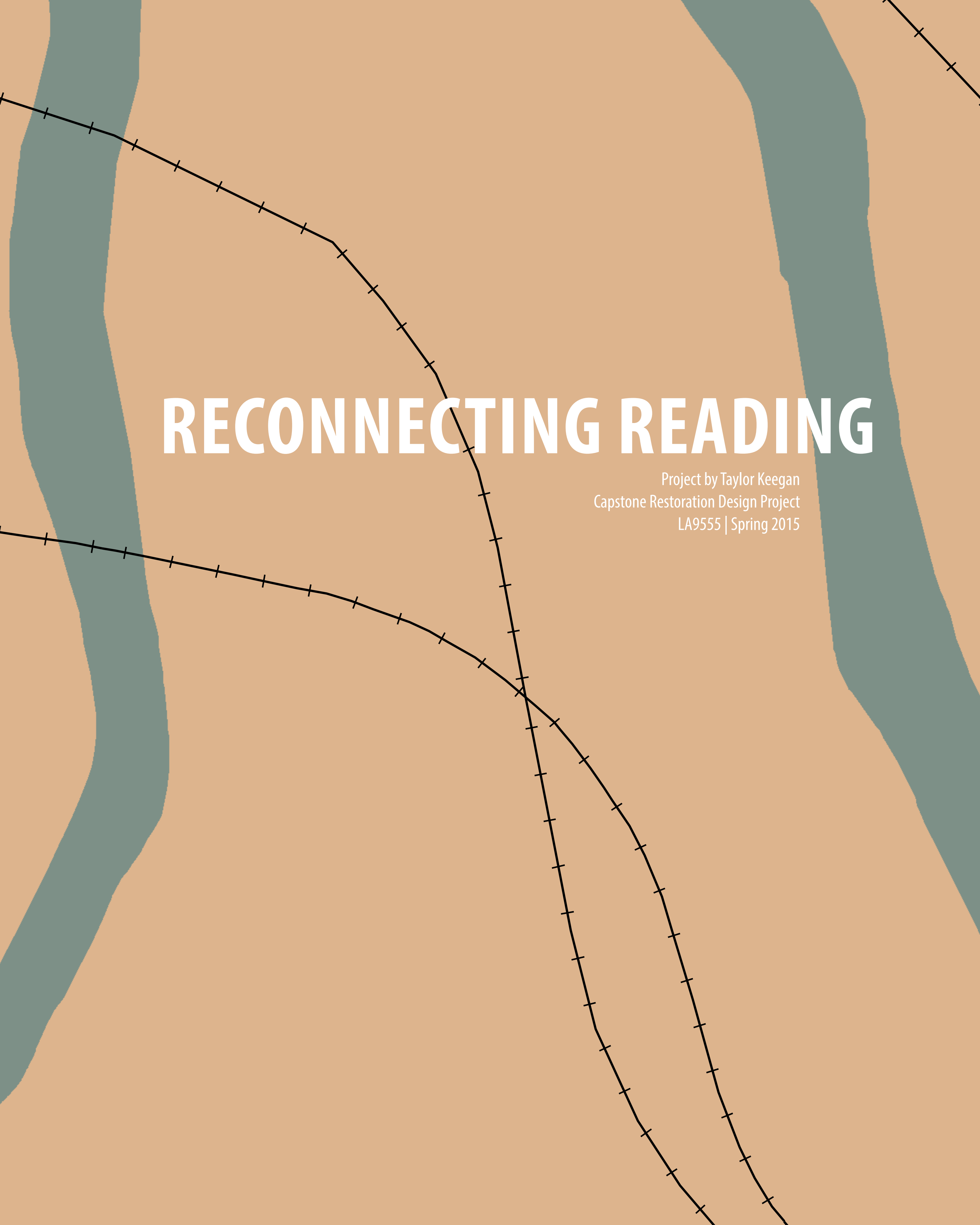

RECONNECTING READING

Project by Taylor Keegan
Capstone Restoration Design Project
LA9555 | Spring 2015

The Reading

THANKS

THANK YOU TO THE BERKS CONSERVANCY, AND THE CITY OF READING, FOR SERVING AS MY CLIENT FOR THIS PROJECT ESPECIALLY RALPH JOHNSON, KIM MURPHY, AND BRIAN KELLY. ALSO THANKS TO AMY JOHNSON OF THE CITY OF READING AND LAURA CRAIG FROM AMERICAN RIVERS.

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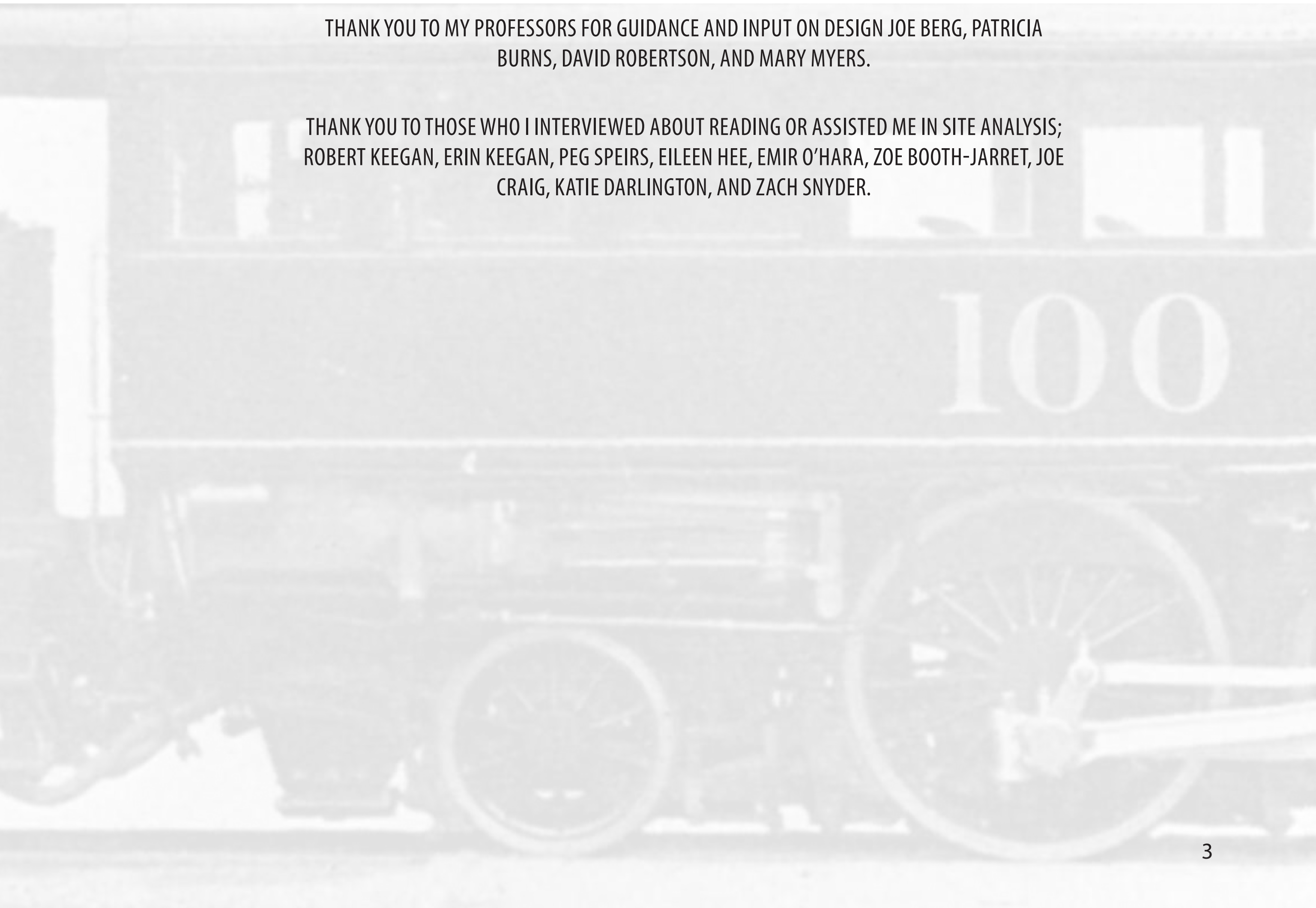

THIS PROJECT INCLUDES RETHINKING PUBLIC SPACE IN READING, PENNSYLVANIA SPECIFICALLY ADDRESSING ECOLOGY AND CONNECTIVITY. THE FOLLOWING PAGES INCLUDE AN INVENTORY ANALYSIS OF THE TRAIL AND CITY, A MASTER PLAN OF THE READING WATERFRONT, BIKE AND PEDESTRIAN LANE ENHANCEMENT AREAS, A DAM REMOVAL PROPOSAL, DETAIL DESIGN OF CONFLUENCE POINT PARK AT THE TULPEHOCKEN AND SCHUYLKILL RIVERS AND A RESTORATION AND MONITORING PLAN. THIS PROJECT WAS COMPLETED FOR TEMPLE UNIVERSITY'S SCHOOL OF ENVIRONMENTAL DESIGN, THE BERKS CONSERVANCY, AND THE CITY OF READING TO REIMAGINE THE RIVER AND RECONNECT READING.

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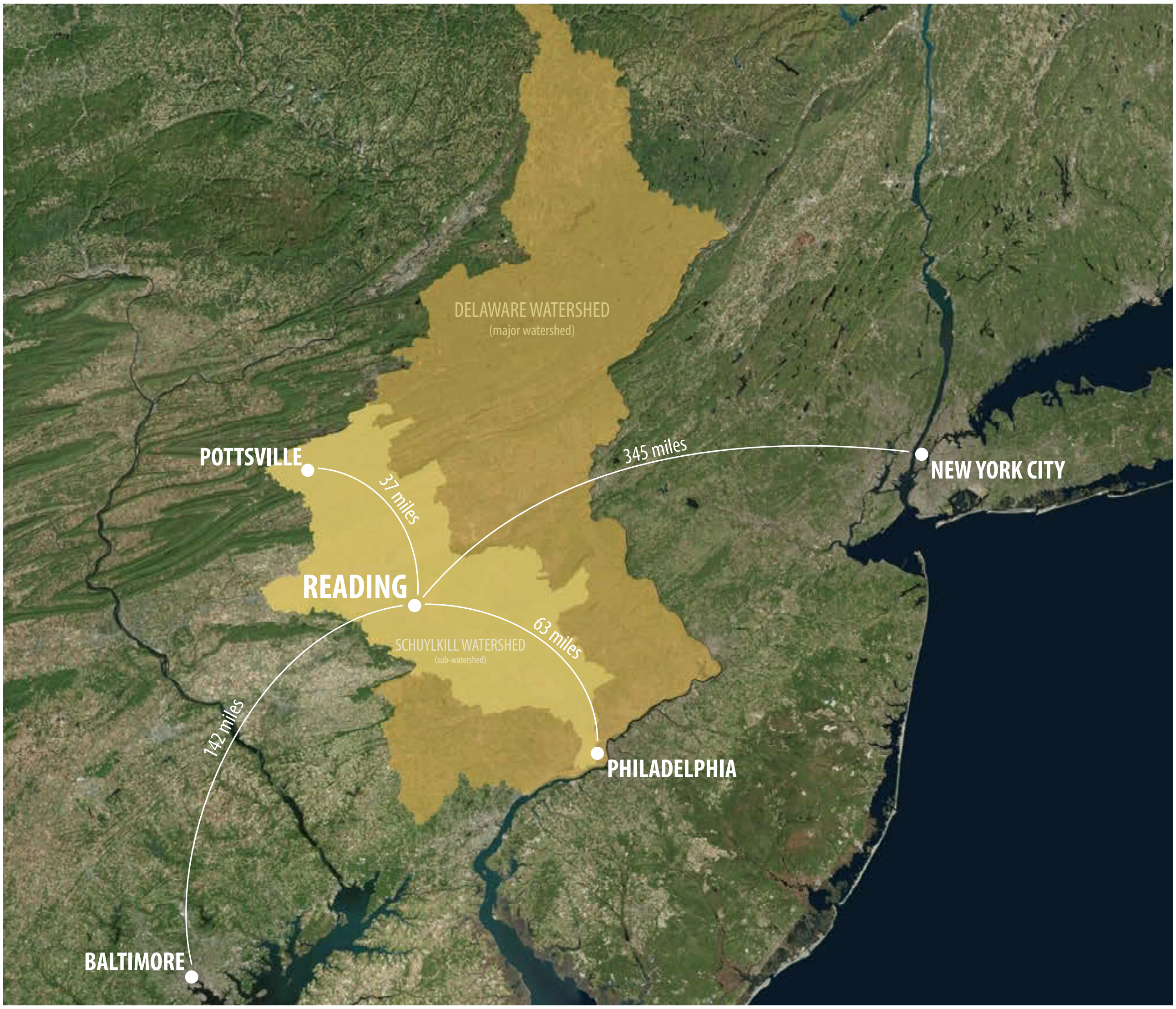
INTRODUCTION

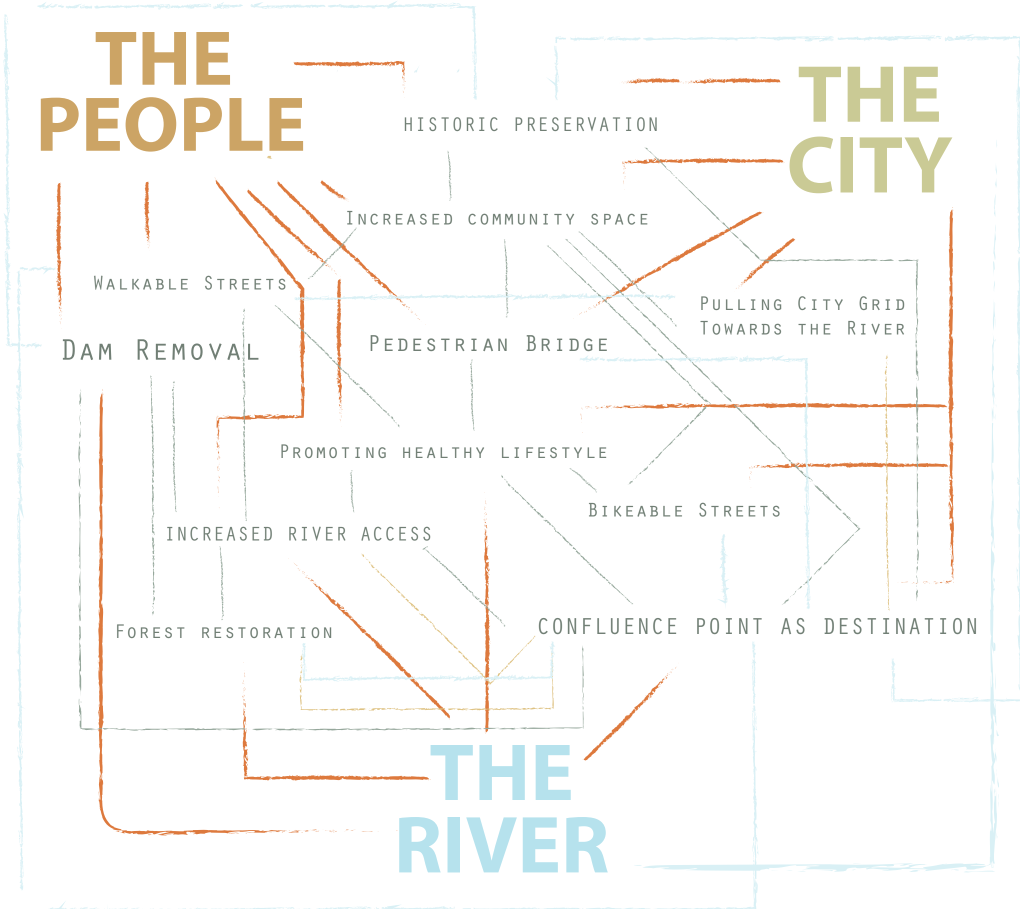
Today, Reading is the seat of Berks County, and sits just north of Philadelphia which can be reached by car in just over an hour. Reading has a rich history connected to the Schuylkill River and the Reading Railroad. This city, like many cities along the Atlantic seaboard, developed during the industrial revolution and saw economic decline with dwindling industrialization. The city is contained in the Schuylkill River Watershed, which is part of the greater Delaware Watershed. It can be reached in three hours from New York City, an hour and a half from Philadelphia and two and a half hours from Baltimore.

The Schuylkill River was the lifeline of Reading, and served as a primary corridor for transportation of goods from which was a major route for transportation from Pottsville to Philadelphia. Industry boomed along the river, and countless canals and dams were built along the route from the Appalachian Mountains down to the confluence of the Delaware and Schuylkill Rivers in Philadelphia. Railroads forced the abandonment of the canals along the Schuylkill and Susquehanna rivers in the 1880s, just as the vehicle caused the decline of the rail in the years following World War II until the 1970s. Meanwhile, the other industry along the river, like the Bushong Paper Mill along the Tulpehocken River saw a similar boom and collapse. In 1971, The Reading Company declared bankruptcy and the rail lines were taken over by Conrail in 1976 (Treese, Lorett (2003).

Currently there is a large Rails to Trails movement, specific to the Schuylkill River Rail line. The scope of this project focuses on a three mile portion of the trail that runs through Reading collectively called the Union Canal Trail and the Thun Trail. It also looks at the removing Bushong (Tulpehocken) Dam and reimagines the waterfront as a major asset for the city, providing connectivity within Reading as well as within the greater context of the Schuylkill Watershed.


DELAWARE WATERSHED
(major watershed)
POTTSVILLE
37 miles
345 miles
NEW YORK CITY
READING
63 miles
SCHUYLKILL WATERSHED
(sub-watershed)
142 miles
PHILADELPHIA
BALTIMORE

RECONNECTING



READING

PROJECT GOALS

RECONNECT THE RIVER

BY REMOVING TULPEHOCKEN DAM

RECONNECT THE CITY

BY REDUCING THE HARD EDGE OF THE HIGHWAY AND THE RIVER AND BUILDING A PEDESTRIAN BRIDGE.

RECONNECT THE PEOPLE

BY REDESIGNING CONFLUENCE POINT AS A DESTINATION, AND CREATING OPPORTUNITIES ALONG THE WATERFRONT FOR COMMUNITY


TULPEHOCKEN RIVER
ROUTE 422
SCHUYLKILL RIVER
BUTTONWOO
WEST
READING
PENN AVENUE

THE CONTEXT


READING
STONECLIFF SKATEPARK
KISSINGER CANAL
BUSHONG'S MILL DAM
CONFLUENCE POINT
FUTURE WALK TO WORK FACTORY
READING CANAL
BUTTON WOOD BRIDGE ENTRANCE
READING AREA COMMUNITY COLLEGE (RACC)

OPPORTUNITIES

Points of interest manifest as the orange swirls and include environmental opportunities, historic artifacts, structures, and/or historic significance. Highlighted in this design are the canals, the turbine at confluence point, and current community development (a guerilla skate park just above the turbine). Currently the major development along the waterfront is a "walk to work" factory; Lobbying these developers to increase the mixed use nature of the land, and pull the grid back to the city is a great opportunity for revitalization. Additionally, the Schuylkill River Trail and its greater connection to the region provides opportunity for Reading as a tourist and historical destination along the corridor.

