

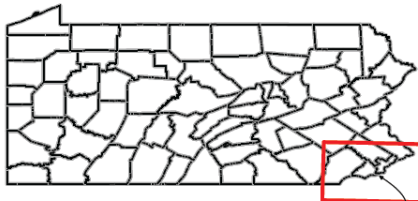
# Urban Conservation and Coastal Wetland Planning

Assessment and Planning for the John  
Heinz National Wildlife Refuge in  
Philadelphia, PA

Dan Salas, Ecologist  
Cardno JFNew

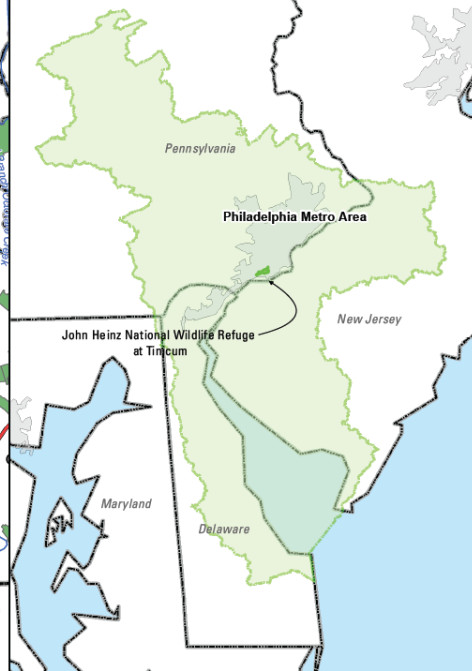


### Refuge Location in Relation to Regional and State Context

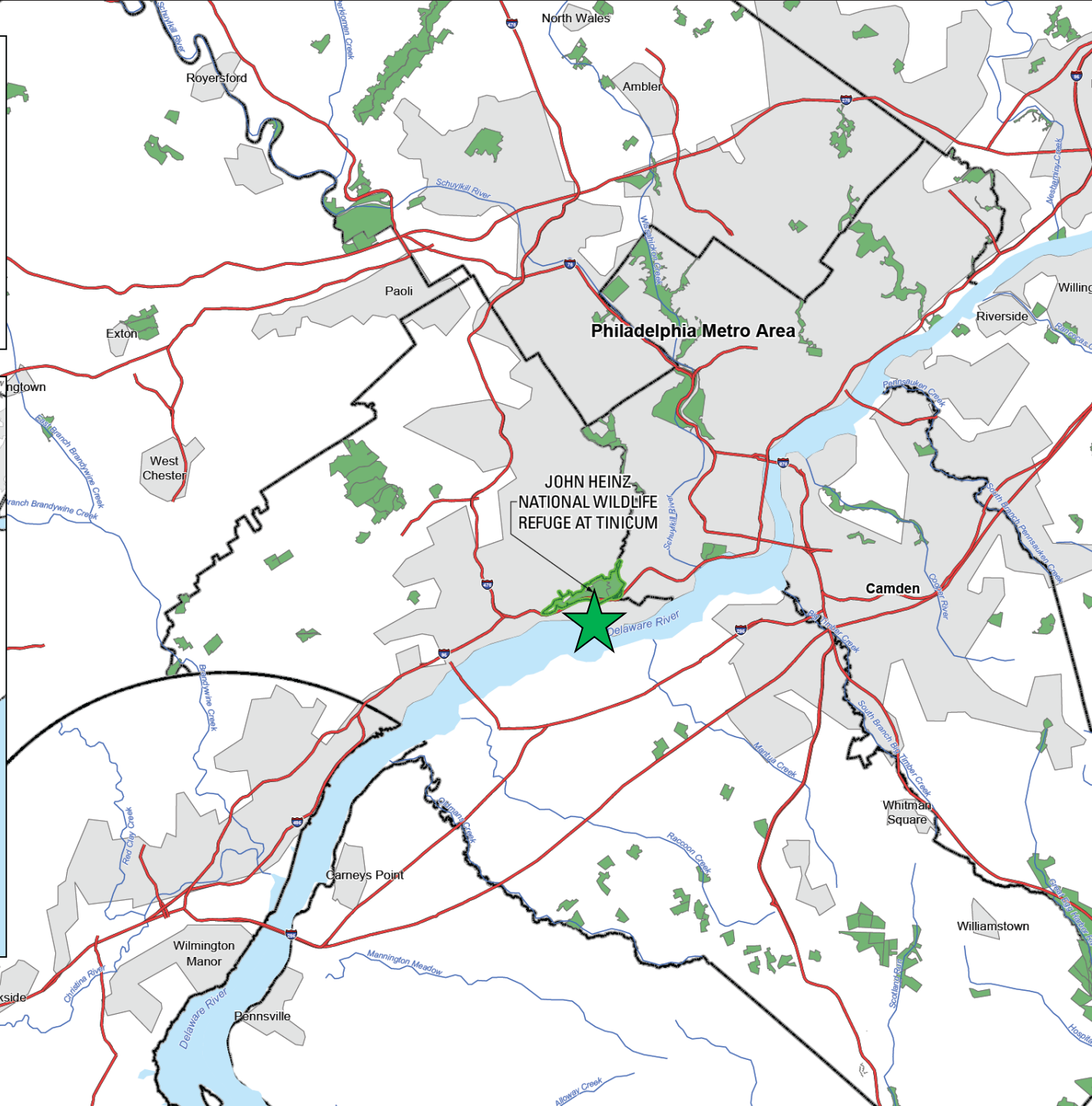


John Heinz National Wildlife Refuge at Tinicum

### Refuge Location in Relation to the Delaware Estuary



John Heinz National Wildlife Refuge at Tinicum



Philadelphia Metro Area

JOHN HEINZ NATIONAL WILDLIFE REFUGE AT TINICUM

Camden

Whitman Square

Williamstown

Wilmington Manor

Pennsville

Carneys Point

West Chester

Exton

Paoli

Royersford

Ambler

North Wales

Willing

Riverside

Newtown

Newark

Brookside

Delaware River

Delaware River

Mannington Meadow

Raccoon Creek

Mantua Creek

Swiss branch Brandywine Creek

South branch Brandywine Creek

South branch Brandywine Creek

Coopers Creek

Coopers Creek

Schuylkill River

Schuylkill River

Schuylkill River

River City Creek

Branch Brandywine Creek

Branch Brandywine Creek

Albany Creek

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

Scotch Run

# Location

- Pennsylvania's last and largest (80%) intact freshwater tidal marsh.
- Major stop-over for the Atlantic Coast/Delaware River migratory flyway.
- 4<sup>th</sup> largest metropolitan area in the U.S.
- 350 years of European settlement and influence – one of oldest settlements in the U.S.

