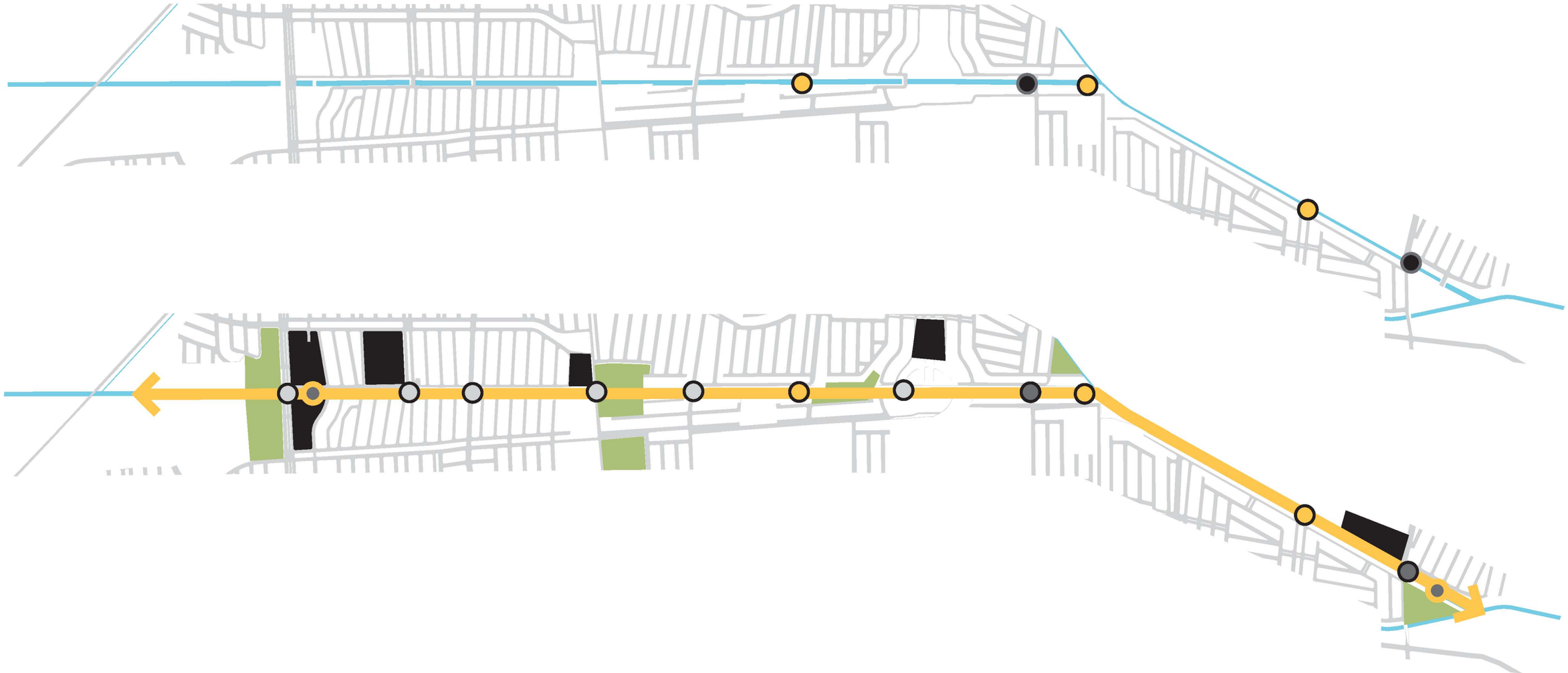
Muhlenbergia capillaris

PLANT TAXONOMY

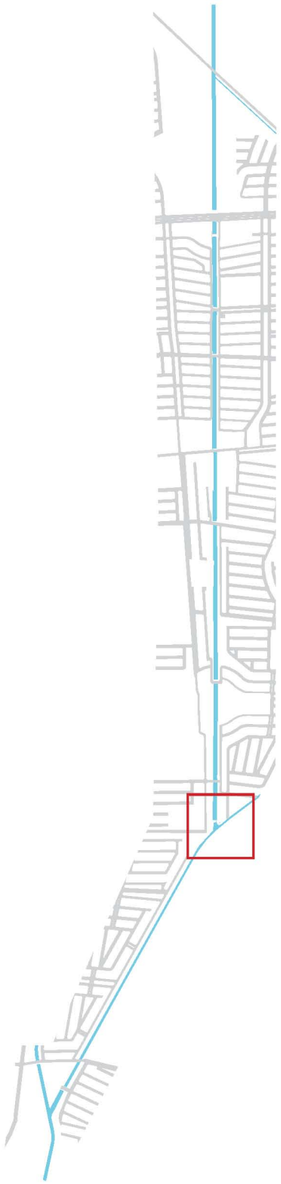
NAME	SCIENTIFIC NAME	HEIGHT	WIDTH	NATIVE	WATER EFFICIENT	PERRENIAL	BI-ANNUAL	ANNUAL	DECIDUOUS	EVERGREEN	WELL DRAINED	DRY	MOIST	AQUATIC	WETLANDS	RIVERBED/ RIPARIAN	DESERT	BRUSH	WOODLAND	SLOPES/HILLS	PLAINS/PRAIRIES/PASTURE	ROCKY	GRAVEL	LIMESTONE	SAND	CLAY	LOAM	CALICHE	FULL SUN	PART SHADE	SHADE	BEES	BUTTERFLIES	BIRDS	HUMMINGBIRDS	PERIOD OF BLOOM	J	F	M	A	M	J	JL	A	S	O	N	D
RAIN GARDENS																																																		
TREES																																																		
WHITEHORN ACACIA	*Acacia constricta*	2700-4500	2700-4500	✱	●	×				×		×					×		×	×				×	×		×		○	◑	●																		
LITTLELEAF ASH	*Fraxinus greggii*	5800	2400		●	×						×								×		×		×	×	×	×		◑																		
GOLDENBALL LEADTREE	*Leucaena retusa*	3650-7600	3500-4500		●	×			×			×					×			×		×		×	×	×	×	×	○	◑																		
ESCARPMENT LIVE OAK	*Quercus fusiformis*	6100-12000			●	×				/		×					×			×				×	×	×	×	×	○	◑																		
MEXICAN BLUE OAK	*Quercus oblongifolia*	9100	9100		●	×				×		×					×			×				×	×	×	×			◑																		
SHRUBS																																																	
WHITE SAGE	*Artemisia ludoviciana*	450-900		✱	●	×				/		×							×	×	×	×		×	×	×	×	×	○																		
CENTENNIAL COYOTE BUSH	*Baccharis pilularis*	1200	1500		●	×				×		×								×					×	×	×		○	◑																		
WOOLLY BUTTERFLYBUSH	*Buddleja marrubiifolia*	1200	1200		●	×				/		×					×			×				×	×	×	×			◑																		
FAIRY DUSTER	*Calliandra conferta*	75-250	900		●	×			×			×						×		×				×				×		◑																		
OCOTILLO	*Fouquieria splendens*	6000		✱	●	×				×		×					×				×	×			×		×			◑																		
SILKTASSEL	*Garrya wrightii*	1900		✱	●	×				×		×								×		×		×						◑																		
LITTLELEAF RAIN SAGE	*Leucophyllum minus*	1200	1200	✱		×				/	×	×					×			×			×	×				×	○																		
BROOM DALEA	*Psorothamnus scoparius*	600		✱		×			×			×								×					×				○																		
ORANGE ZEXMENIA	*Wedelia texana*	200-900	600	✱	●	×				×	×	×	×									×		×	×			×	○	◑																		
FLOWERS																																																	
TUBULAR BLUESTAR	*Amsonia longiflora*	150		✱	●	×			×		×	×								×				×		×			○																		
MAXIMILIAN SUNFLOWER	*Helianthus maximiliani*	900-3000		✱	●	×						×	×								×				×	×	×	×		○																		
INDIAN RUSHPEA	*Hoffmannseggia glauca*	150		✱		×							×	×			z				×					×																						
FENDLER'S PENSTEMON	*Penstemon fendleri*	300-450		✱	●	×						×					×				×	×	×			×				○																		
GRASSES																																																	
SIDEOATS GRAMA	*Bouteloua curtipendula*	600-900		✱		×						×	×	×							×	×			×	×	×		○	◑																		
NEW MEXICO FEATHERGRASS	*Hesperostipa neomexicana*	600-900		✱	●	×						×	×	×						×			×		×				○																		
ALKALI SACATON	*Sporobolus airoides*	300-900		✱		×							×	×						×	×		×		×		×			◑																		
MUHLY GRASS "REGAL MIST"	*Muhlenbergia capillaris*	450--900	900		●	×				×		×	×								×				×	×			○																		