READING CANAL

GUERILLA SKATE PARK AT CONFLUENCE

CONFLUENCE TURBINE

CONSTRAINTS

The major constraint of the site is the strong edge that is formed by route 422 (the red stripe) combined with the river; these double geographic features create an area that physically separates the city which has then created cultural and socioeconomic differences. Furthermore, there are limited routes from one side of the highway/river to the other further fragmenting the city. Ecologically, the area is inundated with Japanese Knotweed and other invasive creating and increased sense of remoteness, and risk. Additionally, the Bushong/Tulpehocken Dam currently fragments the river, preventing endangered fish species like Shad from spawning. It also is a liability for the city and its community as many people drown in unmaintained dams every year.

TULPEHOCKEN DAM

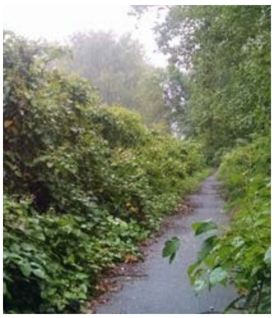
INVASIVES BLOCKING VIEWS

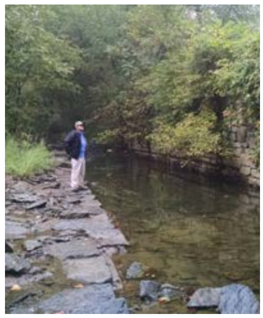
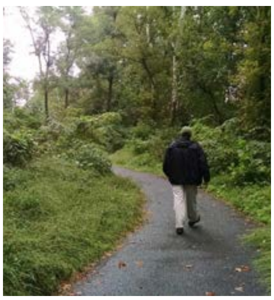
CRUMBLING FOUNDATION

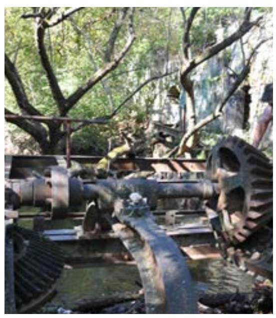
CHARACTER OF THE CONFLUENCE

The trail is currently three miles long and is contained in roughly 176 acres of waterfront and river. It runs along the Schuylkill and Tulpehocken Rivers in Reading. The photos found in this spread show the overall character of the trail- some parts wide open, and others quite enclosed and some being nondescript while others having interesting infrastructure and historical context.

The current perceptions of the trail are varied depending on the location, however the most consistent factors include the 1.) historic context of the river as well as the historic infrastructure that is lined up and down the trail, 2.) the current crime and vandalism deters individuals from enjoying the trail 3.) Current uses include ATVs, bicycles, walkers, runners, fishermen, and boat traffic.






Thun Trail looking West towards the Schuylkill River just north of Confluence Point.

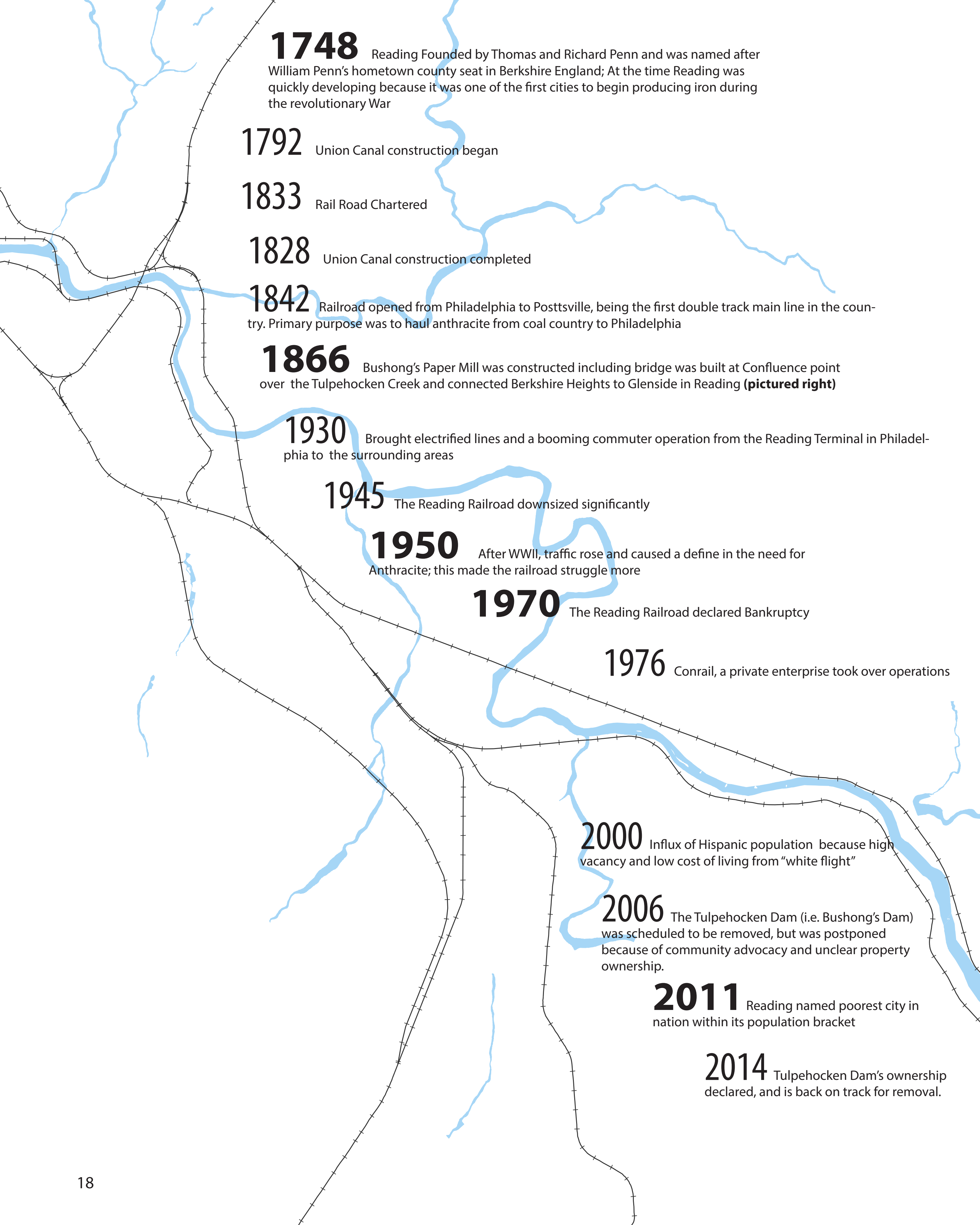
Looking west onto River Road towards the Schulkill River from Buttonwood Bridge.

Gurilla Skate Park Construction on the foundation of Bushong's Paper Mill

Looking West towards River Island created by breach on the Tulpehocken River. Pictured right are the turbine remains.

SITE CONTEXT

Includes a historical narrative and overall context including both an environmental and social inventory.



1748 Reading Founded by Thomas and Richard Penn and was named after William Penn's hometown county seat in Berkshire England; At the time Reading was quickly developing because it was one of the first cities to begin producing iron during the revolutionary War

1792 Union Canal construction began

1833 Rail Road Chartered

1828 Union Canal construction completed

1842 Railroad opened from Philadelphia to Posttsville, being the first double track main line in the country. Primary purpose was to haul anthracite from coal country to Philadelphia

1866 Bushong's Paper Mill was constructed including bridge was built at Confluence point over the Tulpehocken Creek and connected Berkshire Heights to Glenside in Reading **(pictured right)**

1930 Brought electrified lines and a booming commuter operation from the Reading Terminal in Philadelphia to the surrounding areas

1945 The Reading Railroad downsized significantly

1950 After WWII, traffic rose and caused a define in the need for Anthracite; this made the railroad struggle more

1970 The Reading Railroad declared Bankruptcy

1976 Conrail, a private enterprise took over operations

2000 Influx of Hispanic population because high vacancy and low cost of living from "white flight"

2006 The Tulpehocken Dam (i.e. Bushong's Dam) was scheduled to be removed, but was postponed because of community advocacy and unclear property ownership.

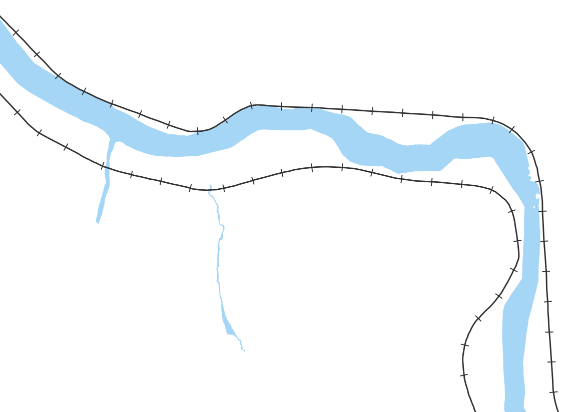
2011 Reading named poorest city in nation within its population bracket

2014 Tulpehocken Dam's ownership declared, and is back on track for removal.

Bushong Mill Bridge taken from the West side of the Tulpehocken River. The stack pictured remains, as does the foundation of the old covered bridge in the Tulpehocken River. The birdge is said to have burned down in 1958.

THE INDUSTRIAL MONOPOLY

Reading has an interesting story as an industrial city, owing its success and failure to the process surrounding energy and transportation. As Robert Jones describes in *The Reading Railroad: An Illustrated Timeline* "with the steady decline of anthracite business after 1926, the Reading had no new industries to serve to replace the anthracite business, so the bulk of the Reading tracks went to places that there was nothing to ship from. One could say that the Reading lived and died by monopoly"



1940

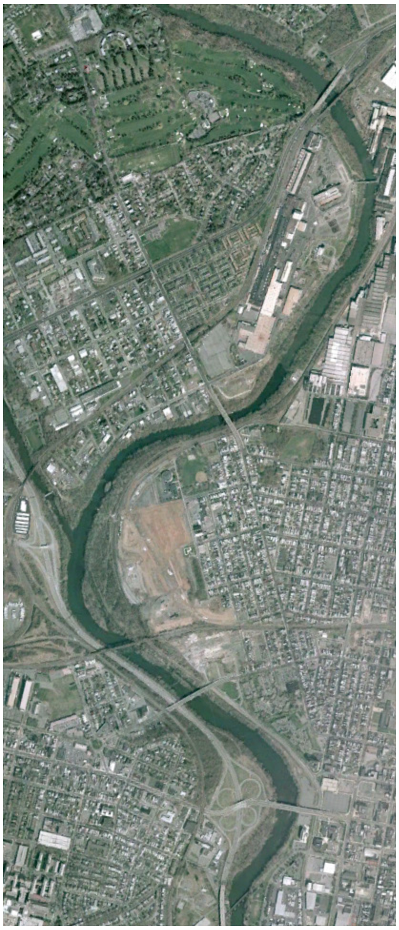
1958

1971

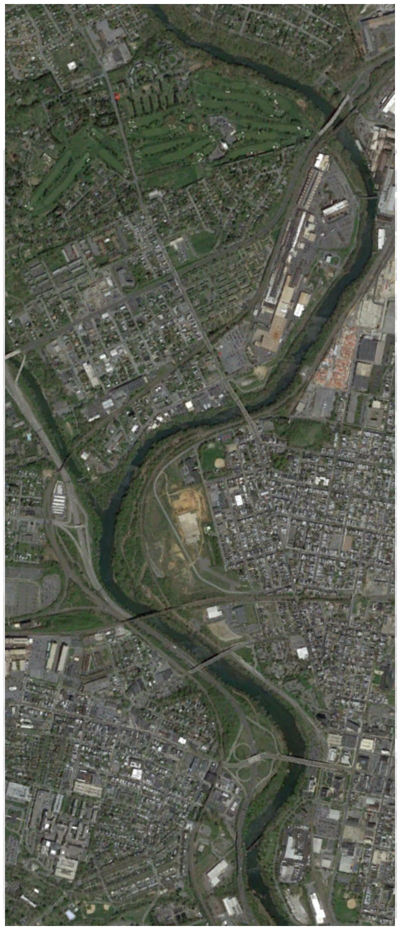
CITY FORM

As the industry of Reading evolved, so did it's infrastructure, this graphic spread demonstrates a visual journey of Reading's ever evolving infrastructure in historical photos and maps. The most important forms to note are the dominance of transportation routes crossing the river and redevelopment in the corridor. This includes the development of Route 422 seen in 1971, the development along the east banks of the Schuylkill River and the transitions of primary arteries in and out of the City. The following quote describes Reading's relationship as a post-industrial rail-road city.

1992



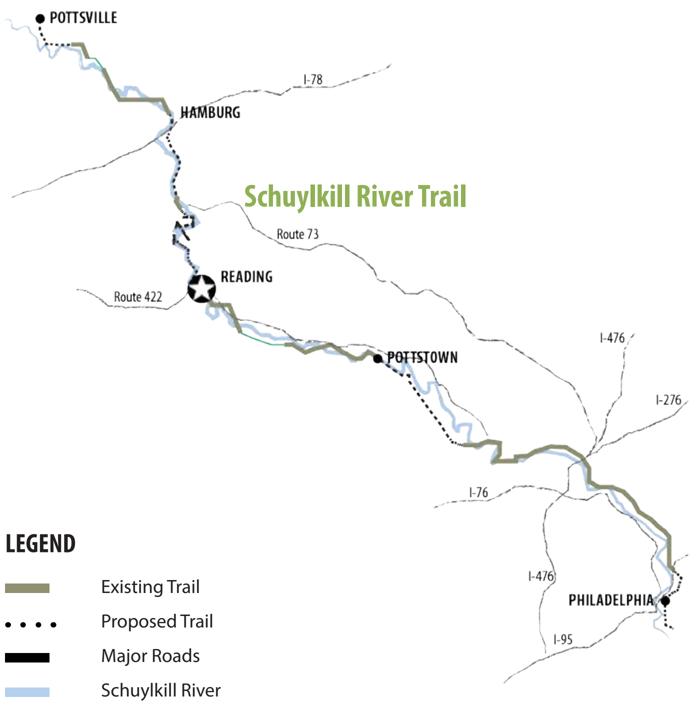
2008



2015

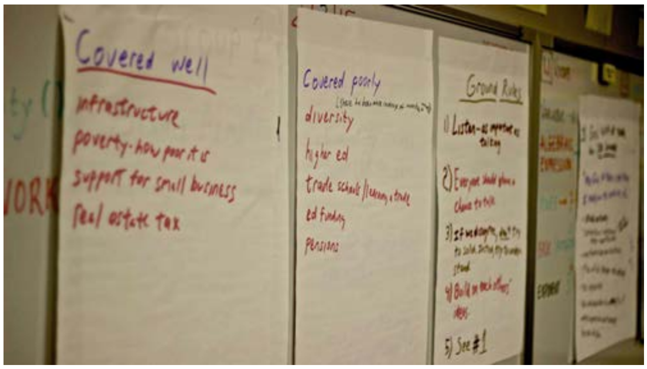
THE CITY AND TRAIL

Reading has a large portion of green space within its city limits, with an extensive trail network connecting different parks with each other. With completed trails depicted in green, the yellow dashed lines, represent parts of the trail that have signage and connectivity issues. Note the more vehicular related corridors, with major roads being called out with darker grey strokes. Below, is how Reading fits into the greater Schuylkill River Trail, which is somewhere in the middle.




DOWNTOWN READING
Marion St
Spring St
Windsor St
Centre Ave
Oley St
Greenwich St
Schuylkill Ave
Buttonwood St
N Front St
N 2nd St
N 5th St
N 9th St
N 11th St
N 13th St
Walnut St
Washington St
Penn St
Franklin St
Chestnut St
Hill Rd
Clymer St
Mineral Spring Rd
Perkiomen Ave
Howard Blvd
N 23rd St
Carsonia Ave
Bingaman St
Canal St
S 10th St
South Street
S 13th St
S 15th St
S 17th St
Fairview Ave.
Schuylkill River
Hancock Blvd
Morgantown Rd
Upland Ave
W Neversink Rd
Klapperthal Rd.

KEYSTONE CROSSROADS
RUST OR REVIVAL?



Photos were taken by WHYY during the event

February 14, 2015

PUBLIC INPUT

Lead in Partnership by WHYY and the Penn Project for Civic Engagement, five postindustrial cities were selected to have public forums on how to improve media coverage and overall community development. Reading was one of the six including Philadelphia, Pittsburg, Lancaster, Harrisburg and Bethlehem. Reading's meeting was sponsored on February 14th, 2015. Below are some of the questions and answers observed during the community gathering.

DESCRIBE ONE HOPE OR FEAR.

+ For the "Good ol' boy network to be broken down

+ Individuals and agency to make positive change

+ Embrace true economic development

+ Improve schools as a way to improve economics

- Absentee landlords

- End of partition policy

- Lack of political communication

- More men in prison than graduate high school

- For the children

IF YOU HAD GOVERNOR WOLF'S ATTENTION FOR 30 SECONDS, WHAT WOULD YOU SAY?

"Stable educational funding, correctional institutions need more support"

"Improve both pedestrian and vehicular infrastructure"

"Push more students into trades then into college"

"Take over police contracts and take away pensions"

"More support for the elderly"

"Even if wrong, don't change no child left bend"

READING TAPESTRY

Esri, the major geographic information systems supplier, created a "big data" overview of each census tract in the United States. Reading contains eight of the 16 over arching categories which was compiled based on census data. As can be seen to the right, the three largest groups of people fall under the Global Roots, High Hopes, and Senior Styles categories. The Senior Styles category, which includes a portion of the baby boomer population, makes up a large part of the area surrounding the City of Reading. Within Reading, we see a higher distribution of High Hopes and Global Roots who typically have a lower average income, are younger a young age, and come from diverse backgrounds. Designing for three different, dynamic populations includes considering ADA accessibility, and activities and recreation that include a range of physical abilities and cultural interests.

TAPESTRY LEGEND

High Society

Well educated, affluent, married, least ethnically diverse. Median household income: $100,216 12% of US households: generate one-quarter of the total US income.

Solo Acts

Well educated, young renters, prefer city life, dining out, museums and travel . Income ranges from 39,000 to 84,000.

Metropolis

Median income is $39,000. Ages range from Gen X to retired. Education levels vary. Reside in older, single family homes or row houses, many have service-related jobs. Rely more on public transportation and own fewer vehicles. Like music, watch TV.

High Hopes

Median income is 40,928, young, mobile, college educated. One-third are younger than 35 years-mix of married couples, single parents, and singles who seek the "American Dream" of home ownership and a rewarding job. Live in single-family houses; approximately half own their homes.

Global Roots

Young, Diverse, and renters. Married and single parents mixed; usually with children. Youth reflects immigration trends; half of all households immigrated to US within the past 10 years. Spending high for baby products.