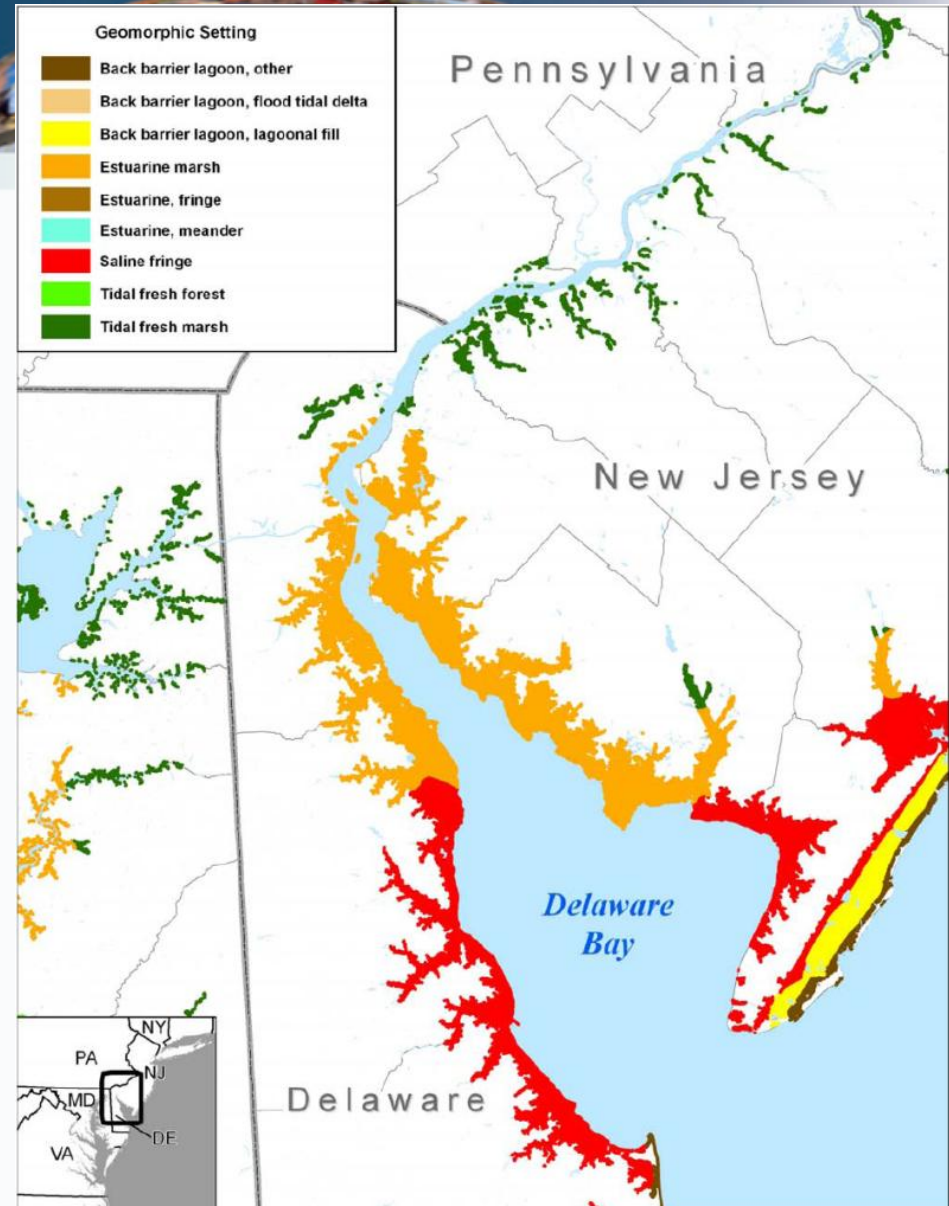


Figure 2.1.7. Geomorphic Settings for the Delaware Bay Region. Source: Titus et al. (Section 2.2).