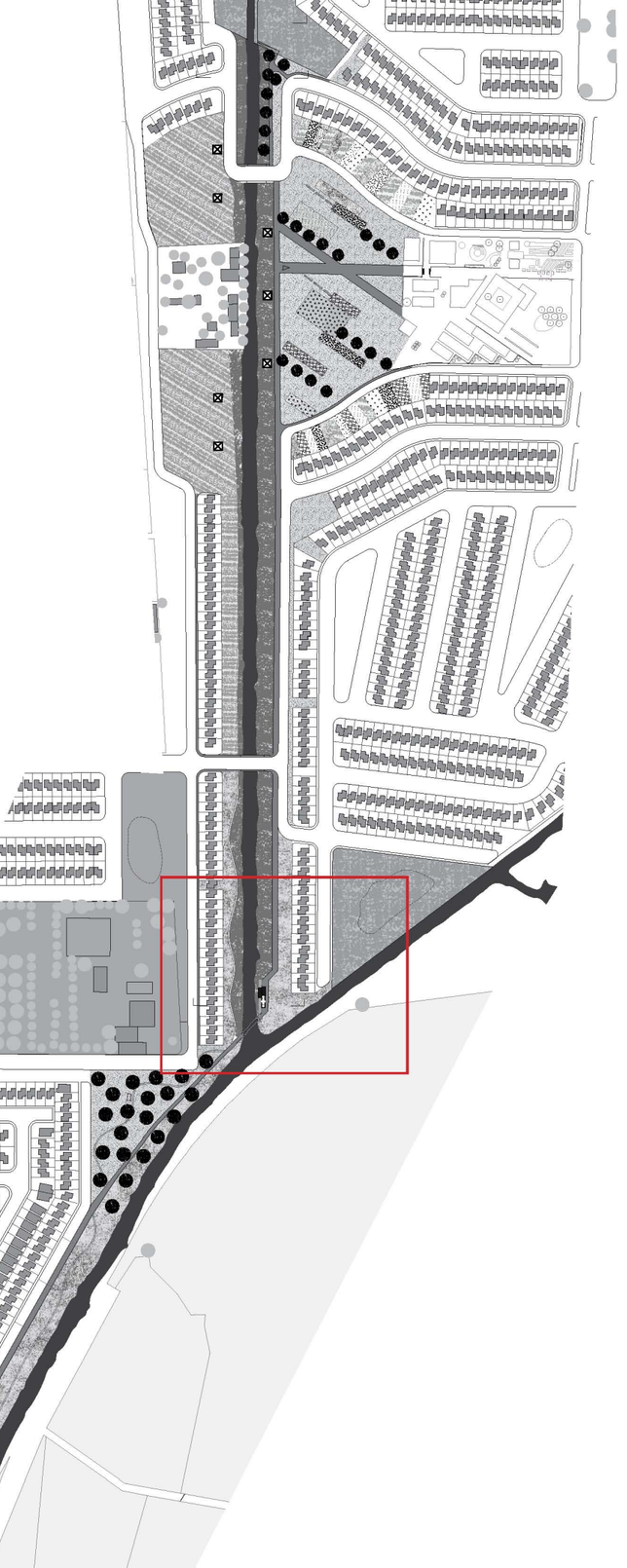


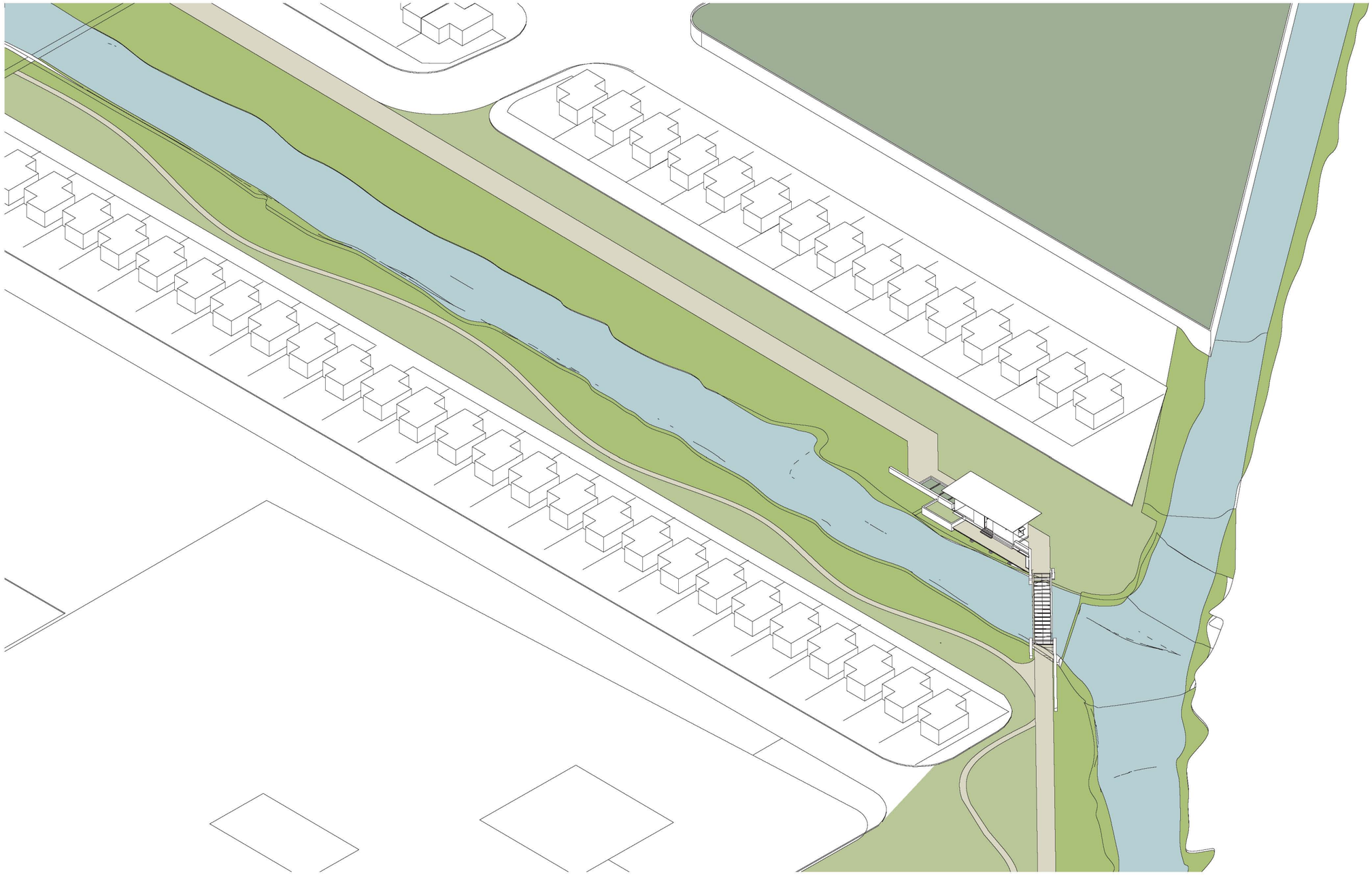


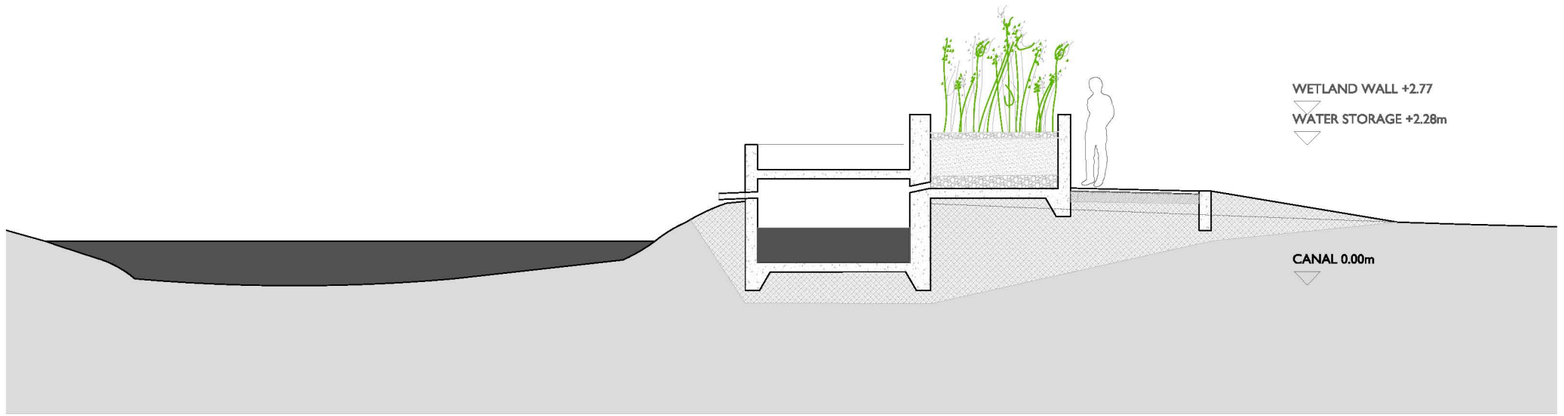