Senior Styles

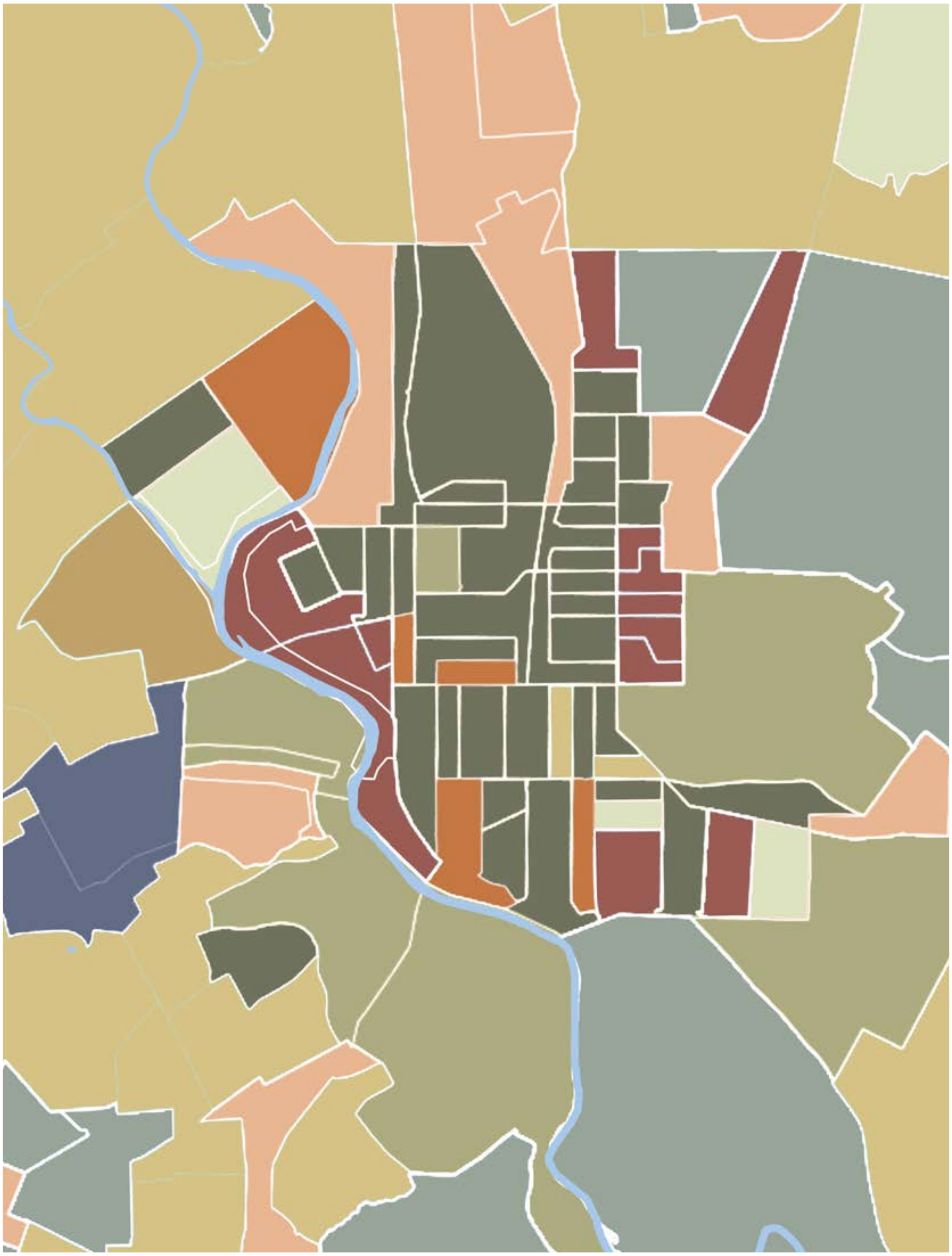
Median income $41,334. Diverse lifestyles. Golf is favorite sport. Read newspaper daily and prefer to watch news via TV. More likely to shop through QVC than online

Traditional Living

Median age of 37.8 years, own single-family homes in established, slow-growing neighborhoods. Purchase standard, four-door American cars, belong to veterans' clubs and fraternal organizations and rely on traditional media such as newspapers for their news.

Factories and Farms

From small towns and farms, enjoy garden care, fishing, hunting, pets, and membership in local clubs. Employed in manufacturing + agricultural industries. Married couples, sometimes with children. Median household income is $37,716. Most own their homes.



FISH AND DAMS

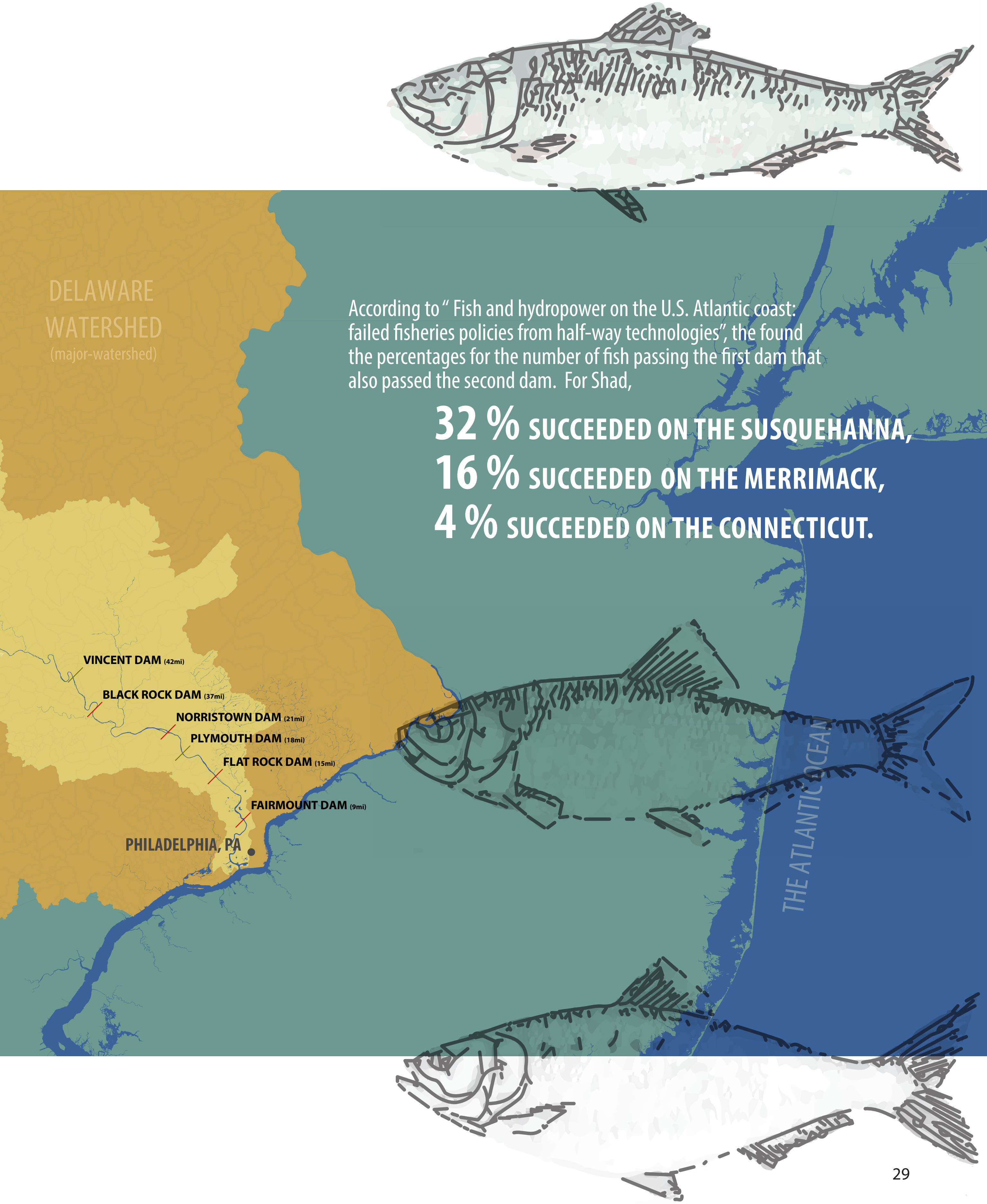
Since 1999, the Pennsylvania Fish and Boat Commission (PFBC) has socked nearly 4.5 million juvenile shad in the Schuylkill River. These fry, or juvenile shad, are tagged for monitoring. in 2003, large numbers of adult shad returned to the Schuylkill River indicating success during the 2000, and 1999 stockings. The PFBC currently stocks shad fry annually around Reading. American Shad, Alewife, and Herring pictured below are anadromous fish species, and spawn in the Delaware Watershed. In restoring the river to its natural flow, or by amending dams with fish ladders, we can increase the likelihood of these species returning to their spawning grounds north of Reading. The Schuylkill begins in Pottsville and terminates into the Delaware River in Philadelphia. The Tulpehocken, where the dam removal will take place terminates in the Schuylkill River in Reading, and feeds from the Blue Marsh Reservoir, which was created for flood control in the 1970s. Currently there are six dams along the Schuylkill River up to the Tulpehocken Dam at the confluence of the Schuylkill and Tulpehocken Rivers. "One metric used was the percentage of fish passing the first dam that also passed just the second dam. For shad, the numbers were 16 percent on the Merrimack, 4 percent on the Connecticut, and 32 percent on the Susquehanna. But on these rivers the second dam is only the beginning of the journey — these rivers and many others have multiple dams blocking access to historical spawning reaches" http://e360.yale.edu/feature/)us_dams_are_not_effective/2636/

"The long-term goal is to decrease reliance on stocking by developing a self-sustaining population of shad. Spring runs averaging between 300,000 to 850,000 returning American shad will be considered a restored fishery. "

-Schuylkill River American Shad, PFBC
http://fishandboat.com/shad_schu.htm

According to " Fish and hydropower on the U.S. Atlantic coast: failed fisheries policies from half-way technologies", the found the percentages for the number of fish passing the first dam that also passed the second dam. For Shad,

32 % SUCCEEDED ON THE SUSQUEHANNA,
16 % SUCCEEDED ON THE MERRIMACK,
4 % SUCCEEDED ON THE CONNECTICUT.



THE DAMS

TULPEHOCKEN DAM

The Tulpehocken Dam, also known as the Bushong Dam was constructed in 1866 as a portion of Bushong Paper Mill (Reading Paper Mill). It is located on the Tulpehocken Creek near the conflux into the Schuylkill River in Reading, Pennsylvania at Lat 40’34’62”42, long -75’95’22”18. The river is part of the Schuylkill River Watershed, and is contained within the great Delaware Watershed. Currently the dam and mill run are the the most visible remains from the old Paper Mill Company; now deteriorated and a safety hazard, a second life is being imagined for this historical landmark. At this point in time the costs to repair the dam are estimated to exceed any benefits. In formulating this monitoring plan, information was used from Drexel’s Academy of the Natural Sciences, The Pennsylvania Fish and Boat Commission, American Rivers.

The Tulpehocken creek drains a limestone hill just south of the Appalachian Blue Mountains in northern Berks County; the Tulpehocken is a well known trout fishing stream in southeastern Pennsylvania. Currently bisecting the river is Blue Marsh Dam, completed in 1979, which was born from the Flood Control Act of 1962. Along the Tulpehocken river, there is currently one USGS flow station located at Lat 40`22’08”, long 75`58’46”, which is approximately 3.5 mi northwest of town square in Reading, and 3.9 miles downstream of Blue Marsh Lake (station 01470870). The station has been recording since October 1950. The gauge is currently funded by the U.S. Army Corps of Engineers, Philadelphia District and the Pennsylvania Department of Environmental Protection. According to the NWS, the Action stage is 9 ft; Flood stage: 10.5 ft; Moderate flood stage: 12 ft; Major flood stage: 14 ft.

Dam Removal at a similar scale along the Pennypack River has taken place at several different locations due to initiatives put forth by Huntington Pike Dam, Frankford Dam, Rawhn Street Dam and Spring Street Dam all served as precedents for baseline analysis of dam removal. None of these sites underwent long term monitoring, so initial assumptions are formed on site analysis of flood line, slope alterations, and plant communities. As with any restoration project maintenance and adaptive management strategies were analyzed to determine how the Confluence Dam Removal can be most successful,

SPRING STREET

RHAWN STREET

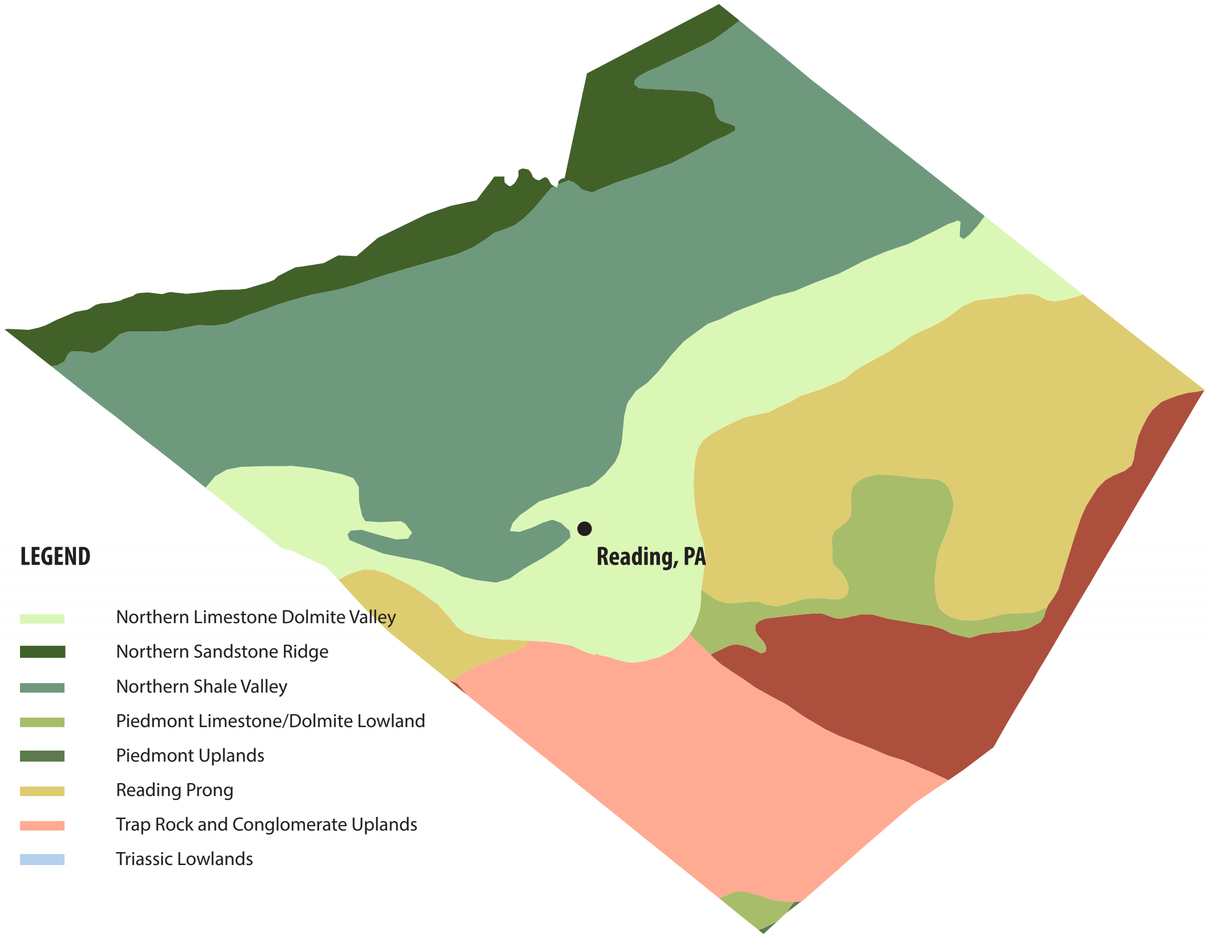
FRANKFORD AVE

HUNTINGTON PIKE

BAILEY'S ECOREGION III

Berks County falls in an interesting area, where many ecoregions converge. Reading is located within the Northern Limestone/Dolmite Valleys which is characterized by its base-rich soil, muted terrain, low drainage density, and limestone, dolomite, and calcareous shale bedrock. According to the Pennystone Project, the Northern Limestone/Dolmite Valley has "undulating broad and fertile valleys with extensive farming."   Streams "offer gentle gradients with good year-round flow. Local relief varies from 50 to 500 feet.". Current woodlands tend to be limited to steeper areas and are primarily Appalachian Oak forest in the north and Oak-Hickory-Pine forest in the south." (Pennystone, EPA 67). http://www.pennystone.com/ecoregions/EPA67.php Within the Northern Limestone The major soil types for the sites are Urban Land Duffield (Um), seen in pink. Interestingly, along the banks of the river Gibralter silt loam (Gc) on the west and Duffield Reder silt loam (DfD) on the east are found.

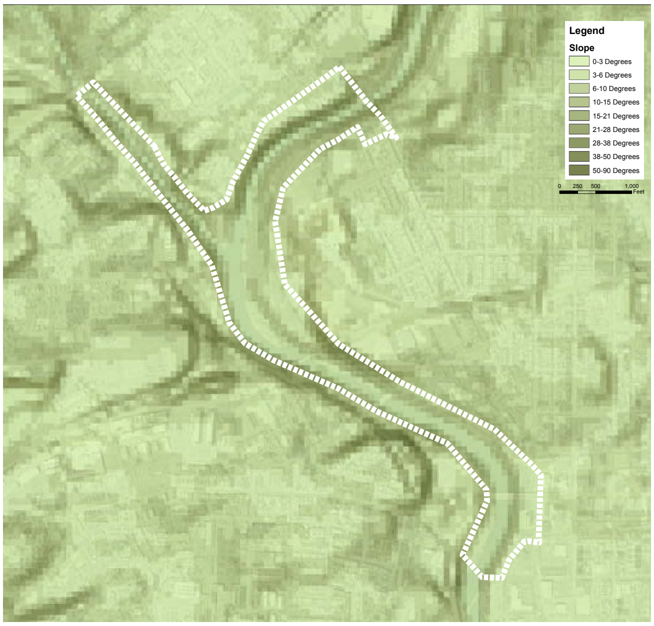
The major soil types for the sites are Urban Land Duffield(Um), seen in pink. Interestingly, along the banks of the river Gibralter silt loam (Gc) on the west and Duffield Reder silt loam (DfD) on the east are found.