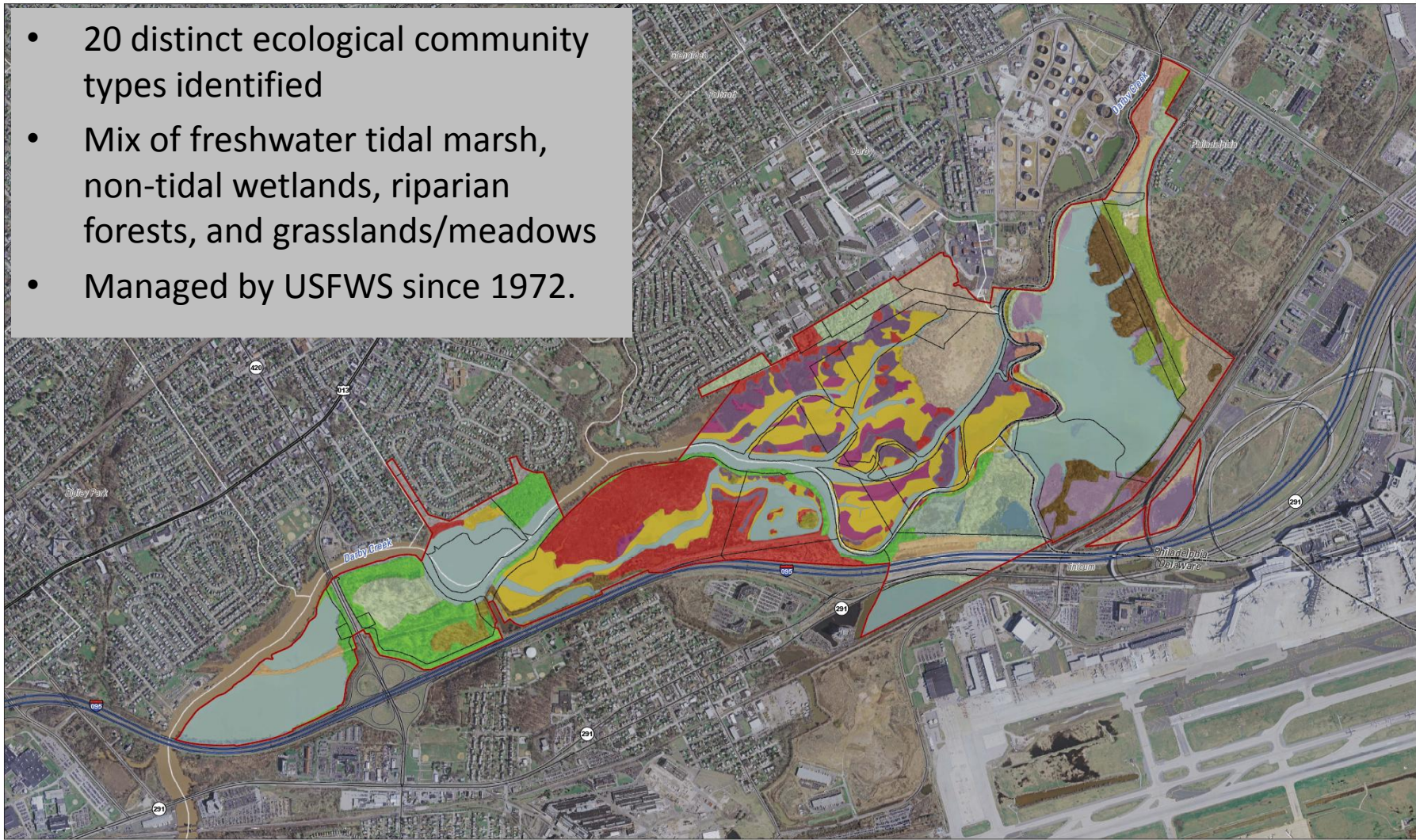
From Reed, D.J., et.al. 2008.



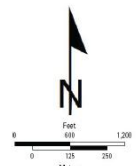


John Heinz National Wildlife Refuge at Tinicum Philadelphia, Pennsylvania

- 20 distinct ecological community types identified
- Mix of freshwater tidal marsh, non-tidal wetlands, riparian forests, and grasslands/meadows
- Managed by USFWS since 1972.



Approved USFWS Acquisition Boundary Municipal Boundaries County Boundaries	<b>Transportation</b> Interstate Highway US Highway PA Highway Local Roads	<b>Community Type</b> Acer negundo Forest Acer rubrum Forest Acer-Elymus Forest Acer-Fraxinus-Ulmus Forest Acer-Ulmus-Populus Forest Highly Altered Forest Community Mesic Old Field Community Mixed Forb High Marsh Veg Nuphar Pontederia Marsh Open Water Phragmites Dominated Marsh Prunus-Acer-Quercus Forest Quercus-Liquidambar Forest Salix nigra Forest Schizachyrium Herb Veg Typha Hibiscus Marsh Typha Marsh Veg Urban Land Wet Meadow Community Wild Rice Marsh Veg
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Sources:  
 Boundaries - USFWS  
 Municipal Boundaries and Highways - PennDOT/PASDA  
 Community Data - Delaware Riverkeeper Network  
 Photo - 2005 DVRPC Mosaic





# Planning Goals

- Preparation of the Comprehensive Conservation Management Planning (CCP) (15-Year Strategic Plan).
- Identify restoration opportunities on refuge lands that address regional conservation concerns.
- Create a plan and process that was usable to USFWS and understandable to the general public.