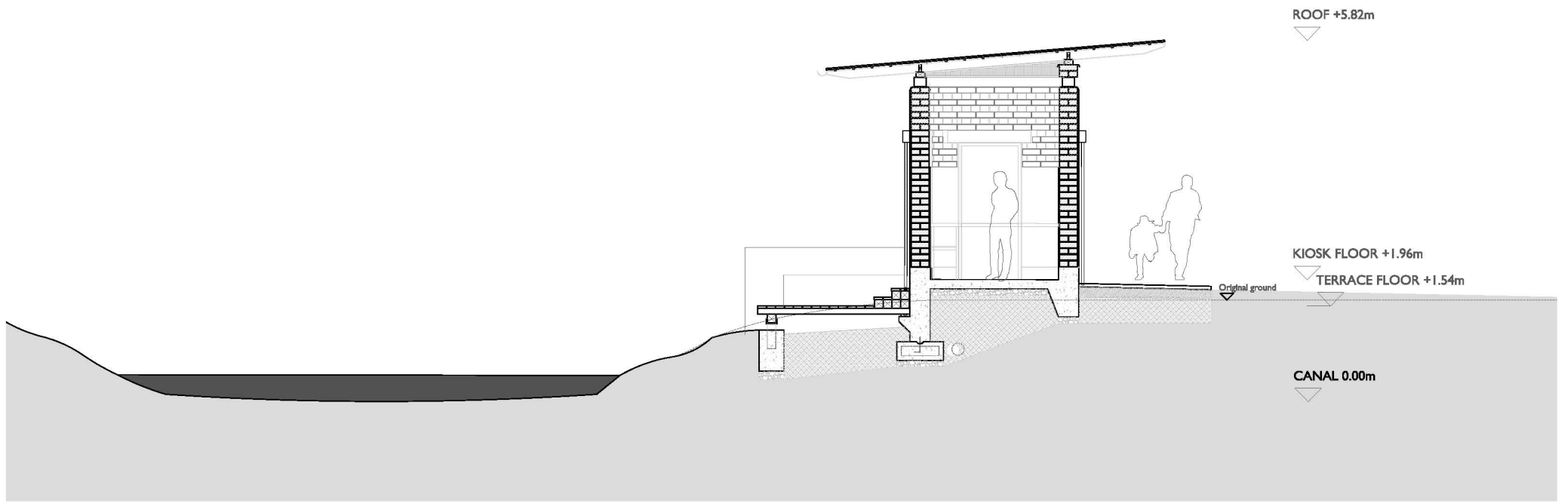
New vehicular bridge
New pedestrian bridge
Existing vehicle bridge
Vehicle bridge converted to pedestrian