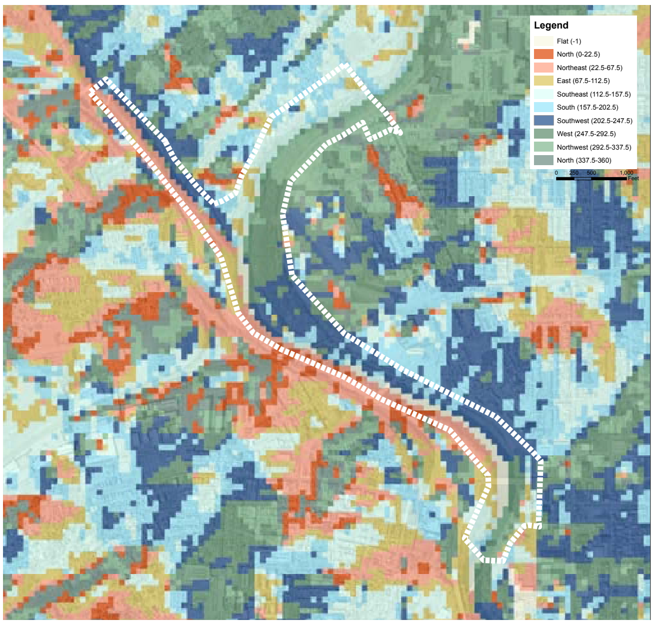
SOILS ANALYSIS

Reading, Pennsylvania

ENVIRONMENTAL INVENTORY



SOILS ANALYSIS



ASPECT

Slope and Aspect tell a story about micrclimate and can give clues as to what types of habitat has formed in a given area, the hydrology of a space, and inform restoration design. The Slope Analysis graphic illustrates the current slope within and surrounding the context boundary. What we see here is a relatively healthy floodplain, with the exception of the north west portion of the southwest arm, which contains steep slopes (greater than 38 degrees). This area also is used for dumping, both organic and inorganic materials. The aspect graphic demonstrates the variety of north, south, east and west facing slopes. To the west of the site, there are considerably more north and northeast facing slopes, where as the east side of the site contains more northwest and southwest facing slopes. This would indicate that our site contains a major drainage area or river, which would be the Schuylkill River.

In the case of the Schuylkill River hydrology, FEMA Flood levels were collected from PASDA, and analyzed according to Hazard Levels. Seen in light blue are the 100 year storm flood events (or less than .1% chance of flooding). Evidence of flooding is apparent near RACC, as the buildings are constructed on columns extending 12' above ground level. Additionally, Confluence Point tends to be flooded during these 100 year flood events. Designing for flooding will be an important aspect of this project.

FEMA FLOOD LEVELS

THE FLORA

The most dominate species of trees include the same found in the Appalachian Oak forest in the north and Oak-Hickory-Pine forest in the south. With regard to specific site analysis, several mature oaks were present on the site, both in the floodplain and along the steeper slopes in the site. Colonies of black locust are common along the river, and should be left as early successional species. These are also good nitrogen fixing species, and so will assist in remediating the urban soils present throughout the site

Furthermore, several mature American sycamores were present along the river; without the degradation of competing invasive species including Japanese knotweed and Japanese honeysuckle this community was most likely the Sycamore - (river birch) - box-elder floodplain forest.

Typical riverbank along the site ext

ent, this photo was taken of one of the river islands remaining from the one of the canals

TREES

Black Locust *(Robinia pseudoacacia)*
American Sycamore (*Platanus occidentalis)*
Black Birch (*Betula nigra)*
River Birch (*Betula lenta*
Red Maple (*Acer rubrum)*
White Oak (*Quercus alba)*
Black Cherry (*Prunus serotina)*
Shagbark Hickory (*Carya ovata)*

(-) Princess Tree (*Paulownia tomentosa)*
(-) Persian Silk Tree (*Albizia julibrissin)*
(-) Norway Maple (*Acer platanoides)*

SHRUBS

Red Osier Dogwood (*Cornus sericea)*

(-) Japanese Honeysuckle (*Lonicera japonica)*
(-) Japanese Knotweed (*Fallopia japonica)*
(-) Multiflora Rose (*Rosa Multiflora)*

HERBACEOUS

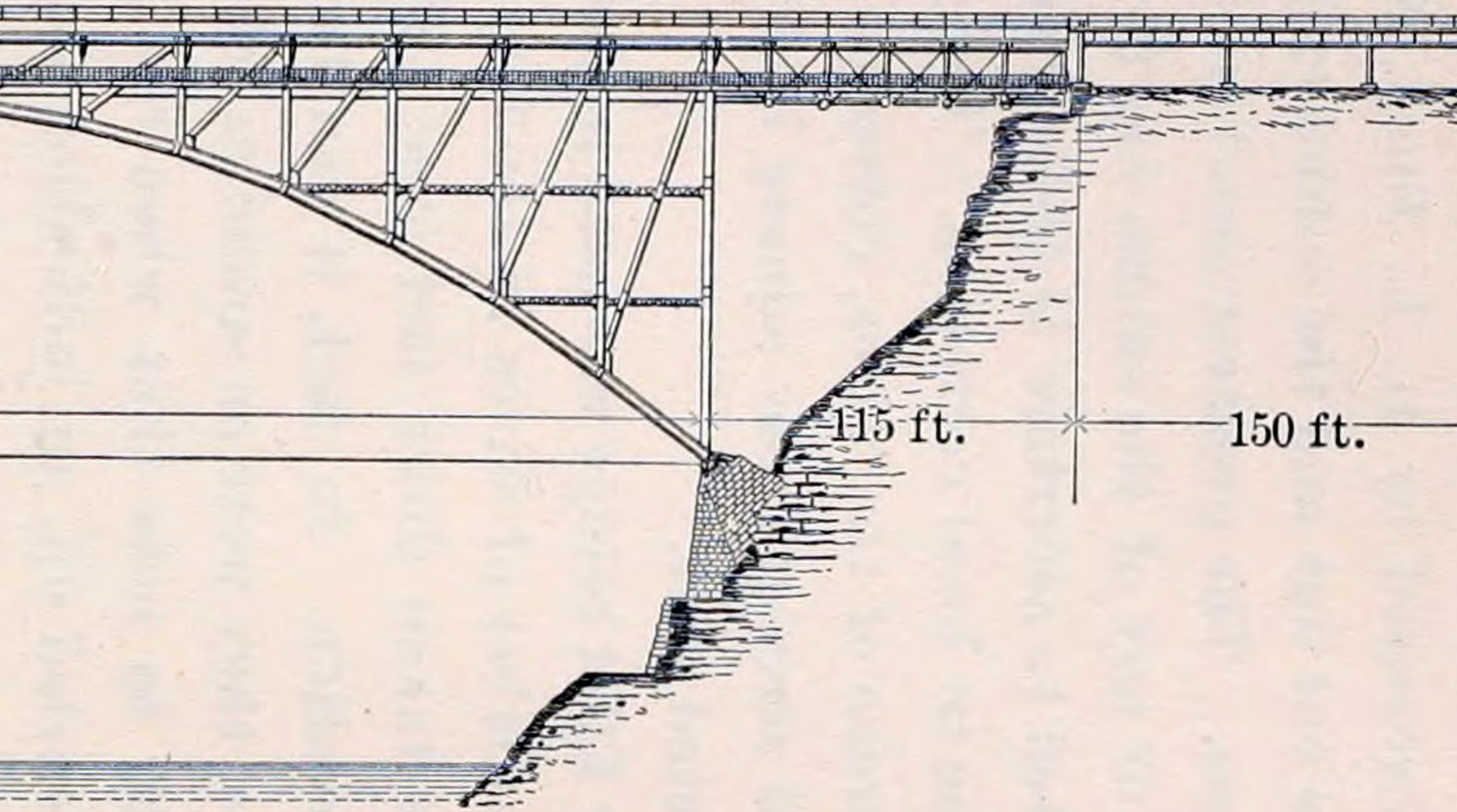
Switchgrass (*Panicum sp)*
Sedges (*Carex sp.)*
Ferns (*Osmunda sp.)*
Jewelweed (*Impatiens capensis)*
Goldenrod (*Solidago sp.)*
Aster *(Symphyotrichum ericoides)*
Smartweed *(Polygonum pensylvanicum)*
False Sunflower *(Heliopsis helianthoides)*
Joe Pye Weed *(Eupatorium purpureum)*
Potato Bean *(Apios sp.)*

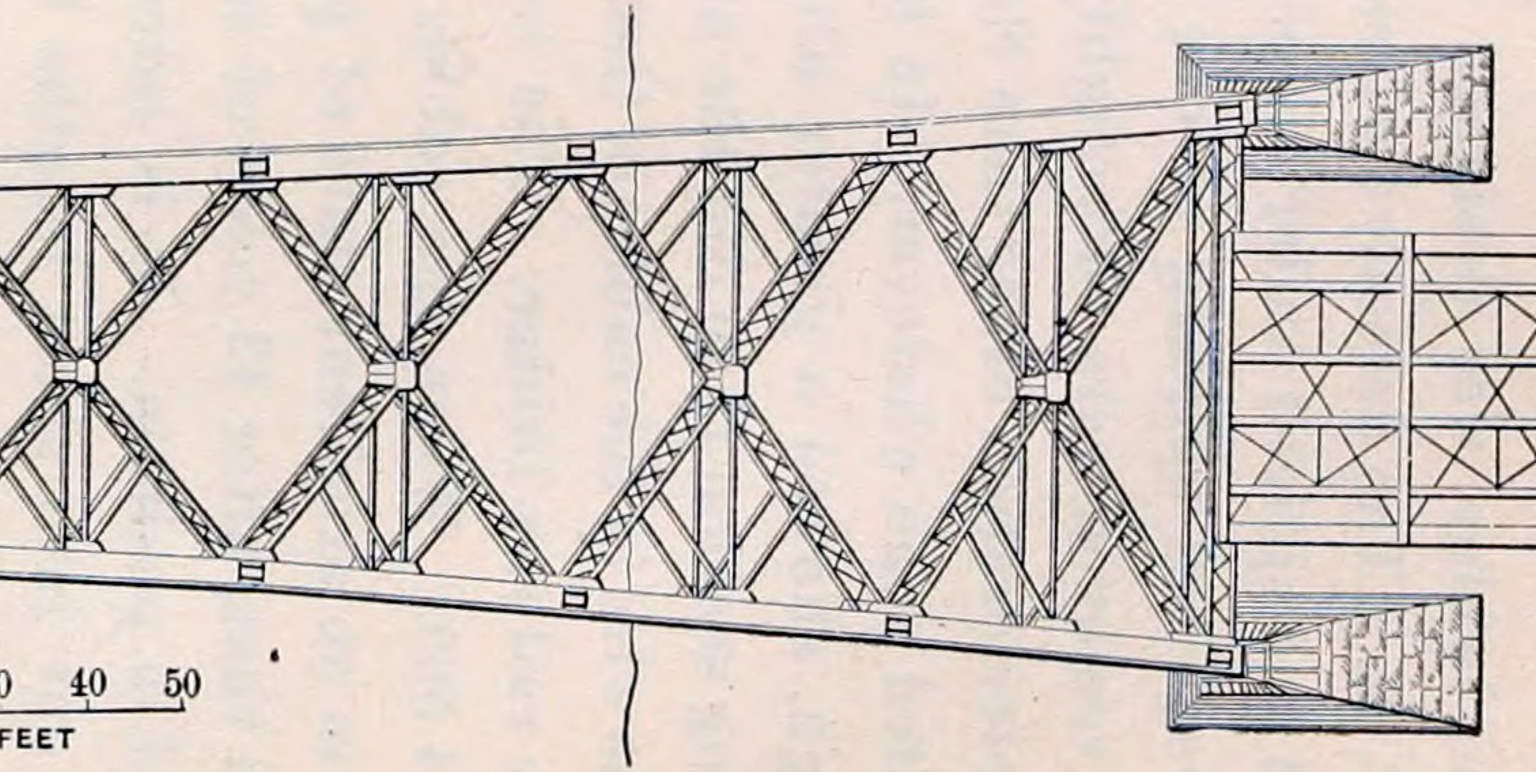
(-) Wild Grape *(Vitis sp)*
(-) Oriental bittersweet *(Celastrus orbiculatus)*
(-) Japanese Stiltgrass (*Microstegium vimineum)*
(-) Wineberry (*Rubus phoenicolasius)*
(-) Mile a minute (*Persicaria perfoliata)*

(-) denotes non-native

CONCEPT EXPLORATION

Precedents and three concept explorations


115 ft.
150 ft.


40
50
FEET

Located in Meidreich, Germany and designed by Latz + Partner in 1991. Photo from Landezine

PRECEDENT ONE

Duisburg Nord

The first precedent was a former coal and steel production plant was abandoned in the mid 80s, leaving a polluted post-industrial landscape behind. The intention for the design was to heal and understand our industrial past rather than rejecting it. This landscape has numerous detail designs that can serve as an example for Confluence Point park.

Located in Kreuzberg, Germany. and designed by Atelier LOIDL. Photo from Landezine

Photo from Landezine

PRECEDENT TWO

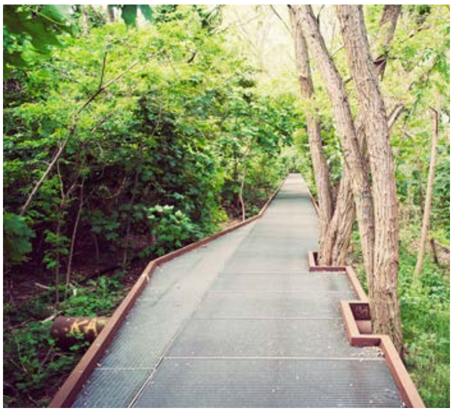
Park am Gleisdreieck

Outside of Berlin, the second precedent, Park am Gleisdreieck connects the Potsdamer Platz to the Shoenberger Sudgelande. Now reclaimed, Gleisdrierck "triangle of rails" was completed in 2013. The project looked to create a landscape that restored it to its basic essentials utilizing detail, materials, and vegetation. As a former transportation corridor, this landscape shares similar infrastructure and could be used to inform specific programming surrounding the former Reading Railroad.

PRECEDENT THREE
Schoeneberger Sudgelande Park

Designed by Odious, this landscape is an extension of an abandoned rail line that was no longer used after World War II. An extension of the Gleisdrierck, this landscape is located just outside of Berlin. Within the nature park, a few of the buildings were restored or renovated to be used as administrative areas, while the industrial remnants were used as sculptural or storytelling pieces for the park. This landscape has done a great job at specifically highlighting historical features along the industrial corridor and facilitated modern place making and historical storytelling.