*Image from L. Woodward, USFWS*



# Planning Process





# Issues/Concerns

- Over-abundant Deer Populations
- Invasive Species
- Climate Change Adaptation
- Biological Connectivity
- Degraded Water Quality
- Spill Prevention and Response
- Contaminants
- Loss of Biological Integrity and Reference Condition
- Habitat Use and Restoration Conflicts
- Compatible Public Uses
- Environmental Education and Interpretation Focus



*Common reed (Phragmites australis)  
dominated tidal marsh.*

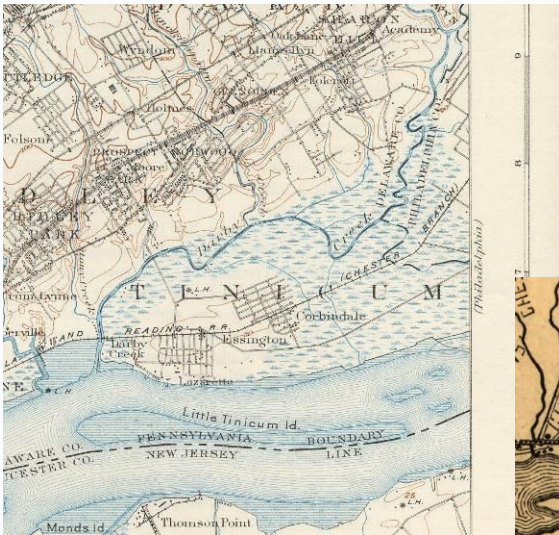


*High deer population numbers have led to habitat degradation.  
Photo: L. Woodward, USFWS*



# Wetland History

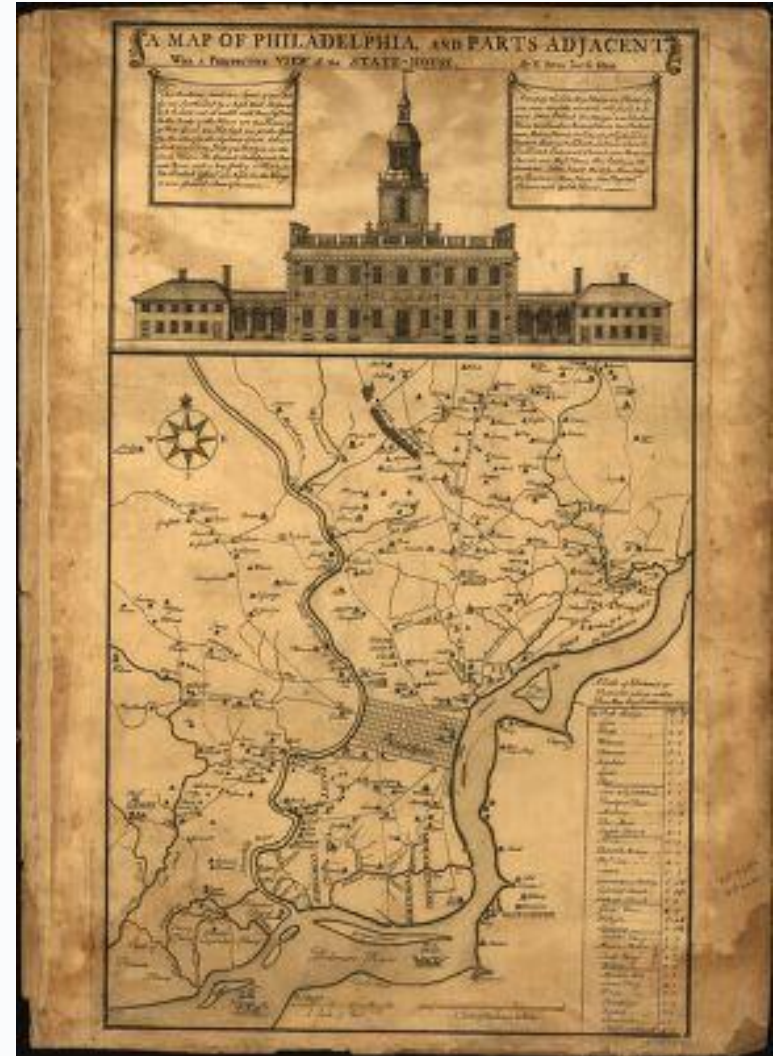
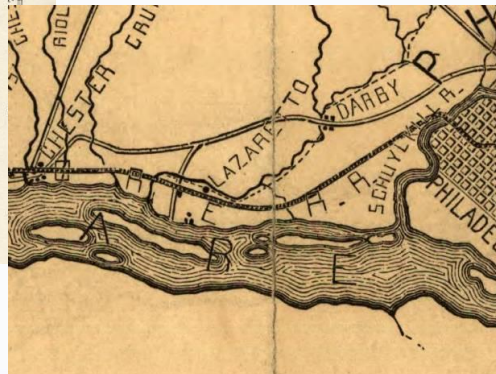
- Several maps of area and surrounding lands from as early as 1757.
- Written accounts of area history and site-specific history were previously completed.