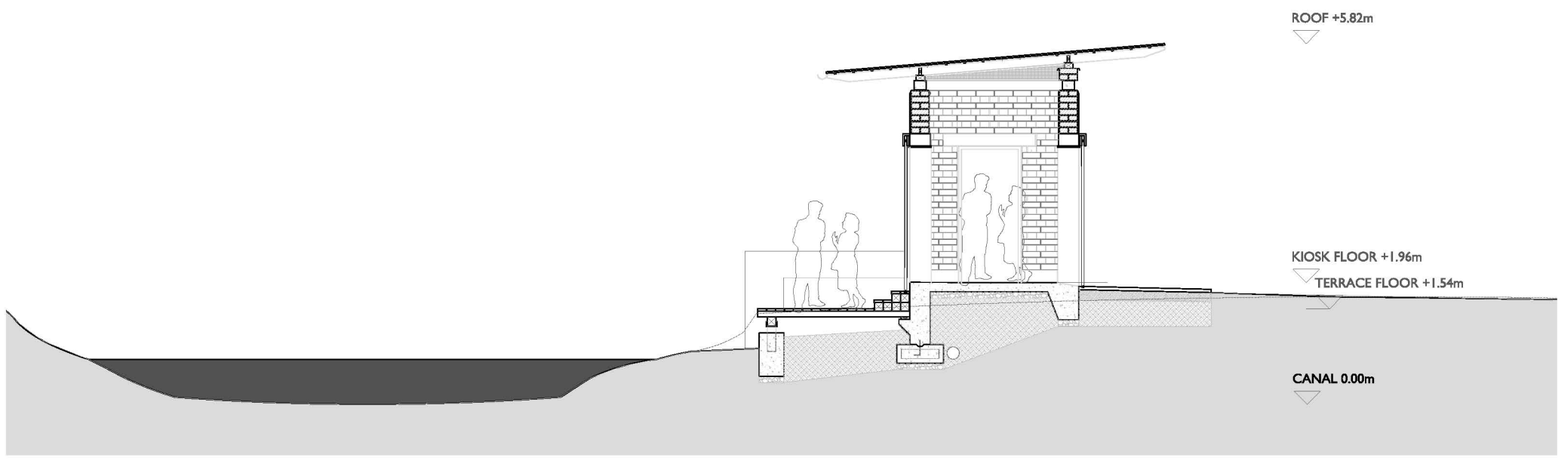


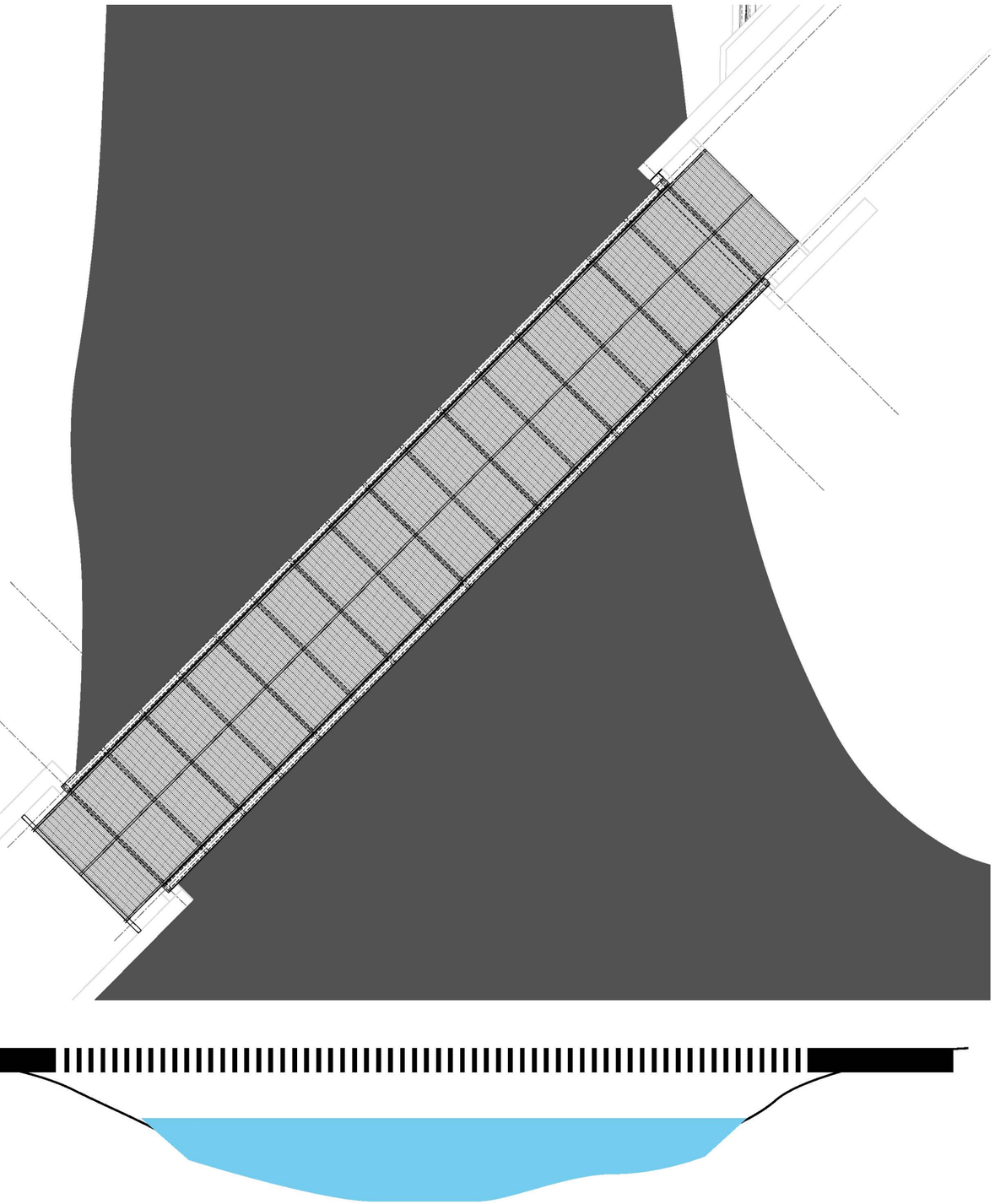


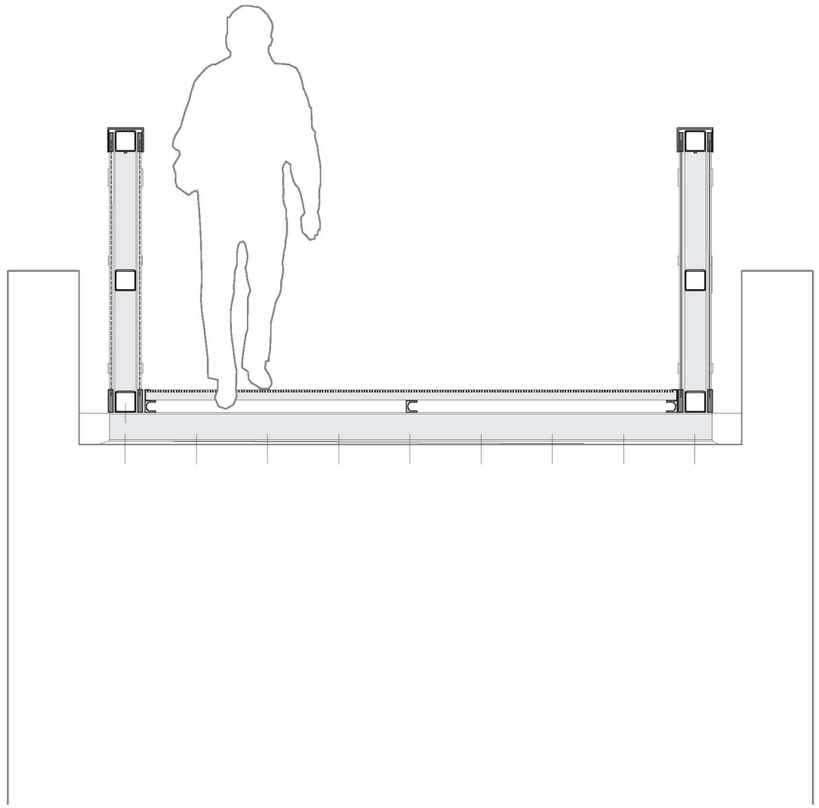



WETLAND WALL +2.77
WATER STORAGE +2.28m
CANAL 0.00m