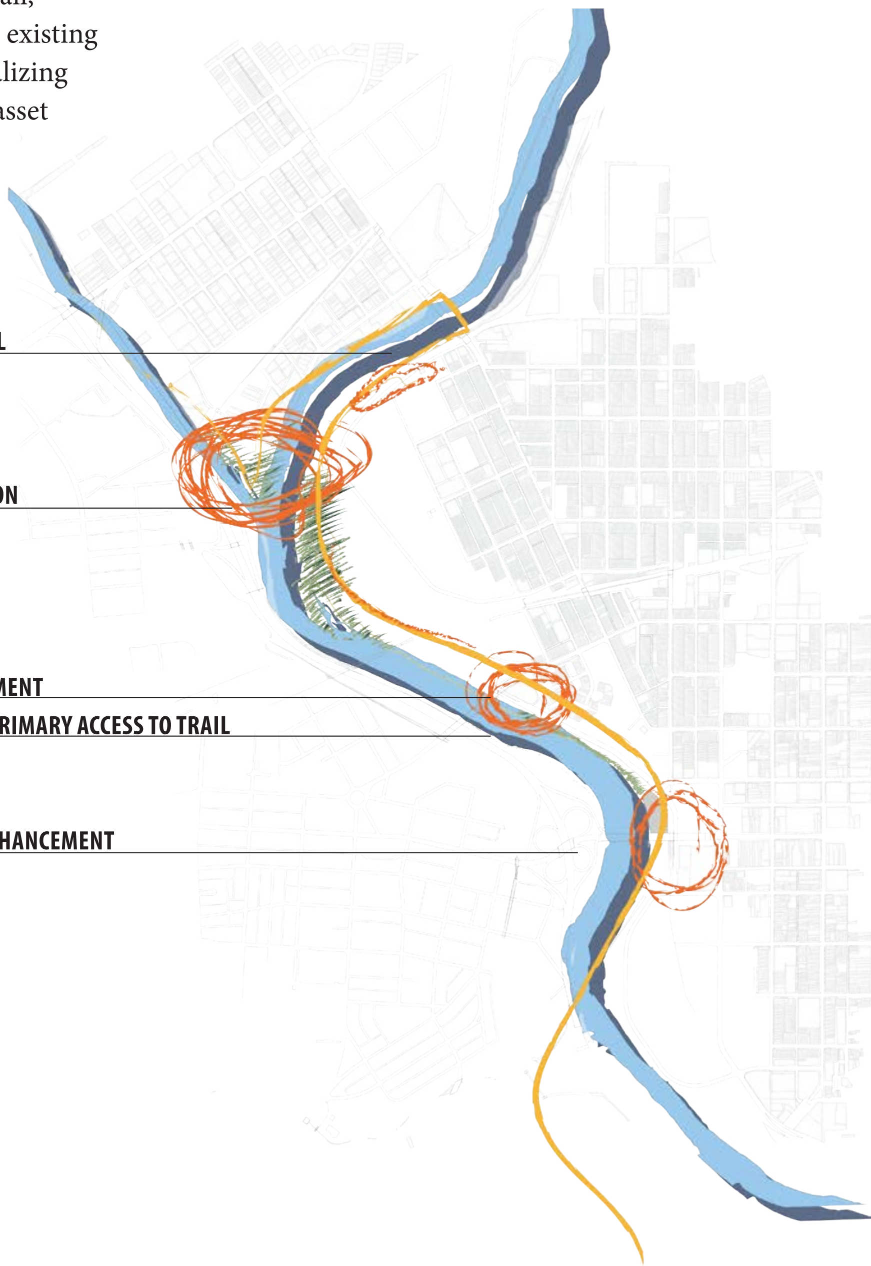
Photos from Landezine

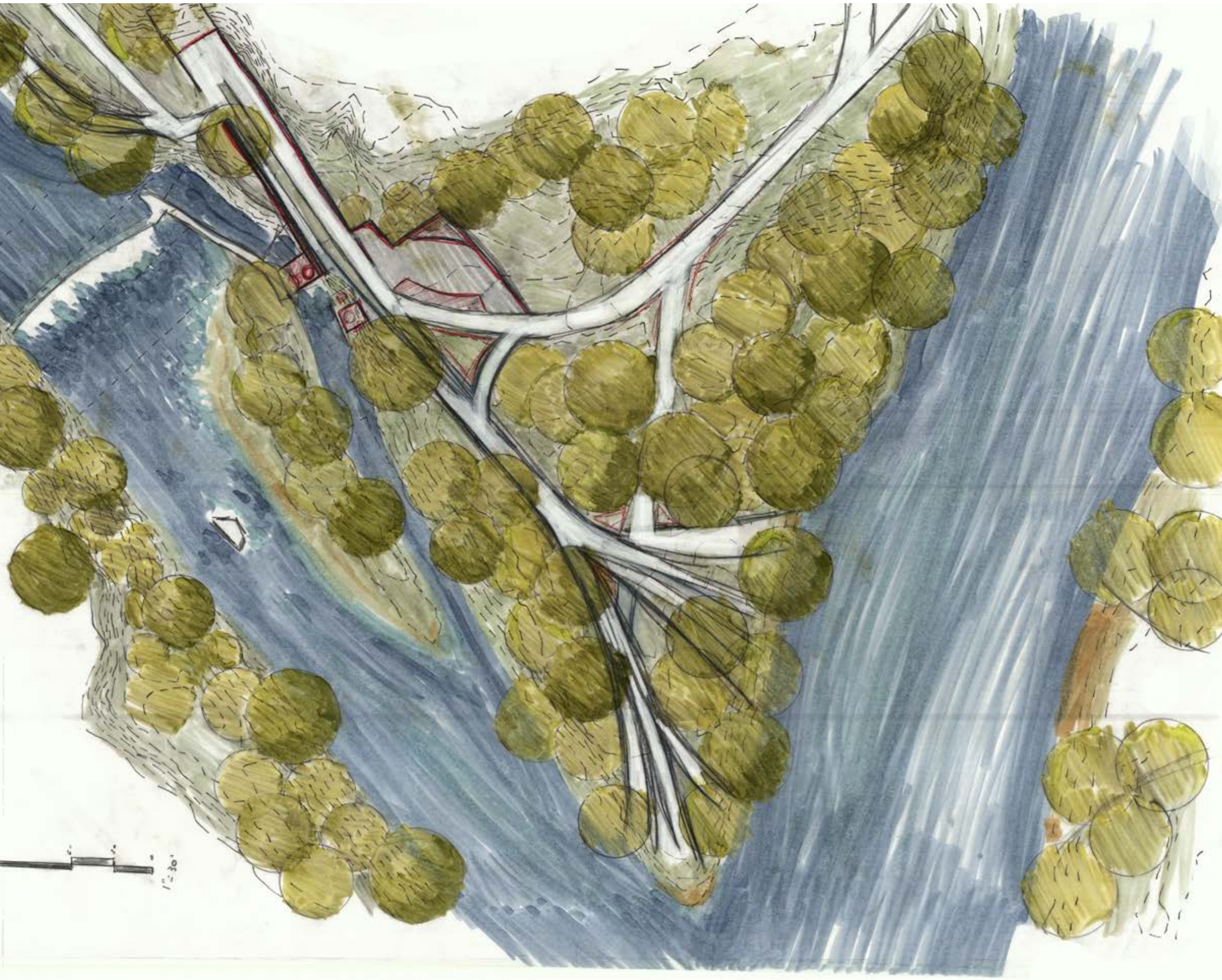


IMPRESSION

Concept One

Concept one plays at the minimal enhancements that can be made along the corridor, specifically focusing on Confluence Point. The includes activating specific spaces along the trail, creating some programmed elements through existing historical aspects and points of interest, formalizing social trials, and making the existing dam an asset rather than a hazard.



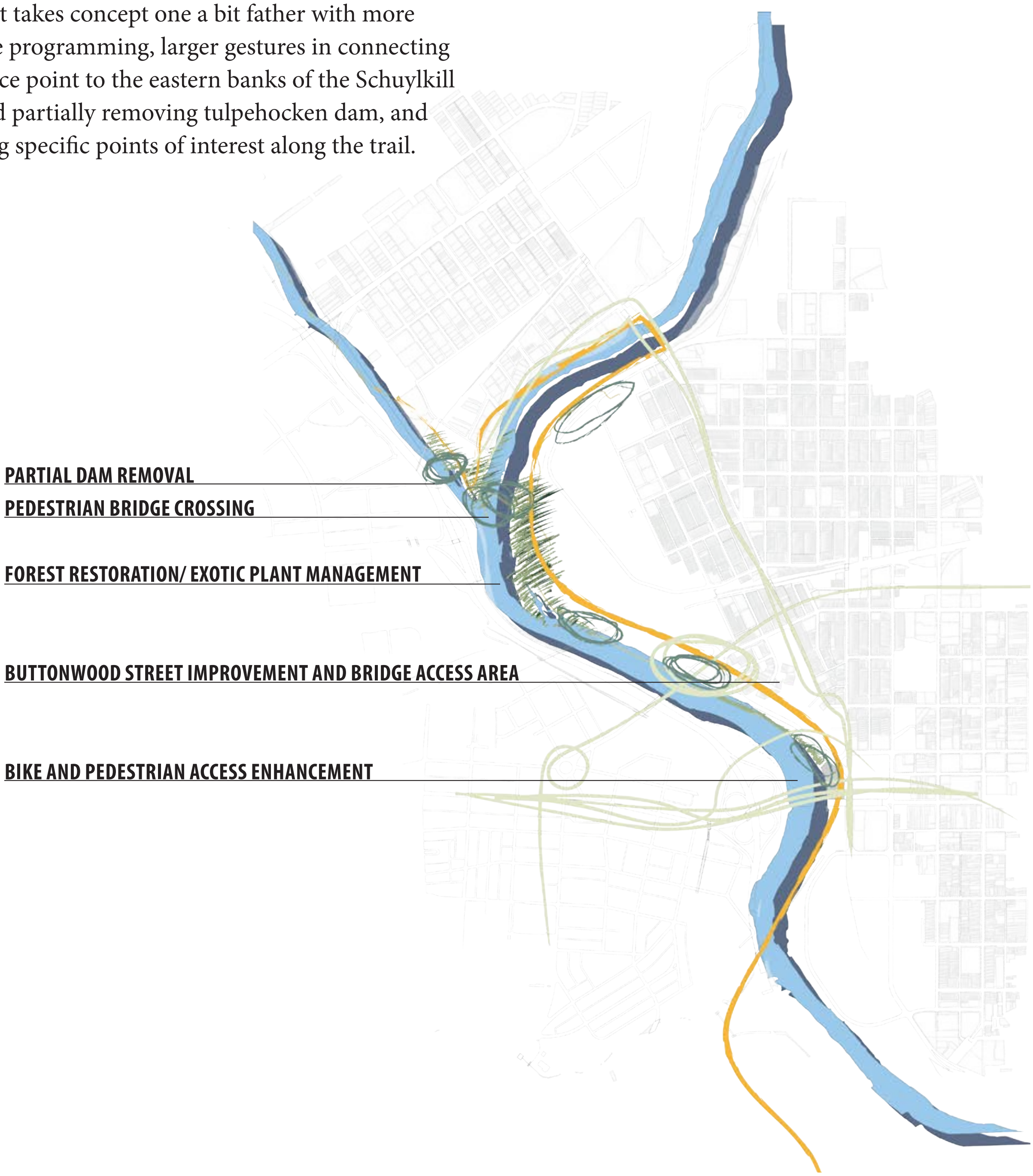


0′ 30′ 60′ 90′

IMAGE

Concept Two

Concept two is a middle ground between the more master planning design suggestions in concept three, but takes concept one a bit father with more extensive programming, larger gestures in connecting confluence point to the eastern banks of the Schuylkill river, and partially removing tulpehocken dam, and activating specific points of interest along the trail.

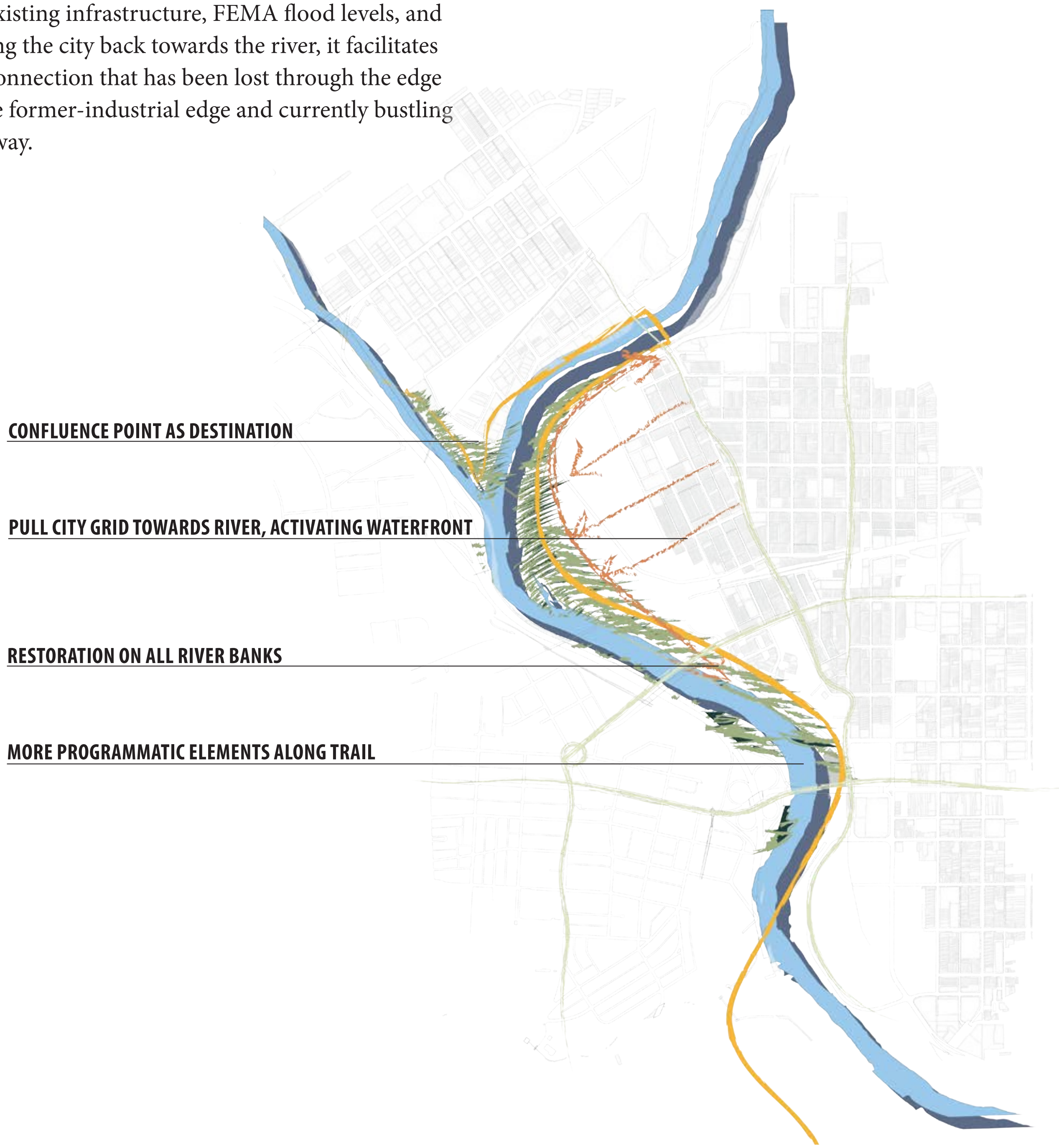


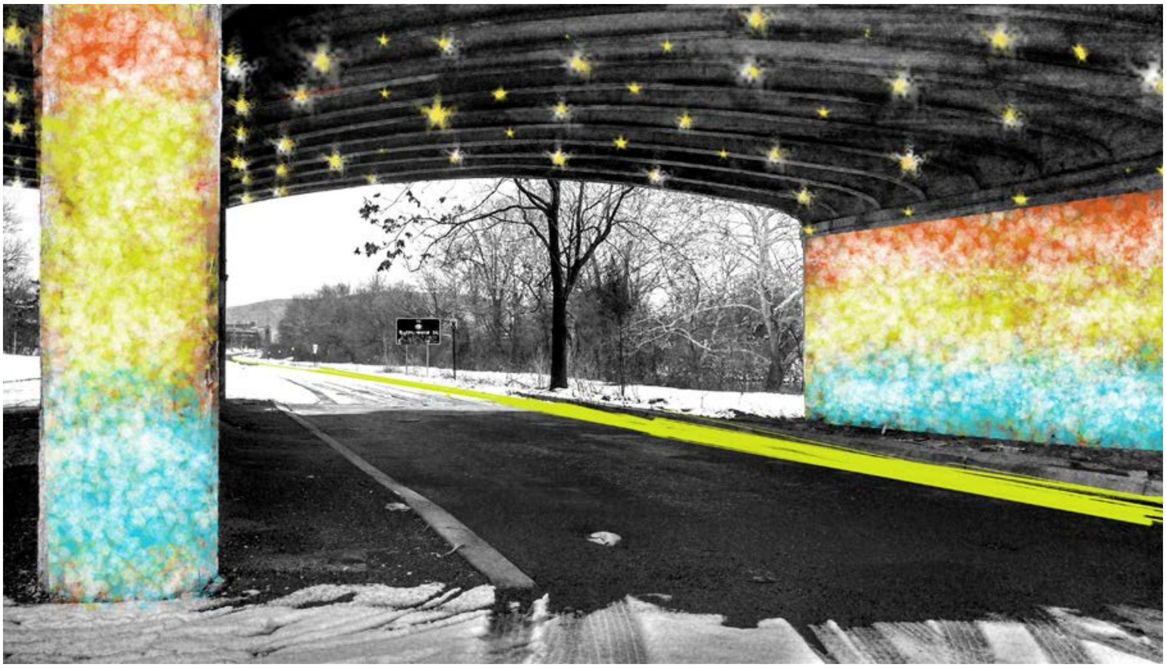

0′
30′
60′
90′

IDEA

Concept Three

Concept three articulates larger moves, and suggests long-term design suggestions. Celebrating the existing infrastructure, FEMA flood levels, and pulling the city back towards the river, it facilitates the connection that has been lost through the edge of the former-industrial edge and currently bustling highway.





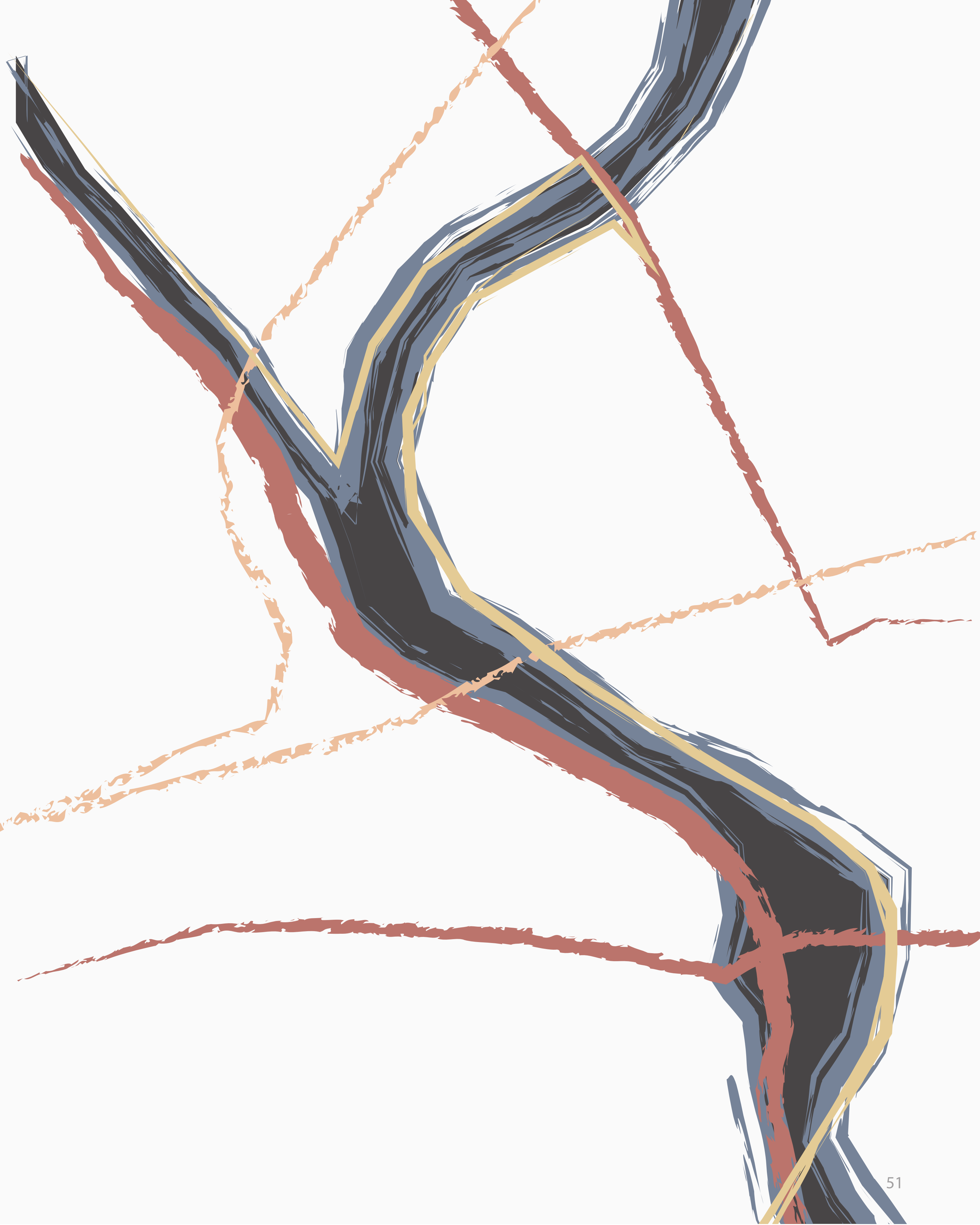
Re-imagine the Buttonwood Bridge Trail Arrival

Surfaces over turbines for experiential learning

Bike Lanes along River Road

MASTER PLAN AND DESIGN

Caption/ Subtext



DESIGN GOALS AND MASTER PLAN

RECONNECT THE RIVER

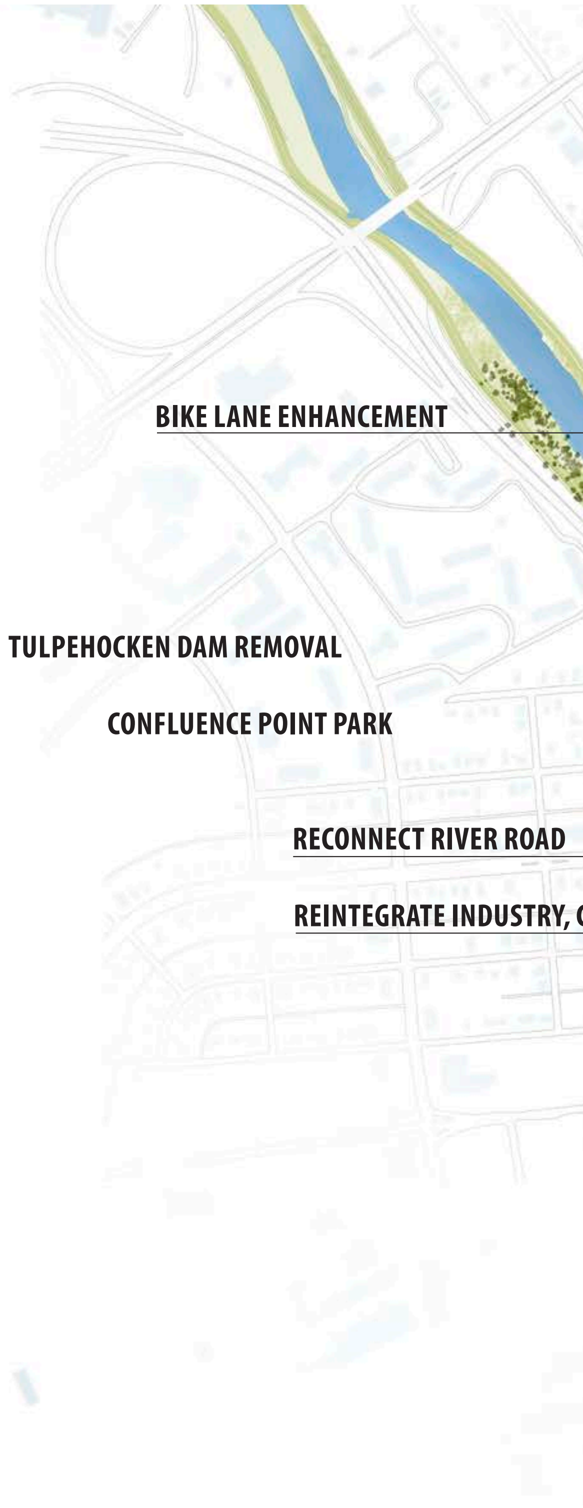
BY REMOVING TULPEHOCKEN DAM

RECONNECT THE CITY

BY REDUCING THE HARD EDGE OF THE HIGHWAY AND THE RIVER AND BUILDING A PEDESTRIAN BRIDGE.