*USGS Topographic Map 1898,  
reprinted 1930*



*Philadelphia Baltimore RR, 1850*



*Map of Philadelphia and Surrounding Areas, 1757*





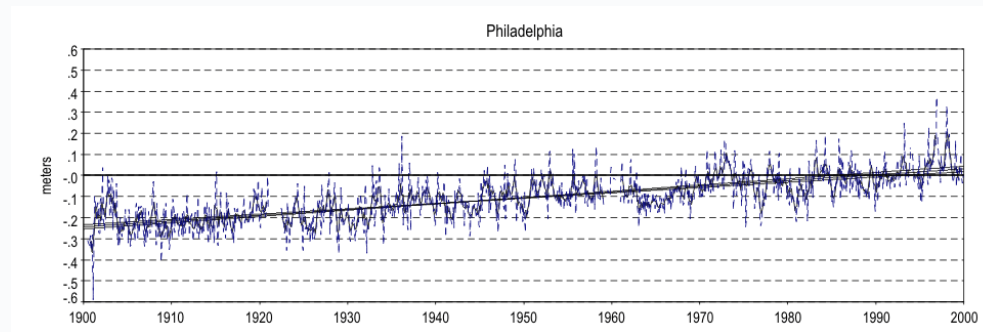
# Wetland History

20<sup>th</sup> Century site specific details well documented from previous reports.

- 1900+ - Dike repairs and maintenance.
- 1930's - Marsh ditching for mosquito management.
- 1950's-1960's - Dredge and fill operations associated with I-95 and PHL.
- Post 1970 – Additional species introductions.
- Ongoing – Sea level rise.



*McCormick, et. al. vegetation surveys and community types, 1968*



*NOAA Philadelphia Delaware River tidal data 1900 – 2000, 2001*



# Freshwater Tidal Marsh Major Concerns

- Climate Change
  - Sea Level Rise
  - Changes in Salinity
  - Species Introduction/Migrations
  - Extreme Weather
- Invasive Species
  - *Phragmites*
- Surrounding Land Use
- Inherent Complexity of Restoration
  - Site Constraints
  - Critical Elevations



*Views across  
freshwater tidal  
marsh.*



# Marsh Field Surveys

- Utilized a combination of survey transects, canoe meander inventories, and Bing Maps.
- Combined ground elevation surveys with vegetation composition and dominance.



*Vegetation/marsh elevation survey in reference area of marsh.*

*Transition from *Zizania*,  
to *Peltandra*, to open  
water.*

# Field Survey Results

- 113 plant species identified (not an exhaustive survey)
  - 73% native species
  - 12% exotic (but not invasive)
  - 15% invasive and exotic
- Compiled data into Excel database to compare densities, distribution, and develop prioritization for management.