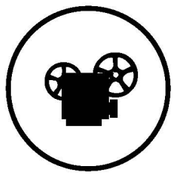

ROOF +5.82m
KIOSK FLOOR +1.96m
TERRACE FLOOR +1.54m
Original ground
CANAL 0.00m

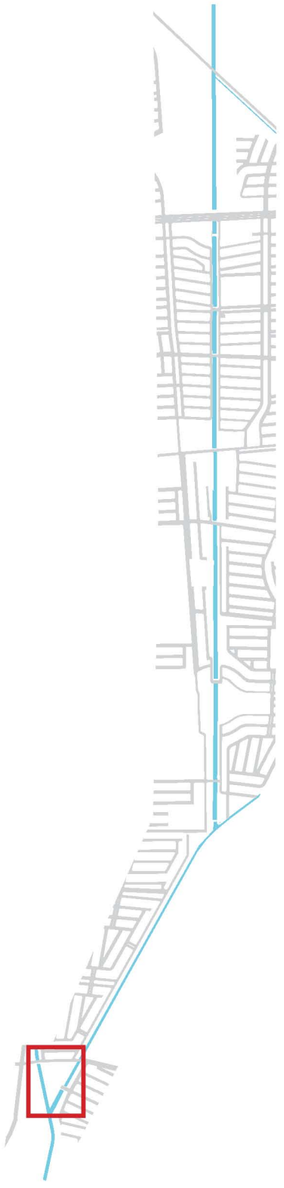

ROOF +5.82m
KIOSK FLOOR +1.96m
TERRACE FLOOR +1.54m