RECONNECT THE PEOPLE

BY CREATING CONFLUENCE POINT AS A DESTINATION, AND CREATING OPPORTUNITIES ALONG THE WATERFRONT FOR COMMUNITY




Active Rail line
Schuylkill Ave
Front Street
CITY, AND RIVERFRONT
BUTTONWOOD BRIDGE ENTRY ENHANCEMENT
RIVER ROAD BIKE LANE ENHANCEMENT
Buttonwood Ave
RACC STREETSCAPE REDESIGN
Penn Ave

THE CONFLUENCE

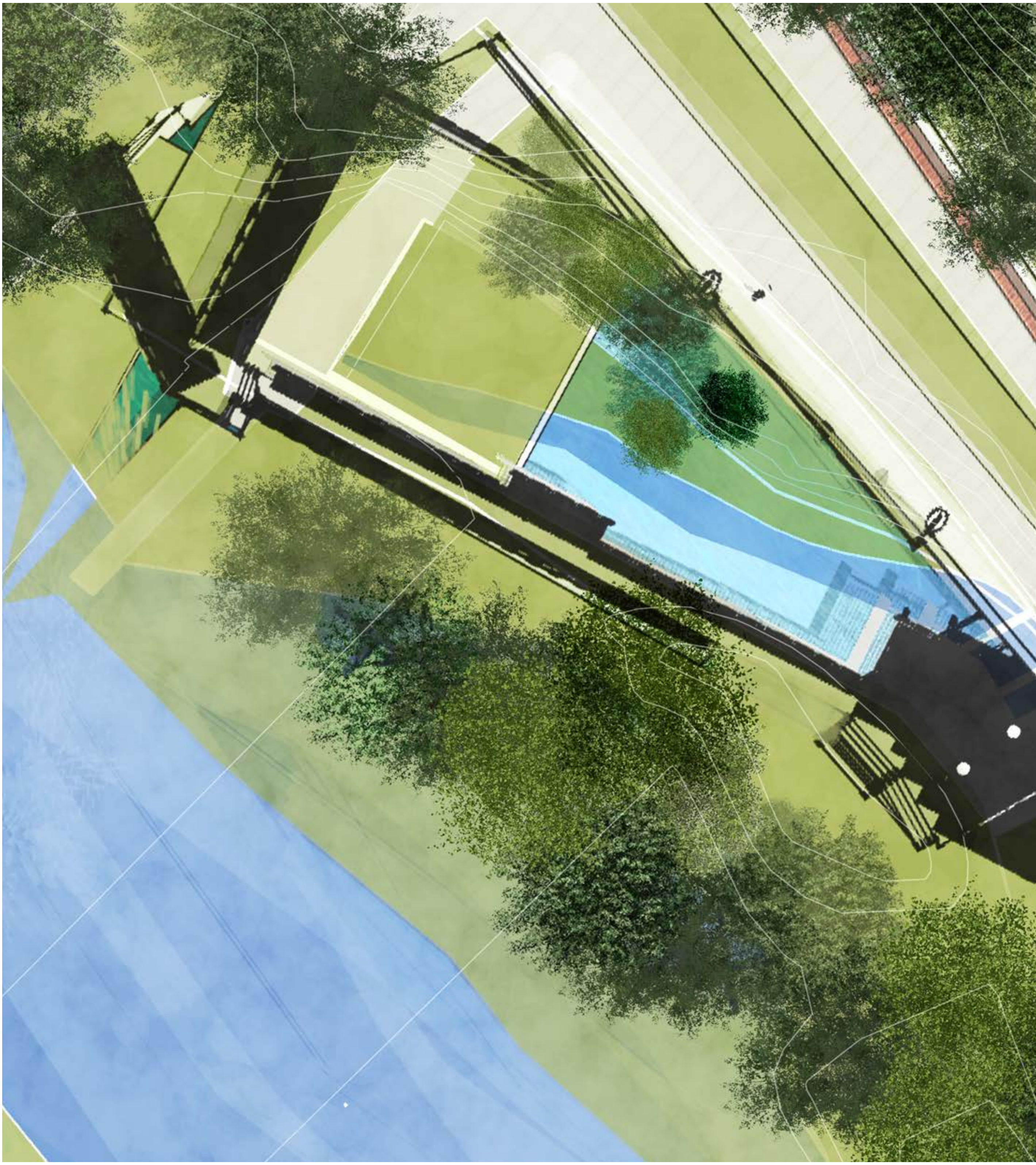
Confluence point park;

CONFLUENCE POINT

Confluence point park provides numerous opportunities for social, ecological and economic opportunities. Upon the dam being removed, and safety hazards mitigated, the existing infrastructure of the turbine, mill foundation, the construction of a skate park, and the opportunity to celebrate the confluence of the Tulpehocken and Schuylkill Rivers make this a ___ opportunity for Reading to invest in a new historical and recreational destination.

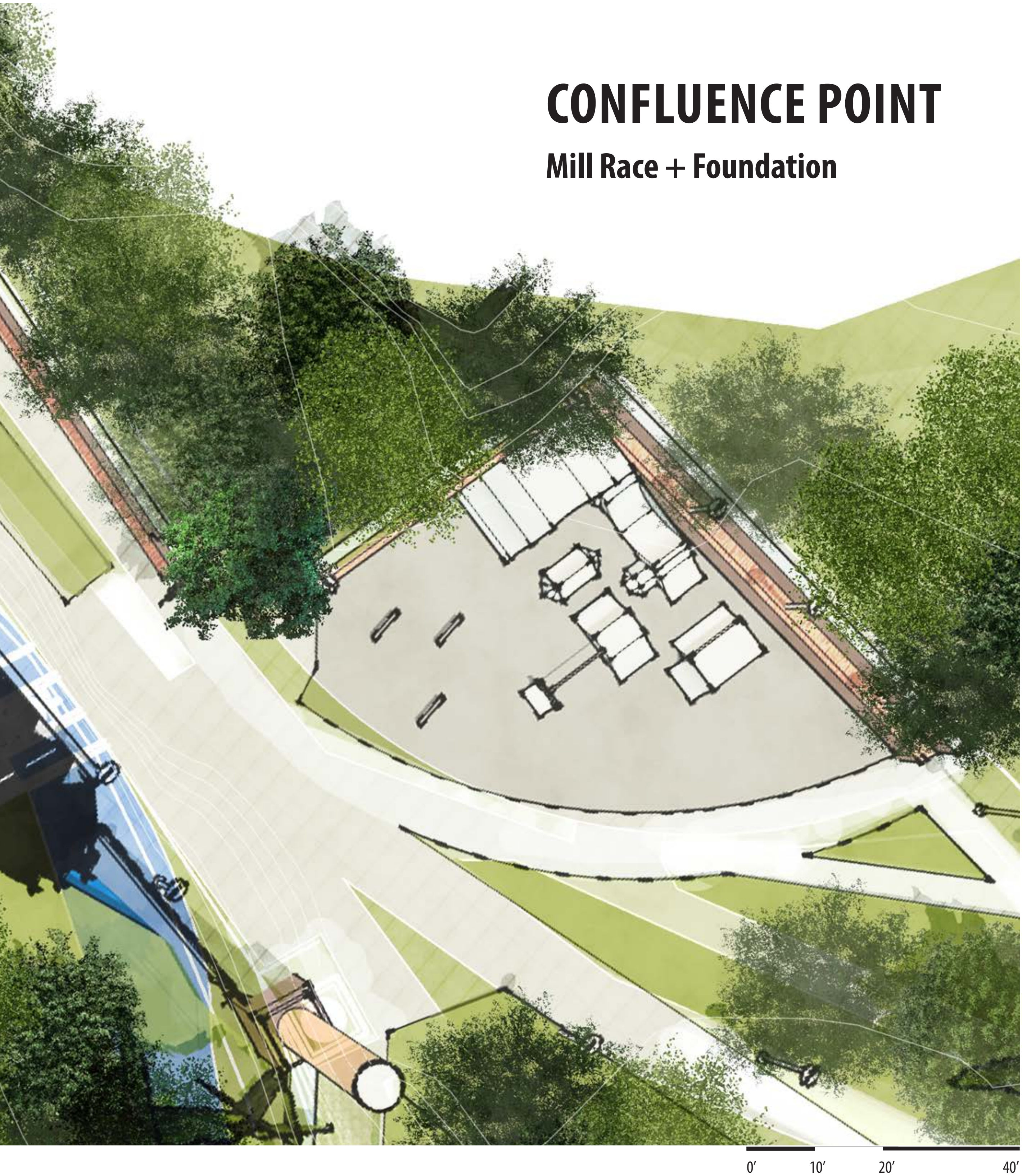
Area Context


0′
30′
60′
90′



CONFLUENCE POINT

Mill Race + Foundation



Confluence point park would benefit from lighting, seating areas, and a formalized boat drop and fisihing area.

CONFLUENCE POINT

Bridging the Gap

The grander design gesture for this project is proposing a pedestrian bridge, pulling people on the east banks of the Schuylkill River to its west banks, and then onto confluence point. At this point in time, one has to leave the river to get to the other side of it, which seems counter intuitive and deters people from continuing up and down the trail. Through casual conversations with those along the Thun Trail, and subjective analysis, exploring a route across the water would greatly benefit the pedestrian and bike passage along the river corridor.

Pedestrian bridge looking west towards confluence point park. Architecture to mimick other bridges along the trail, celebrating the post industrial anindstrial nature of the Schuylkill River Trail.

A proposed catwalk and grating system around the existing infrastructure provides new circulation patterns, and storytelling through passive rereation. Through the water level dropping, this area can now become vegetated, and help restore the natural floodplane

Utillize current infrastructure to provide daytime and evening events such as movies, concerts, or festivals.

RIVER ROAD

Reading, founded in 1748, provides a dynamic existing infrastructure as do many of the cities and small towns up and down the east coast. With the infrastructure evolving with new transportation needs (i.e. pedestrian, to rail, to vehicular traffic), opportunities to provide corridors for pedestrian and bike traffic are abundant. Here, corridors have been highlighted because they are primary routes for

Area Context


BUTTONWOOD BRIDGE ENTRANCE DESIGN
ENHANCE BIKE LANES ALONG RIVER ROAD
REDESIGN OF PENN AVENUE
Buttonwood Ave
Schuylkill Ave
Front Street
River Rd
Active Rail line
Route 422
Penn Ave
Penn St.
0 120′ 240′ 360′

FRIENDLY STREETS

Buffered Bike Lanes

Rumble strips for sensory barrier

Recycled materials as bike lane buffer

Cities around the nation are adopting numerous ways to create safer lanes for bikes and pedestrians. Specific to the areas along River Road and Schuylkill River Trail, bike lanes need to be more clearly called out. This is not only to help those traveling along the trail who are unfamiliar with the route, and also alert vehicular traffic to higher amounts of bikes and pedestrians along the route. River Road is currently four lanes and is approximately 35' wide; 12' is needed for bike lanes, which leaves about more than enough room for two vehicular lanes (23') . As a short term measure, bike icons can be painted in the right hand lanes indicating shared lanes. A more comfortable proposal would be for the right lanes to be turned into bike lanes, and for the road to be converted into a two lane road. For a longer term solution, and one that could be implemented on many of the proposed pedestrian and bike lane enhancements, more clear delineations can be made to indicate to traffic to share the road. This can be as minimal as rumble strips (top left) and or recycled materials (bottom left) or it can be a streetscape design, as rendered in the right. The most important aspects in promoting more cyclists on the streets is increasing the perceptions of safety, and clear signage as to where bikes, people, and cars default to when all through co-exist along the same route.

Render of River Road near Buttonwood Bridge looking south towards Reading Area Community College

RESTORATION

Overview of dam removal and phased revegetation, and exotic plant management calendar.

RESTORATION

Phased Dam Removal

Because of the adaptive nature of a dam removal, the approach takes on a more fluid approach of establishing and managing plantings instead of a one time planting. Based on the grade of the Schuylkill River and The Tulpehocken upstream, the historic slope of the river is .01% (Rise just over an inch every 100'). The current topography shows .02% slope or 2' change over 1000' above the dam, and then approximately an 8' drop below the dam. This averages out at 3% grade, which indicates an average 3' drop for every 100' of river, which is much steeper than the projected historic conditions. These calculations are based on information obtained from PASDA. To be sure of the actual impoundment sediment studies would have to be conducted.

The dam removal will occur in three phases. The first phase includes removing the top 5' of the dam in the late spring, thus exposing the first bands of sediment along the edges of the river. The exposed areas should be seeded with one of Ernst "Native Steep Slope Mix w/ Grain Rye" (ERNMX-181-2). This mix recommends a heavy broadcast of 75lb per acre, but provides a nice variety of warm season grasses to facilitate erosion control and sediment stabilization.

The second phase of the dam removal should take place early to mid summer removing the bottom 5-7' of the dam as seen fit. Suggested mixes include Ernst OBL-FACW Perennial Food and Cover wetland mix (ERNMIX-120), FACW Meadow Mix (ERNMIX-122), and/or OBL Wetland Mix (ERNMIX-131). These will begin to balance the more general, and fast germination mix from the first phase and facilitate growth of more appropriate natives in their microenvironments. Furthermore, during this time grade controls should be installed based on how much sedimentation drops from the impoundment. Based on the aforementioned calculations a grade control every 100' would be ideal, providing a terracing to help prevent erosion and undercutting. These grade controls can be made from a range of materials varying in permanence (check dams made of coir logs and wooden grade structures to large rip rap).

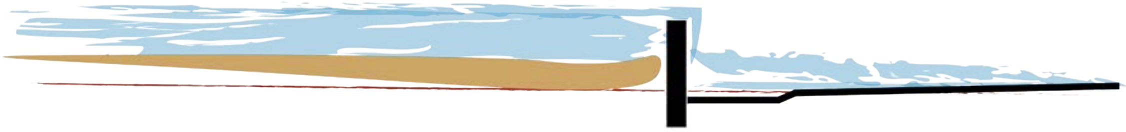
The third phase takes place the following season, which includes management of any invasive species beginning to show within the revegetation area, and facilitating specific plant community growth through more stock planting based on the progression and success of the seeding from the prior season. Moving into

Projected Restoration Goals

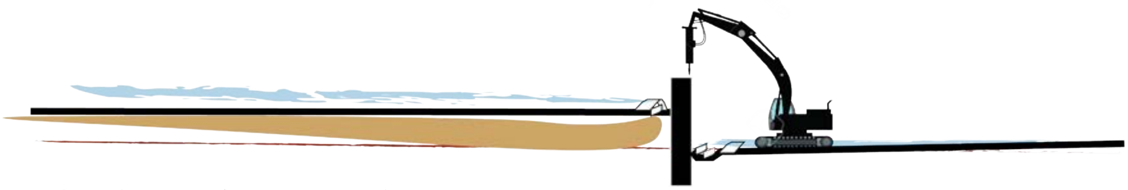
For long-term succession goals, reference communities for the area include the "River bed-bank-floodplain complex which is comprised of seven plant communities: 1.) Sycamore - (river birch) - box elder floodplain forest, 2.) Silver maple floodplain forest, 3.) Red maple - elm - willow floodplain swamp 4.) River birch - sycamore flood-plain scrub, 5.) Black willow scrub/shrub wetland Riverside ice scour communities 6.) Big bluestem - Indian grass river grassland 7.) Water-willow -

(continued on page 74)