CANAL 0.00m

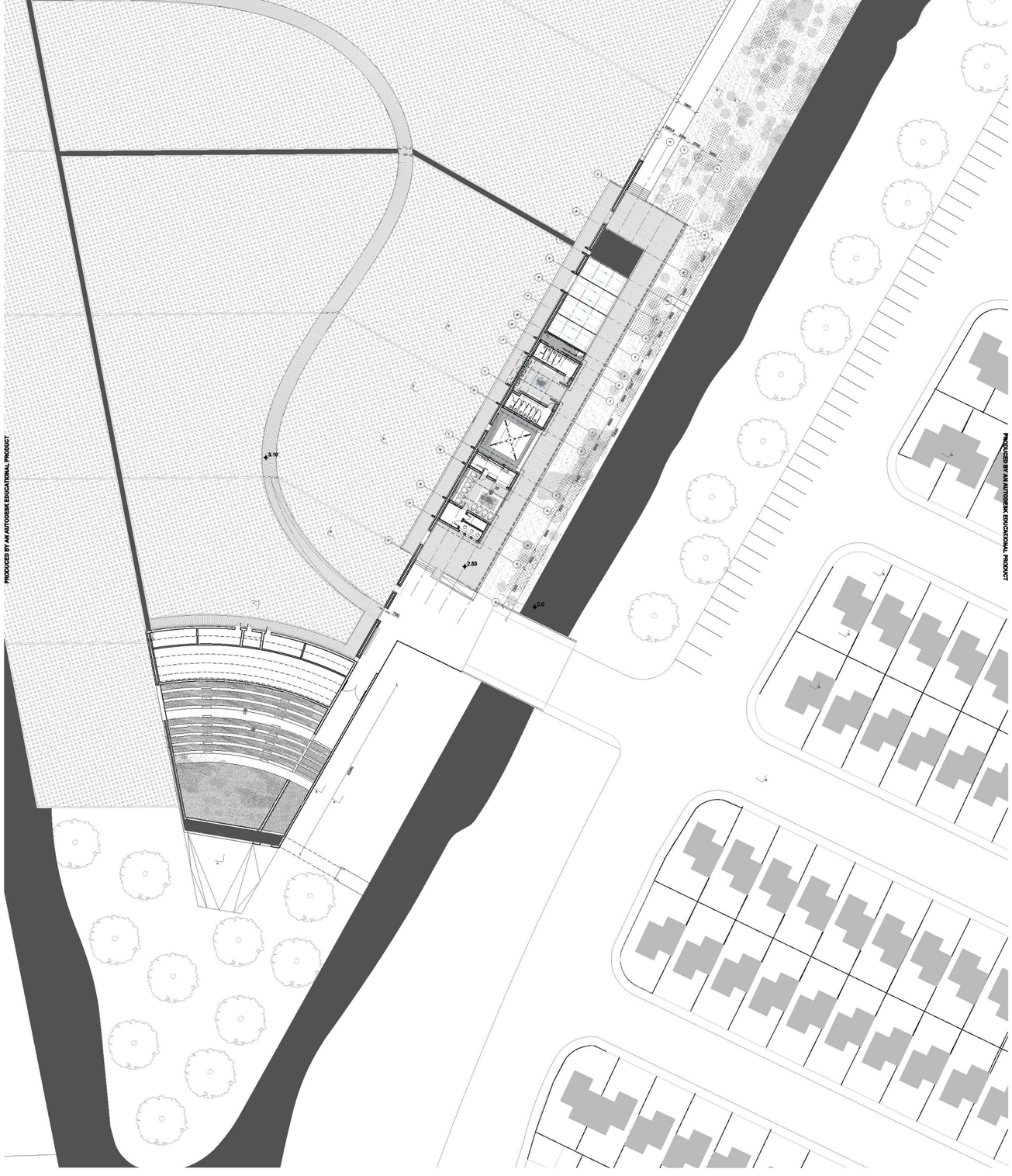


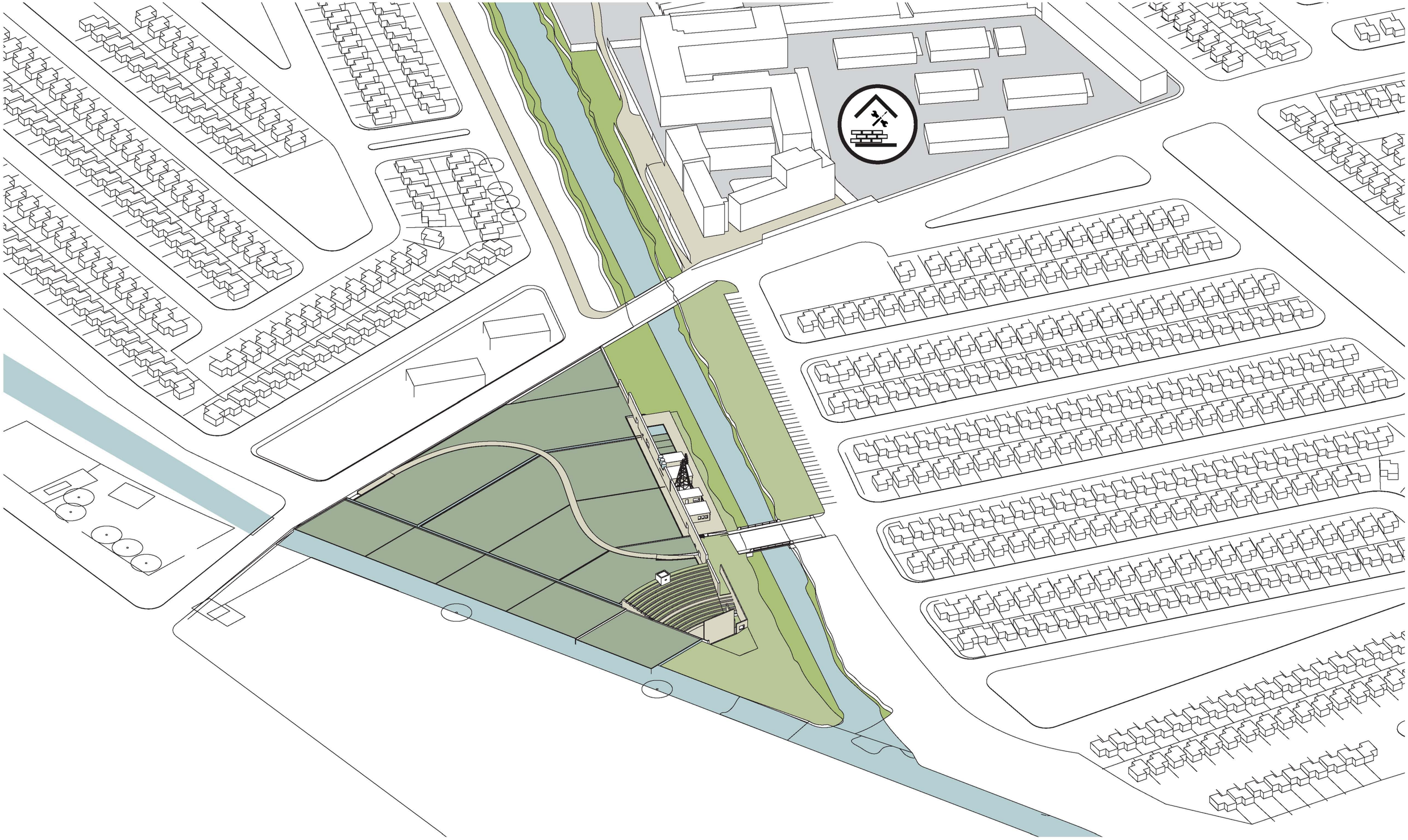


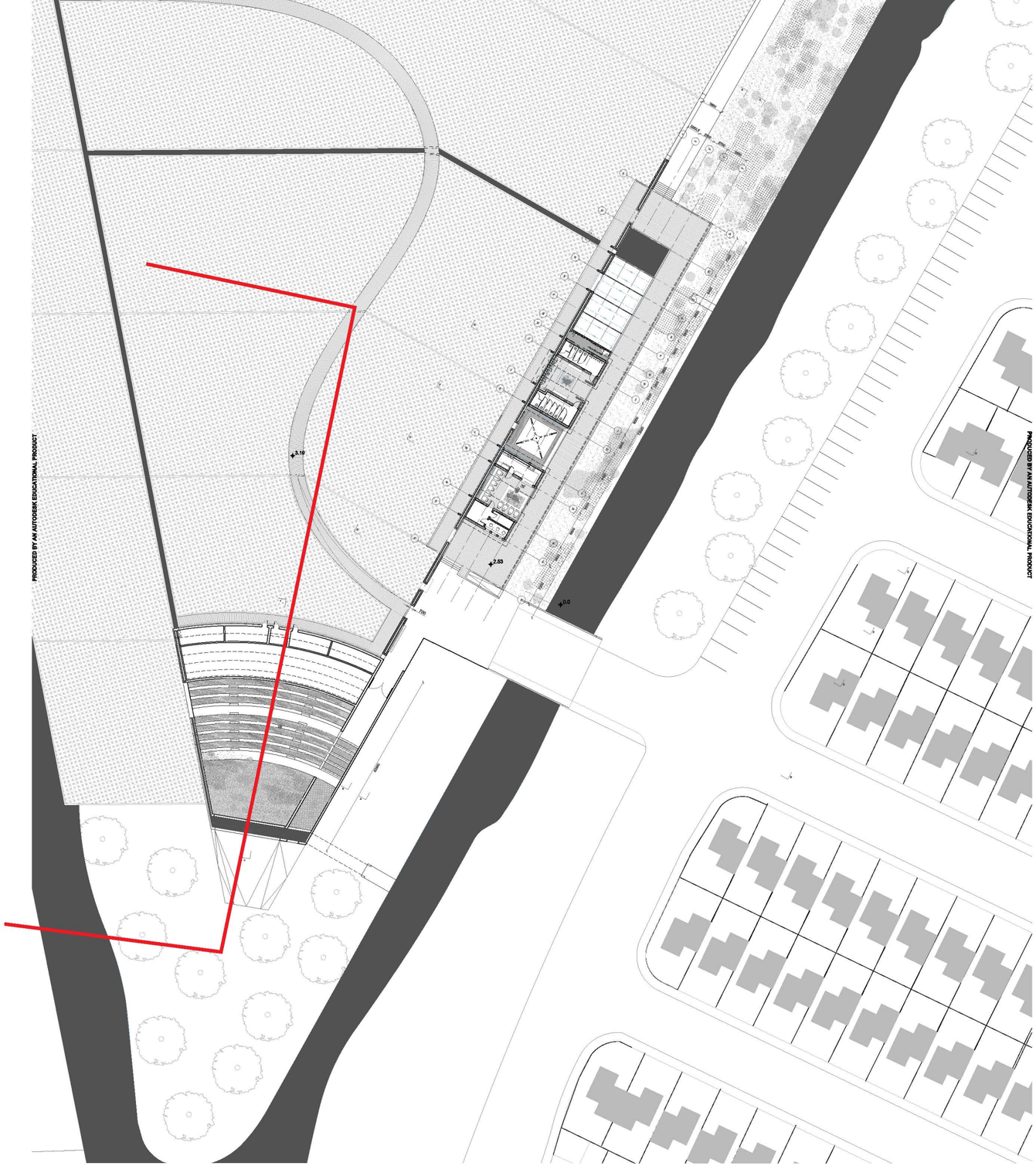
Detail section

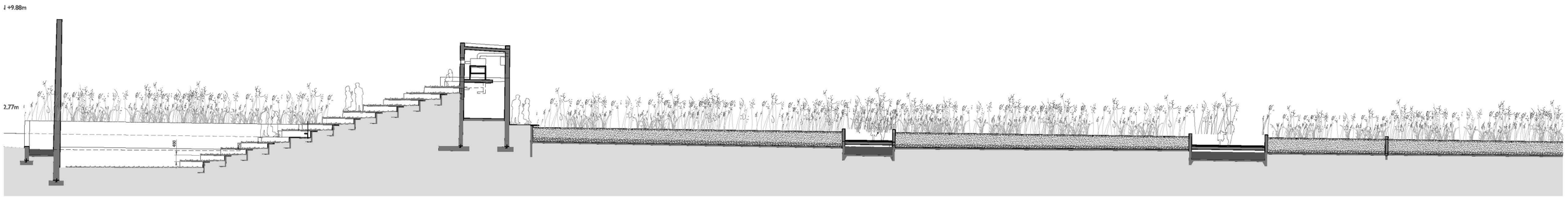