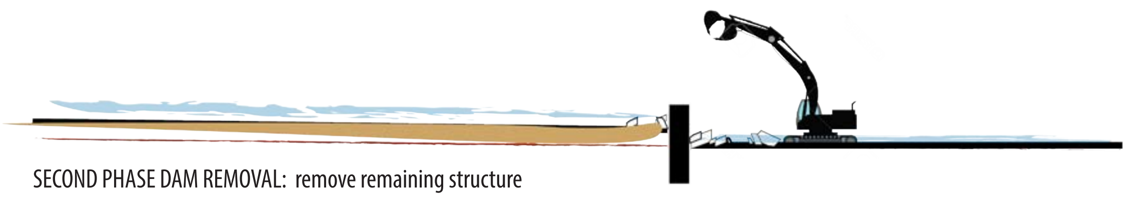
PRE-DAM CONDITION .01% SLOPE



EXISTING DAM CONDITION: 136′ x13′ x 3′ WALL, 02% IMPOUNDMENT SLOPE, and 3% AVERAGE SLOPE INCLUDING DOWNSTREAM OF DAM



FIRST PHASE DAM REMOVAL: remove top 5′



SECOND PHASE DAM REMOVAL: remove remaining structure

SECOND PHASE INSTALL GRADE STRUCTURES EVERY 100′, PROMOTE .01% slope

ERNST SEED MIX COMPOSITION

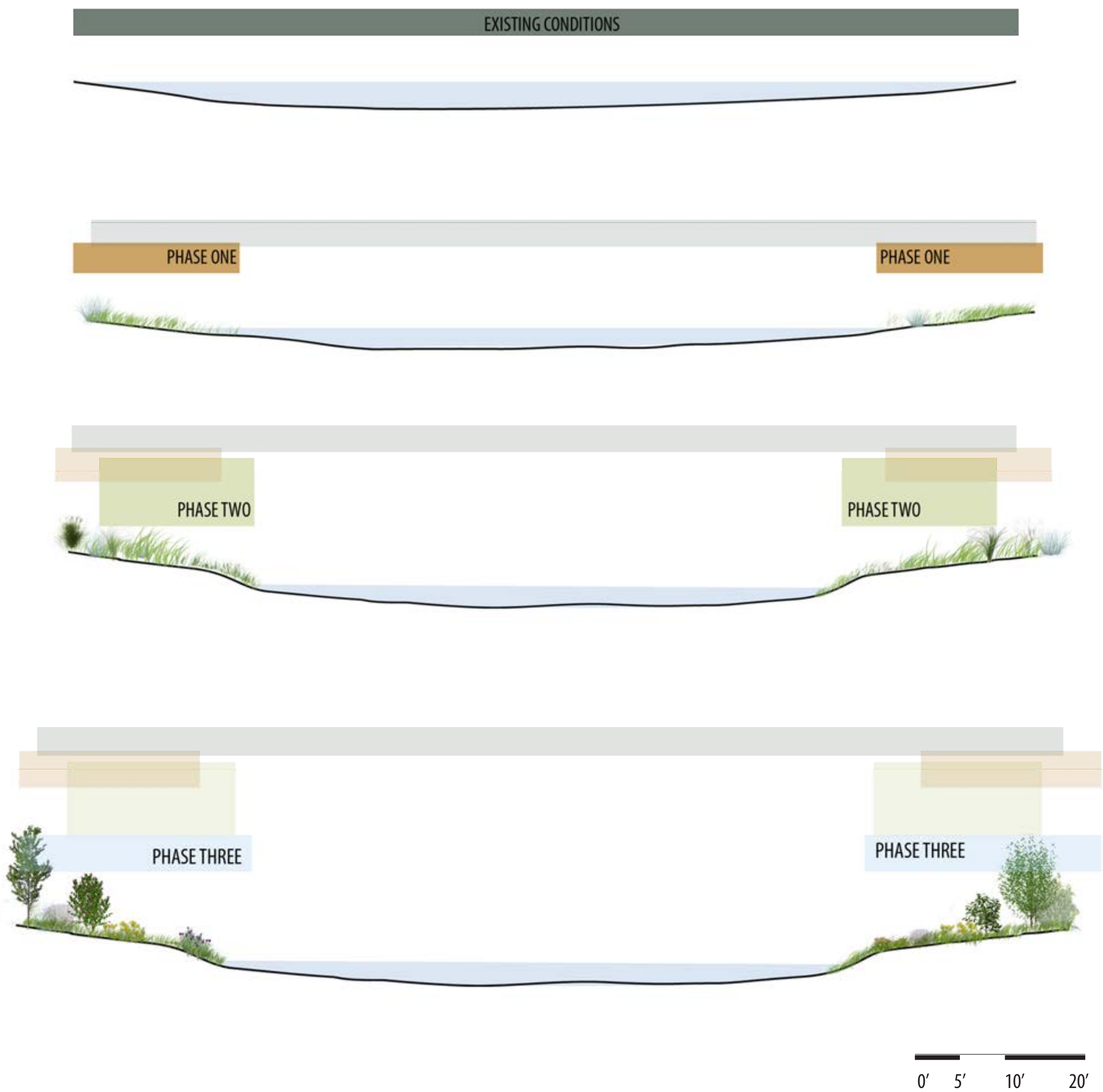
"Native Steep Slope Mix w/ Grain Rye" (ERNMX-181-2)
40% Grain Rye, Variety Not Stated (Secale cereale, Variety Not Stated)
24.2% Indiangrass, PA Ecotype (Sorghastrum nutans, PA Ecotype)
10% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype)
4.5% Autumn Bentgrass, PA Ecotype (Agrostis perennans, PA Ecotype)
4% Canada Wildrye (Elymus canadensis)
3% Big Bluestem, 'Prairie View'-IN Ecotype (Andropogon gerardii, 'Prairie View'-IN Ecotype)
2% Purple Coneflower (Echinacea purpurea)
2% Partridge Pea, PA Ecotype (Chamaecrista fasciculata (Cassia f.), PA Ecotype)
2% Switchgrass, 'Shawnee' (Panicum virgatum, 'Shawnee')
1.5% Ticklegrass (Rough Bentgrass), PA Ecotype (Agrostis scabra, PA Ecotype)
1.5% Lanceleaf Coreopsis, Coastal Plain NC Ecotype (Coreopsis lanceolata, Coastal Plain NC Ecotype)
1% Oxeye Sunflower, PA Ecotype (Heliopsis helianthoides, PA Ecotype)
1% Blackeyed Susan, Coastal Plain NC Ecotype (Rudbeckia hirta, Coastal Plain NC Ecotype)
1% Purpletop (Tridens flavus)
0.7% Slender Bushclover, VA Ecotype (Lespedeza virginica, VA Ecotype)
0.6% Marsh (Dense) Blazing Star (Spiked Gayfeather), PA Ecotype (Liatris spicata, PA Ecotype)
0.5% Wild Bergamot, PA Ecotype (Monarda fistulosa, PA Ecotype)
25% Fox Sedge, PA Ecotype (Carex vulpinoidea, PA Ecotype)
20% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype)
15% Lurid (Shallow) Sedge, PA Ecotype (Carex lurida, PA Ecotype)
8% Hop Sedge, PA Ecotype (Carex lupulina, PA Ecotype)
6% Blunt Broom Sedge, PA Ecotype (Carex scoparia, PA Ecotype)
5% Green Bulrush, PA Ecotype (Scirpus atrovirens, PA Ecotype)
5% Deertongue, 'Tioga' (Panicum clandestinum (Dichanthelium c.), 'Tioga')
4% Giant Bur Reed, PA Ecotype (Sparganium eurycarpum, PA Ecotype)
3% Eastern Bur Reed (Sparganium americanum)
3% Soft Rush (Juncus effusus)
2% Fringed (Nodding) Sedge, PA Ecotype (Carex crinita, PA Ecotype)
2% Rice Cutgrass, PA Ecotype (Leersia oryzoides, PA Ecotype)
2% Woolgrass, PA Ecotype (Scirpus cyperinus, PA Ecotype)
0.4% New England Aster, PA Ecotype (Aster novae-angliae (Symphyotrichum n.), PA Ecotype)

OBL-FACW Perennial Food and Cover wetland mix (ERNMIX-120),
25% Fox Sedge, PA Ecotype (Carex vulpinoidea, PA Ecotype)
20% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype)
15% Lurid (Shallow) Sedge, PA Ecotype (Carex lurida, PA Ecotype)
8% Hop Sedge, PA Ecotype (Carex lupulina, PA Ecotype)
6% Blunt Broom Sedge, PA Ecotype (Carex scoparia, PA Ecotype)
5% Green Bulrush, PA Ecotype (Scirpus atrovirens, PA Ecotype)
5% Deertongue, 'Tioga' (Panicum clandestinum (Dichanthelium c.), 'Tioga')
4% Giant Bur Reed, PA Ecotype (Sparganium eurycarpum, PA Ecotype)
3% Eastern Bur Reed (Sparganium americanum)
3% Soft Rush (Juncus effusus)
2% Fringed (Nodding) Sedge, PA Ecotype (Carex crinita, PA Ecotype)
2% Rice Cutgrass, PA Ecotype (Leersia oryzoides, PA Ecotype)
2% Woolgrass, PA Ecotype (Scirpus cyperinus, PA Ecotype)

ERNMX-131
35% Fox Sedge, PA Ecotype (Carex vulpinoidea, PA Ecotype)
20% Lurid (Shallow) Sedge, PA Ecotype (Carex lurida, PA Ecotype)
7% Green Bulrush, PA Ecotype (Scirpus atrovirens, PA Ecotype)
7% Hop Sedge, PA Ecotype (Carex lupulina, PA Ecotype)
6% Blunt Broom Sedge, PA Ecotype (Carex scoparia, PA Ecotype)
4% Giant Bur Reed, PA Ecotype (Sparganium eurycarpum, PA Ecotype)
4% Blue Vervain, PA Ecotype (Verbena hastata, PA Ecotype)
3% Soft Rush (Juncus effusus)
2% Rattlesnake Grass, PA Ecotype (Glyceria canadensis, PA Ecotype)
2% Eastern Bur Reed (Sparganium americanum)
1% Fringed (Nodding) Sedge, PA Ecotype (Carex crinita, PA Ecotype)
1% Swamp Milkweed, PA Ecotype (Asclepias incarnata, PA Ecotype)
1% Square Stemmed Monkeyflower, PA Ecotype (Mimulus ringens, PA Ecotype)
1% Softstem Bulrush, PA Ecotype (Scirpus validus (Schoenoplectus tabernaemontani), PA Ecotype)
1% Sensitive Fern (Onoclea sensibilis)
1% Woolgrass, PA Ecotype (Scirpus cyperinus, PA Ecotype)
0.5% Ditch Stonecrop, PA Ecotype (Penthorum sedoides, PA Ecotype)
0.5% Boneset, PA Ecotype (Eupatorium perfoliatum, PA Ecotype)
0.5% Joe Pye Weed, PA Ecotype (Eupatorium fistulosum, PA Ecotype)
0.5% Mud Plantain (Water Plantain), PA Ecotype (Alisma subcordatum (A. plantago-aquatica), PA Ecotype)
0.5% Blueflag, PA Ecotype (Iris versicolor, PA Ecotype)
0.5% Nodding Bur Marigold, PA Ecotype (Bidens cernua, PA Ecotype)
0.5% Seedbox, PA Ecotype (Ludwigia alternifolia, PA Ecotype)
0.5% Roughleaf Goldenrod, PA Ecotype (Solidago patula, PA Ecotype)

ERNMX-122
31% Fox Sedge, PA Ecotype (Carex vulpinoidea, PA Ecotype)
20% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype)
14% Lurid (Shallow) Sedge, PA Ecotype (Carex lurida, PA Ecotype)
5% Green Bulrush, PA Ecotype (Scirpus atrovirens, PA Ecotype)
4% Blue Vervain, PA Ecotype (Verbena hastata, PA Ecotype)
3.5% Wood Reedgrass, PA Ecotype (Cinna arundinacea, PA Ecotype)
3% Soft Rush (Juncus effusus)
3% Blunt Broom Sedge, PA Ecotype (Carex scoparia, PA Ecotype)
3% Hop Sedge, PA Ecotype (Carex lupulina, PA Ecotype)
2% Sensitive Fern (Onoclea sensibilis)
2% Oxeye Sunflower, PA Ecotype (Heliopsis helianthoides, PA Ecotype)
1% Rattlesnake Grass, PA Ecotype (Glyceria canadensis, PA Ecotype)
1% Woolgrass, PA Ecotype (Scirpus cyperinus, PA Ecotype)
1% Swamp Milkweed, PA Ecotype (Asclepias incarnata, PA Ecotype)
1% New England Aster, PA Ecotype (Aster novae-angliae (Symphyotrichum n.), PA Ecotype)
1% Flat Topped White Aster, PA Ecotype (Aster umbellatus (Doellingeria umbellata), PA Ecotype)
0.5% Joe Pye Weed, PA Ecotype (Eupatorium fistulosum, PA Ecotype)
0.5% Boneset, PA Ecotype (Eupatorium perfoliatum, PA Ecotype)
0.5% Ditch Stonecrop, PA Ecotype (Penthorum sedoides, PA Ecotype)
0.5% Narrowleaf Blue Eyed Grass (Sisyrinchium angustifolium)
0.5% Seedbox, PA Ecotype (Ludwigia alternifolia, PA Ecotype)
0.5% Great Blue Lobelia, PA Ecotype (Lobelia siphilitica, PA Ecotype)
0.5% Mud Plantain (Water Plantain), PA Ecotype (Alisma subcordatum (A. plantago-aquatica), PA Ecotype)
0.5% Square Stemmed Monkeyflower, PA Ecotype (Mimulus ringens, PA Ecotype)

PHASED REVEGETATION



(previous on page 70)

smartweed riverbed community (Fike). As outlined in Terrestrial and Palustrine Plant communities of Pennsylvania, these communities have persistent emergent vegetation that tolerate semipermanent or usually flooded vegetation found in floodplains, along river banks, or river islands.

To re-establish the riverbank regime along the area being dewatered by the dam, herbaceous vegetation associated with community types that are typically more inundated will include herbaceous species like e.g. Apocynum cannabinum, Justicia americana, Eleocharis spp., Cyperus spp., Polygonum spp., Bidens spp. paired with the more dominant woody species of Betula nigra, Salix nigra, Platanus occidentalis.

In the areas that will experience frequent flooding and longer periods of flooding the plantings should be modeled off of the "Water-willow - smartweed riverbed community," which thrives in more alluvial, rocky soil types; the more rocky areas will be planted with species associated with "Big bluestem - Indian grass river grassland" mixed once again with early successional woody species Betula nigra, Salix nigra, Platanus occidentalis.

Within the islands on the Schuylkill River and the floodplain, two primary woodland communities should dominate with invasive plant management, and should be the target communities for the restoration area upstream and surrounding the dam. These communities include the "River birch - sycamore floodplain scrub" and the "Black willow scrub/shrub wetland"; these communities commonly occur with the aforementioned ""Big bluestem -Indian grass river grassland."

The areas upslope, or experiencing less inundation will be modeled after the "Silver maple floodplain forest" and the "Sycamore -(river birch) - box elder floodplain forest. " The area with the old mill run will be modeled after the he "Red maple - elm - willow floodplain swamp," which tolerates moderate to frequent flooding but occurs naturally in depressions or natural levees; Fike sites that this landscape " position of this community type prevents floodwaters from draining rapidly, and water is retained on the site for prolonged periods."

LEGEND

- Restoration Area
- Projected Seeding Area 1 (40,000 sf)
- Projected Seeding Area 2 (60,000 sf)
- Projected Seeding Area 3 (111480 sf)
- Projected Seeding Area 4 (120,000 sf)

EXOTIC PLANT MANAGEMENT

Exotic plant managment will be crucial for the west bank of the Schuylkill River and in the area of the Confluence. Currently innundated with lesser celanine, Japanese knotweed and Japanese honeysuckle, these species not only decrease biodiversity but compromise the aesthetic value of the waterfront and perceptions of safety by blocking views. The table to the right provides a baseline for the most dominant species along the river corridor, the treatment method most appropriate and the time of year they should be implemented. A combination of manual, mechanical, and chemical treatments can be utilized; most effective attacks use all three methods.

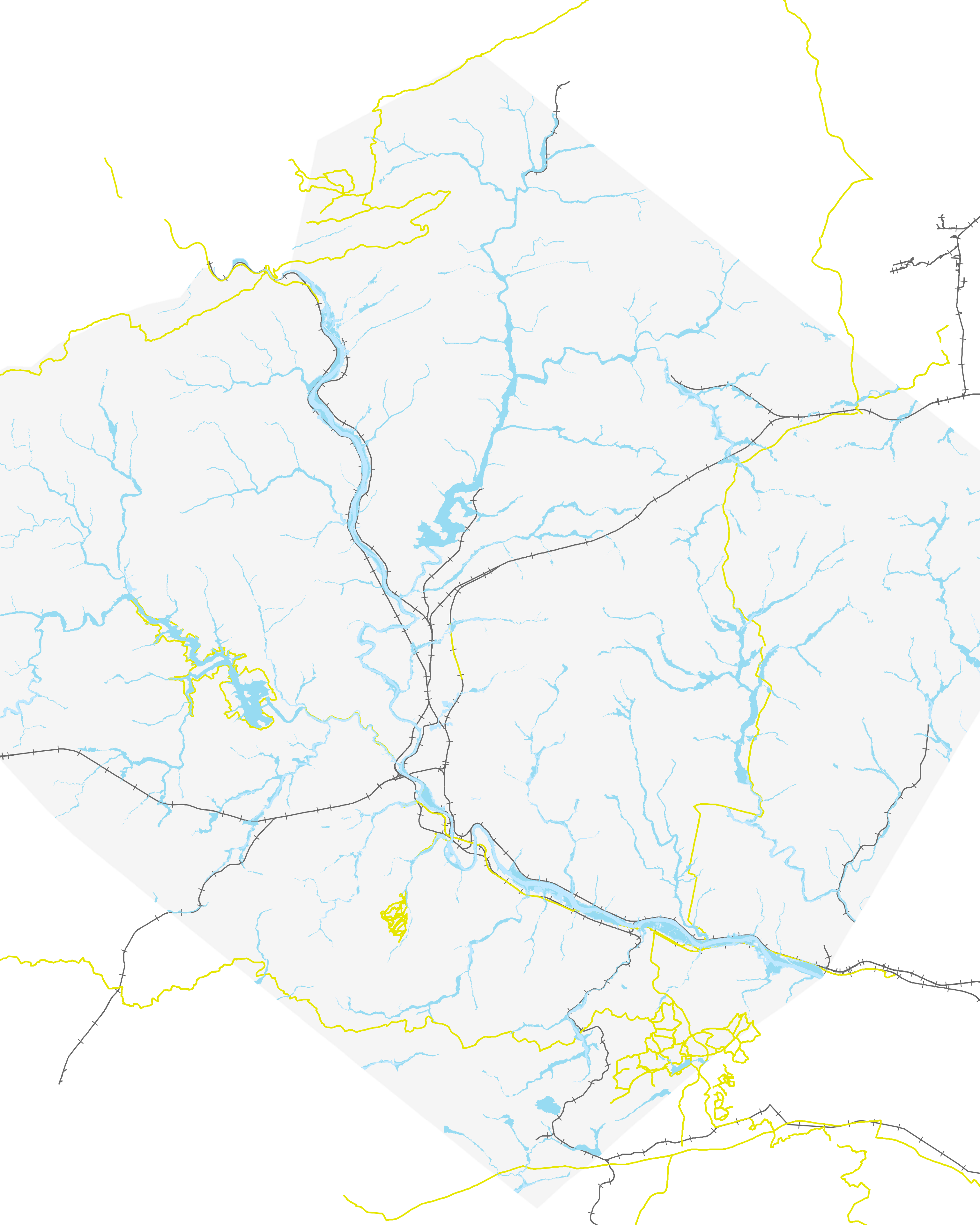
	JANUARY	FEBRUARY	M
Paulownia tomentosa			
Albizia julibrissin			
Acer platanoides			
Lonicera Maackii			
Lonicera japonica			
Fallopia japonica			
Celastrus orbiculatus			
Microstegium vimineum			
Rubus phoenicolasius			
Persicaria perfoliata			
Rosa Multiflora			

LEGEND: mowing,

manual removal, basal bark, cutting, goats, cut stump

MONITORING

Dam Removal Monitoring, assuming Adaptive Management



Technical Approach

According to the Society for Ecological Restoration "Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability" (SER Primer 2). With this in mind, in order to determine if a restoration project is successful in accelerating or aiding in the recovery of an ecosystem, it needs to be measured over time incorporating adaptive management practices. Without clearly stated goals that indicate the most important aspects of a reference ecosystem, and objectives created to reflect the goals the success of a restoration project could be compromised. Furthermore, monitoring and adaptive management are imperative to the process, as the field of ecological restoration is still in its adolescence, and landscape performance is necessary to understand and establish restoration best practices.

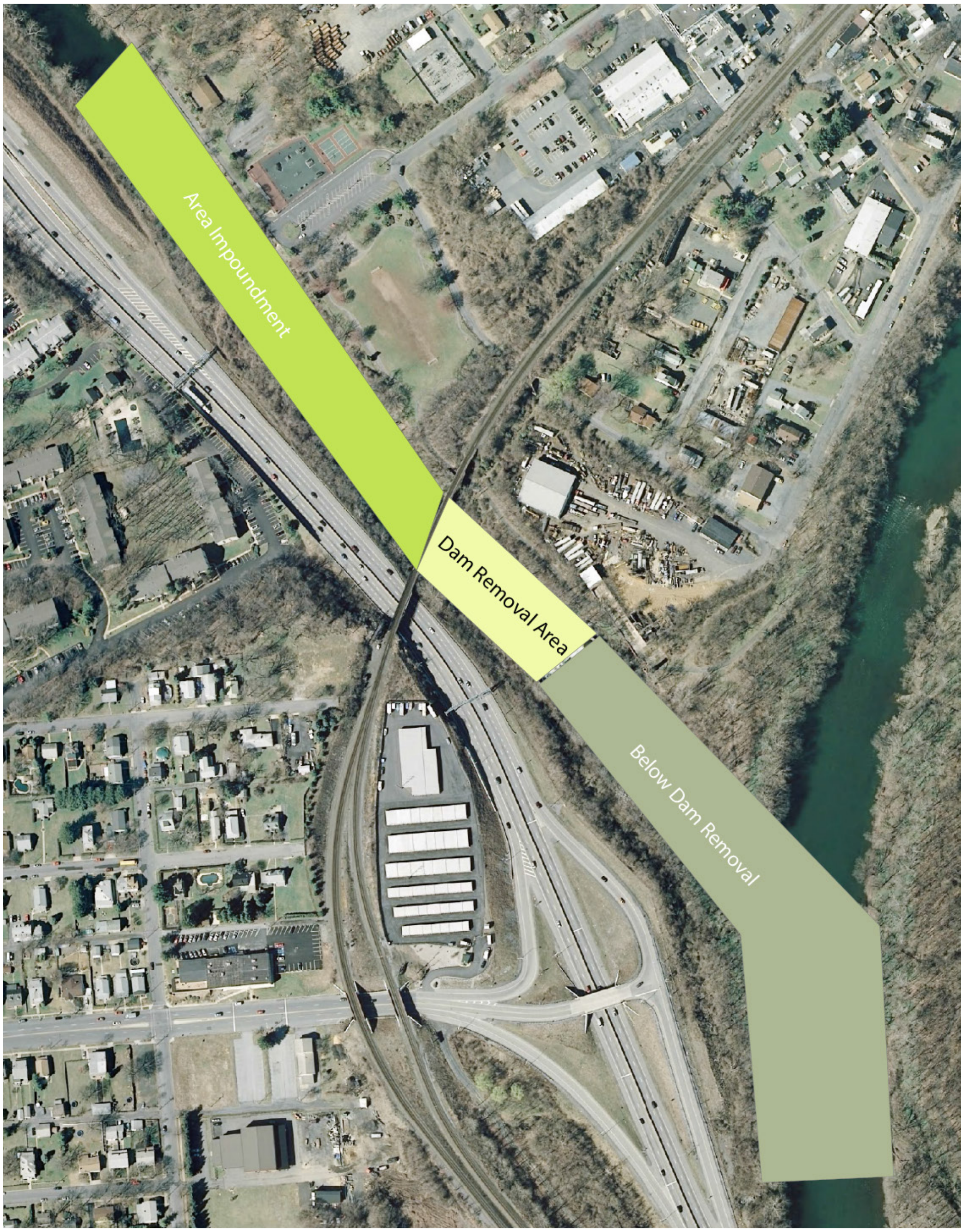
As recommended by the SER primer, "two fundamental questions should be asked with respect to the evaluation of a restored ecosystem. Were the objectives accomplished? Were the goals fulfilled? Answers to both questions gain validity only if the goals and objectives were stated prior to implementation of restoration project work" (SER Primer 7). The monitoring goals for the Tulpehocken Dam Removal are to effectively dismantle the current dam structure while documenting the physical and biological responses within a short term (five year) and longer term (ten year) context. The monitoring objectives include 1.) Recording the primary processes and responses of the overall system to the dam removal and 2.) Evaluating specific changes in overall habitat, sedimentation, water quality, fish migration and habitat and vegetation recovery.

The following sections will discuss the pre and post-construction analysis needed for the dam removal and four primary aspects of post construction ecological monitoring including Sediment and Erosion control, Fish Habitat, Hydrology and Flow, and Vegetation. Three monitoring areas will be defined in three reaches

1.) upstream reference location
2.) the area containing the dam removal and immediately upstream and
3.) the area immediately downstream of the dam.

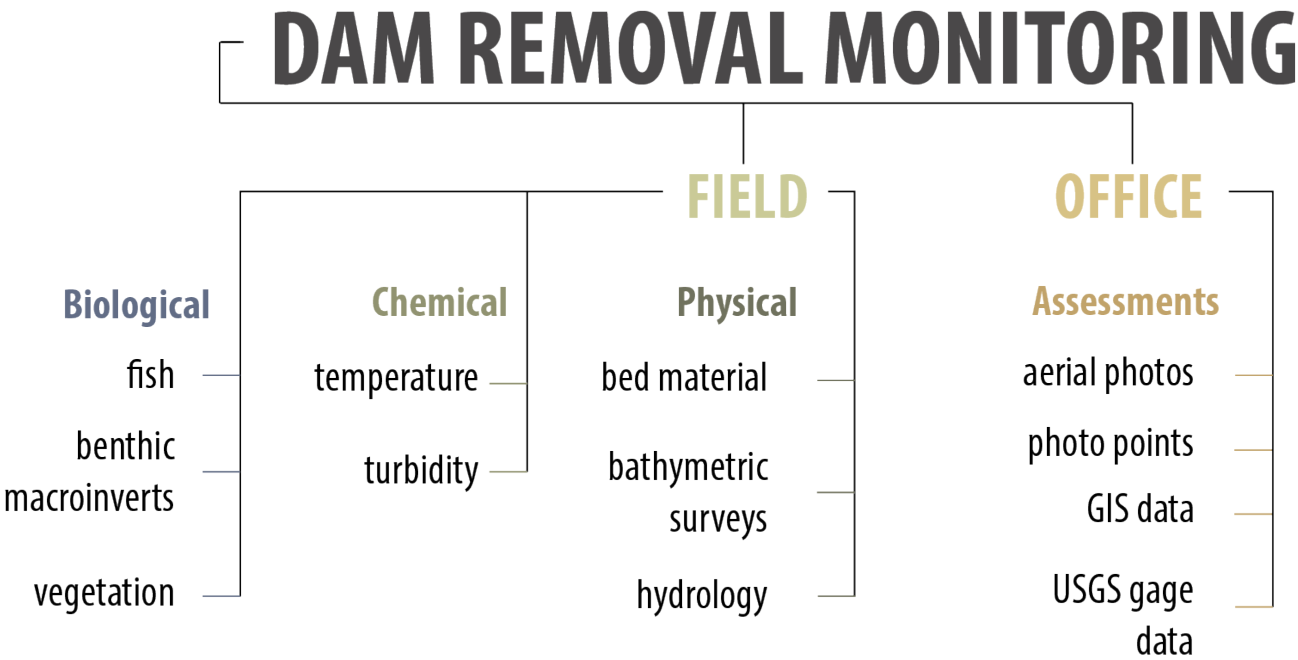
Pre and Post Construction Monitoring by Category

As completed in the Brownsville monitoring proposal, the framework of monitoring was broken down into four two categories field monitoring and office assessments (aerial photos, photo points, GIS data, USGS gage data). Field observations were then broken into the subcategories of biological (fish, benthic macroinverts, vegetation), chemical (temp and turbidity) and physical surveys (bed material bathymetric surveys and hydrology). This model, created by the Brownsville Monitoring Proposal, helps realize the extent and type of field monitoring that needs to take place in



General Reaches for Pre-and Post Construction Monitoring

0′ 95 190′ 380′



Graphic describing Tullos and Grand Graphic monitoring classifications and locations in post-dam removal circumstances conjunction with office monitoring.

Habitat Assessment

An initial habitat assessment should be done to understand how the dam has impacted biological communities both within and surrounding the Tulpehocken Creek. Dam removal typically alters flow and sediment transport which can visibly change the structure and physical habitat. The Academy of Natural Sciences suggests making visual habitat assessments according to EPA rapid assessment protocols that include estimates of biological cover, substrate embeddedness, water velocity and depth, pool variability, sediment deposition, riffle frequency, channel modifications, and bank stability ("Ecological Effects of Small Dams"). Additionally, general information should be collected within the three reaches of the dam as well as other points within the restoration area. This information includes:

Invasive Plant % Cover
Plant Survival and Coverage
Wildlife Observations
Comparative Photographs
Indicators of Hydric Soil Development (site specific)
Percent Organic Matter of Soil (site specific)
Indicators of Wetlands Hydrology (site specific)
Evidence of Use by Community (site specific)
Aerial Photos, Stereoscopic Photos, or Panoramic Photos (site specific)

Sediment and Erosion Control

Dams typically impact riverine systems by altering flow regimes, sediment transport, water temperature, vegetation, channel shape and migratory fish (Poff and Hart 2002). In order to better understand the importance of dam removal and its impact on the aforementioned characteristics, assessments of river channel structure, water quality, sedimentation, and vegetation should be made both up and downstream of the dam (Poff and Hart 2002). Water quality is an important measure for understanding the overall ecological health of the system. It is recommended that samples of water are taken at points both above and below the impoundment; specifically water temperature, pH, dissolved oxygen and conductivity using a YSI DM 6000 multiprobe meter. The Society for Natural Sciences at Drexel suggest that at small dam sites, water samples should be tested for suspended matter, soluble reactive phosphorus (SRP), nitrite+nitrate (NO2+NO3- N), dissolved organic phosphorus (DOP), dissolved organic nitrogen (DON), total phosphorus (TP), total nitrogen (TN), dissolved organic carbon (DOC), and dissolved silicate ("Ecological Effects of Small Dams").

In relation to the sediment, dams tend to alter the amount and distribution of sediment throughout the stream channel. The baseline assessments need to determine three characteristics 1.) The amount of sediment stored 2.) The texture and size of said sediment and 3.) the average annual sediment discharge of the river for sand and gravel. Additionally, the dam also creates an impoundment or backup of sediment behind the dam which can create issues downstream if the dam were to be removed. To determine the extent of the impoundment pebble counts should be conducted both upstream and downstream of the dam structure. Furthermore, surveys should be carried out with a Total Station surveyor to understand how the dam may have affected channel morphology ("Ecological Effects of Small Dams").

For pre-construction monitoring understanding the profile of both up and downstream reaches should be mapped to fully understand the differences in slope or pool riffle structure; this also includes three cross sections of the channel to comprehend channel width and depth ("Ecological Effects of Small Dams"). Additionally a chirp sonar system can be used to understand the size and distribution and thickness of sediment fill behind a dam. A more cost effective, but maybe not as accurate, would be to impose a grid within a measurement area in the channel and use a soil probe to measure the extent of sedimentation.

Fish Habitat

When monitoring migratory fish in a riverine system both capture methods and non capture methods can be employed; this includes, trapping, fishermen's catch, counters, and observation. Trapping is best when trying to measure specific species and estimate age and the condition with the fish. However, it does not do a great job in accounting for juvenile populations. Counters and observation are non capture methods; however these are more effective in situations with fish ladders or with some sort of infrastructure to channel the fish into a specific area. While trapping is the preferred method, fishers catch is the proposed method for its cost effectiveness.

For Fishers Catch, the Kansas Fish and Game Commission for the Bass Monitoring Tournament sets a reasonable precedent, and makes a case for this method through its cost effective measures as well as community building. The KFGC mails booklets for the tournament with record forms to each of the bass clubs in Kansas before bulk fishing begins. The information collected by these forms were the number of participants and the number of hours fished, the number of fish harvested live and dead, the weight of the fish, and the time that the fish were collected. As any shad caught in the Delaware and Schuylkill Rivers have to be released, and weigh ins would not be able to be used to ensure validity, this method would be bolstered by more formalized monitoring with the Pennsylvania Fish and Boat Commission ("Summary Book: 2015 Pennsylvania Fishing Laws and Regulations"). A large amount of the Kansas clubs also practice "catch, measure, and release with weights for scoring obtained later from length-weight tables) (Willis 2). Catch data tends to have problems estimating abundance and species bias.

Important to consider is that the PFBC currently stocks American shad fry each year along the Schuylkill River; one of these locations is in the vicinity of Reading. These stockings continue to be successful, based upon monitoring conducted thus far. Because of these stockings, and its location near the confluence into the Delaware River, an American shad fishery has developed on an annual basis in the tailrace of Fairmont Dam along the Schuylkill River in Philadelphia.

Hydrology and Flow

To measure hydrological progress, it will be important to utilize the current USGS flow stations, and use a weir to periodically measure flow and hydrology.

There are two relevant USGS flow stations that can be incorporated into the office assessment and monitoring of the dam. Along the Tulpehocken river, there is currently one USGS flow station located at Lat 40`22'08", long 75`58'46", which is approximately 3.5 mi northwest of town square in Reading, and 3.9 miles downstream of Blue Marsh Lake (station 01470870) (USGS 01471000 Tulpehocken Creek near Reading, PA). The station has been recording since October 1950. The gauge is currently funded by the U.S. Army Corps of Engineers, Philadelphia District and the Pennsylvania Department of Environmental Protection. According to the NWS, the Action stage is 9 ft; Flood stage: 10.5 ft; Moderate flood stage: 12 ft; Major flood stage: 14 ft. The second USGS flow station, " USGS 01471510 Schuylkill River at Reading, PA" is located near Reading Area Community College along the Schuylkill River (N 40`20'05", W 75`56'12). it may be too far to indicate changes in sedimentation of the actual dam removal, but could be helpful in telling the larger story of hydrology within the smaller watershed that contains Reading.

To measure the flowrate along the Tulpehocken, it would be the most effective to station weirs at locations above and below the dam. The calculations rely on basic knowledge that the discharge is related to the water depth above the bottom of the V. The basic equation has been standardized and reads as

Q= 4.28 C tan (0/2) (h+k)5/12
Q= Discharge (cfs)
C= Discharge Coefficient
0= Notch Angle
h = Head (the distance between the water depth above the bottom of the V)
k = Head Correction factor (ft)

The weir is useful in waterways that lack a 20 foot run; more specifically a V notch weir would be appropriate because of its accuracy and the ability for it to be repeated throughout the season and over an extended period of time.

Vegetation Monitoring

Vegetation monitoring will be done via photo monitoring and measuring transects at specific points both within the active restoration site and the areas that are undergoing exotic plant management and maintenance practices. Transects specifically will be used to monitor the health and regeneration of native plants both in the dam removal area as well as along the three mile extent of the Thun and Union Canal Trails.

Transects should be completed four times a year on May 1st, July 1st, September 1st and December 1st, with each successive date representing the landscape is its respective season. See the transect sheet in Appendix A to see a sample field data sheet. Each end of the transect should be marked with rebar

Introduction

A visual analysis was completed in the Spring of 2015 on various points along the Tulpehocken and Schuylkill Rivers in Reading, Pennsylvania. The study included seven photo locations, varying in orientation and type of photo. The purpose of this study is to record varying degrees of water levels in the spring season as well as presence of invasive species, which are typically the first to become green in the spring. Eight spots were chosen, with the typical sequence and context depicted to the right (confluence area) and along the Schuylkill River (below).

Excerpt from photo monitoring report including photo monitoring points

and recorded with a GPS unit. Each transect should be 120’ long and marked every 40’. At each point, a square meter quadrat should be dropped to account for % coverage and counts of species (when appropriate). Additionally, the forest perpendicular to the transect line on either side (within approximately 50’) should be quantitatively reviewed and photographed.

For photo point monitoring, the current points as shown in the photo monitoring plan should be continued, and additional points need to be established to show effectiveness of EMPT, revegetation, and the dam removal itself. Each photo point should be marked with rebar driven into the ground and also recorded with a GPS unit. Standard practice in photo monitoring is that each photo should be taken with the camera fully zoomed out and, if possible, taken at a time of day that direct sunlight would impact the quality of the photo. If possible, a tripod should be used to take each photo.

Adaptive Management

In the Brownsville monitoring plan (Tullos and Grant), the following assessments were suggested for biological responses in dam removal. In post removal the following assessments need to be understood:

How quickly and what type of vegetation establishes upstream of the dam post- removal
How does the vegetation establishment correlate with reductions in surface (seet, rill and gully) erosion of reservoir sediments?
What are the changes in the vegetation distribution and cover in the riparian zone and both up and downstream of the dam?
What is the habitat quality in within the first year compared to five and ten years of the dam removal?
How do the benthic macroinvertebrates respond downstream of the dam removal over time?

In conjunction with adaptive management practices, once the sediment has settled upon removing the dam, these "post removal" points should be set up and assessed accordingly. Adaptive Management is a paramount portion of the design as well as the monitoring portion of this project. Vandalism, deer browse, use, weather, and other variables can greatly alter the outcome of the design and project. It will be helpful to try to incorporate citizen research into the dam removal, as this will promote community building and lead to reporting things like vandalism on a more regular basis. For deer browse, it will be helpful to incorporate deer fencing for early establishment of more expensive stock like plugs and trees and potentially incorporate seasonal bow hunting along corridors that the deer may travel.

Conclusion

This monitoring plan should be considered as a broad outline for consideration of the final monitoring plan to be created when appropriate funding has been secured for the dam removal. Additionally, as a brief photo monitoring exercise was done for this monitoring class, it was insufficient as it did not capture any of the true growing season due to curriculum constraints. It should be taken as a baseline for a longer three season photo monitoring project. Other photos important to include in future photo monitoring points are locations farther up the reach of the dam in a reference location, and up stream near Stonecliff skate park; this area will tell a story of the dam impoundment and revegetation efforts within the full scope of the dam removal and riparian restoration. Also, because the project is in a waterway, partnering for monitoring will be important to maximize funding and resources. In addition to the City of Reading and the Berks Conservancy, it would be helpful to open discussion and join forces with the Drexel Academy for the Natural Sciences, EPA, the Fish and Boat Commission, and American Rivers. Other potential monitoring and research candidates could be research students from surrounding higher educational institutions such as Penn State Berks Extension, Reading Area Community College, Alvernia, Albright and/or Kutztown University.

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Recommended Reading

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