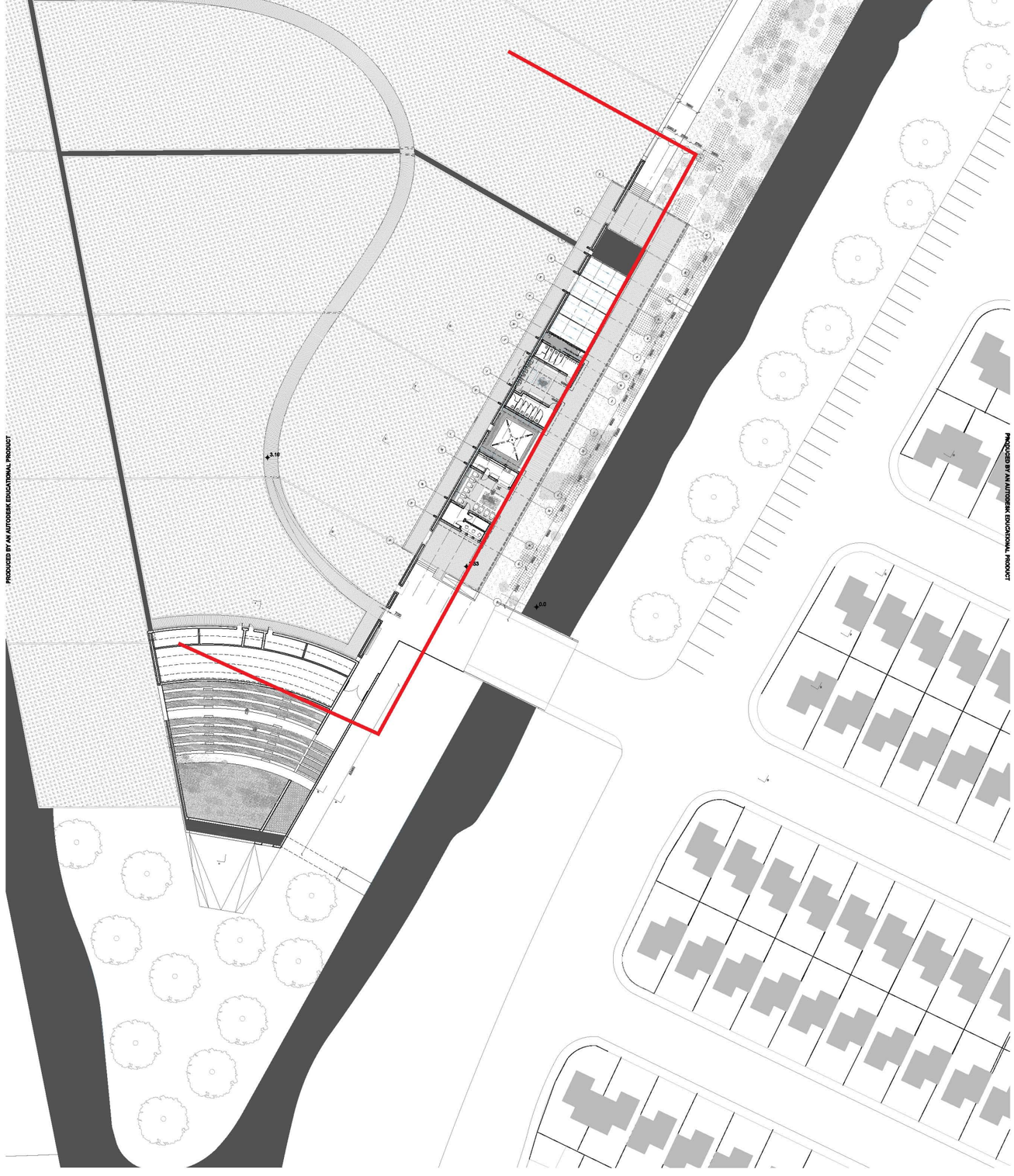


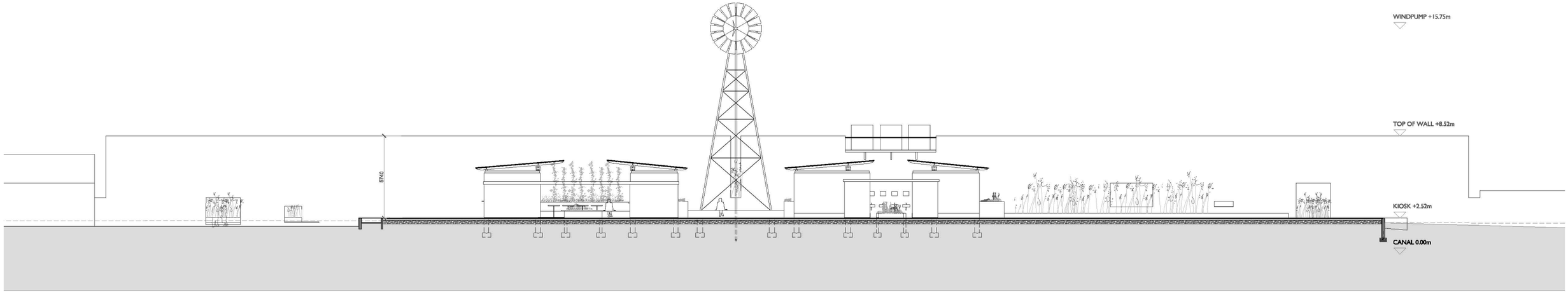

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
3.10
2.53
0.0
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

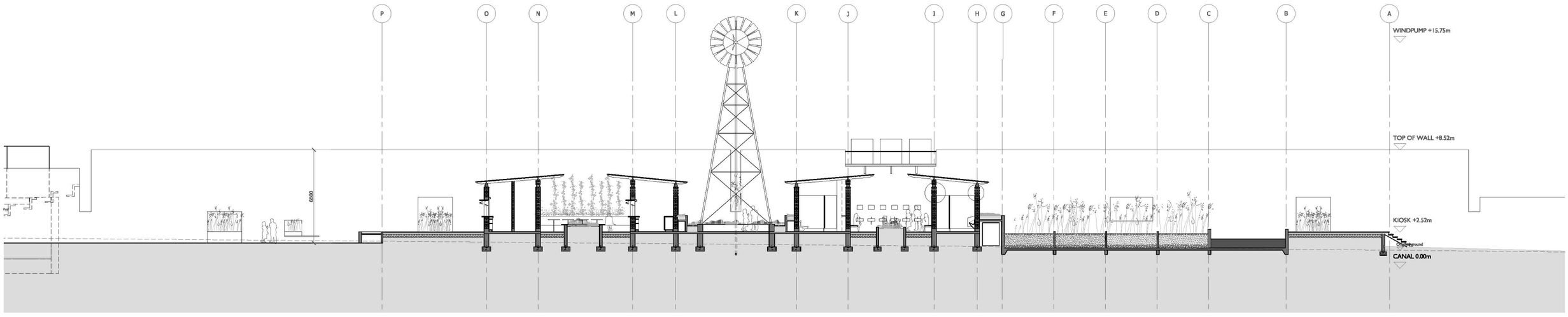


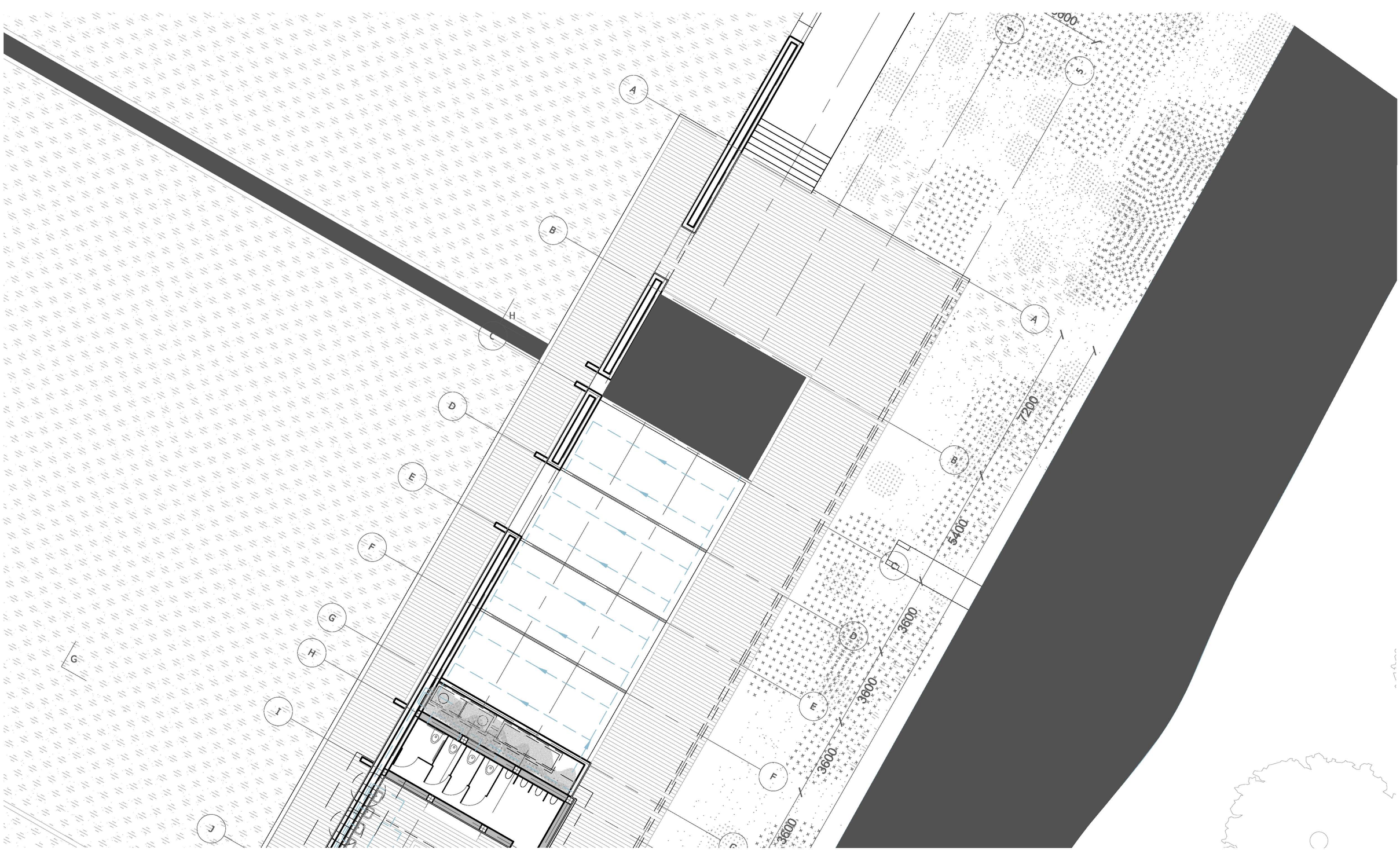

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
3.10
2.53
0.0
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT


+9.88m
2.77m


PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT


WINDPUMP +15.75m
TOP OF WALL +8.52m
KIOSK +2.52m
CANAL 0.00m
5740


P
O
N
M
L
K
J
I
H
G
F
E
D
C
B
A
WINDPUMP +15.75m
TOP OF WALL +8.52m
KIOSK +2.52m
CANAL 0.00m
6500


A
B
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1
2
3
4
5
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7200
5400
3600
3600
3600
3600