*Excerpt from  
vegetation database.*

Map Unit ID	Site Unit ID	Sheet ID	Target Association Type Type	Type Community ID	Soil Ranking	Slope Ranking	Vegetation Structure	Elev. Conditions	Ecological Influences	Observer	Date	Tree Cover		Trees and Relative Density				Shrub Cover	Stem Height (ft)		
												Tree Height (ft)	Tree Height (%)	Dominate	Abundant	Frequent	Occasional			REM	BOE
Impdndm Dike	MSA1	H1	Salix nigra Temporarily Flooded Shrubland	CEGL006065	GNR		Open canopy	Floodplain		Williams, D	11/9/2005	20%	40	BW1	SIM; BOE			REM	1%	6	
Impdndm Dike	IMAC2	H2	Acer saccharinum - Acer negundo (Elymus virginicus) Forest	CEGL006217	G4		Open canopy with marsh	Wetland forest and floodplain	Old side gate channel	Williams, D	11/9/2005	15%	40	SIM; BW1	BOE			REM	1%	5	
Impdndm Dike	MSA2	H3	Salix nigra Temporarily Flooded Shrubland	CEGL006065	GNR		Tidal marsh and forest	Old Darby channel and floodplain	Abandoned channel	Williams, D	11/9/2005	5%	40	BW1					REM	1%	6
Impdndm Dike	BMH1	H4	Urtica angustifolia - Filiphus moscheutos Herbaceous Vegetation	CEGL004201	GNR		Open canopy with marsh	Floodplain and dike		Williams, D	11/9/2005	10%	40	BW1				REM	5%	3	
SR420 West	SWLN1	SR420 West	Unidentified cool season grass meadow	N/A	GNR	SNR	Meadow w/ occasional al. shrubs	dike berm and pipeline ROW	pipeline ROW	Salas, D	11/9/2005	1%	20					AMS	10%	6	
SR420 West	SWAC1	SR420 West	Acer saccharinum - Ulmus americana - (Populus deltoides) Forest	CEGL002586	G4		Early successional forest	south of ROW	near I_95 ramp	Salas, D	11/9/2005	90%	40		BL1	BW1; SIM; AME; MUL				5%	6
SR420 West	SWAC2	SR420 West	Acer saccharinum - Ulmus americana - (Populus deltoides) Forest	CEGL002586	G4		Early successional forest	north of ROW	near I_95 ramp	Salas, D	11/9/2005	80%	30	BOE	SIM	BLC; MUL	AME		10%	6	
SR420 East	SEAC2	SR420 East	Acer negundo Forest	CEGL005033	GNR	SNR	mixed phragmites wetland and forest	fill from I-95 construction	near I_95 ramp	Salas, D	11/9/2005	60%	70		BOE; SIM; MUL	BW1			5%	6	
SR420 West	SEAC1	SR420 East	Acer saccharinum - Ulmus americana - (Populus deltoides) Forest	CEGL002586	G4		mixed wetland and forest	fill from I-95 construction	near I_95 ramp	Salas, D	11/9/2005	60%	70		BOE; SIM; MUL	BW1; BLC; MUL	AME; WHC; WLD; CRA		5%	6	
SR420 East	SESA1	SR420 East	Salix nigra Temporarily Flooded Shrubland	CEGL006065	GNR	SNR	forested wetland	fill from I-95 construction	near I_95 ramp	Salas, D	11/9/2005	80%	70	BW1				SM	5%	6	





# Restoration Prioritization

- 1) Freshwater Tidal Marsh
- 2) Coastal Plain/ Floodplain Forests
- 3) Open Water and Mudflats
- 4) Upland/Riparian Grasslands



*Photo: King rail,  
USFWS*

Prioritization based on:

- 1) Global/state conservation status rankings.
- 2) Existing ability to support species of conservation concern or endangered resources.

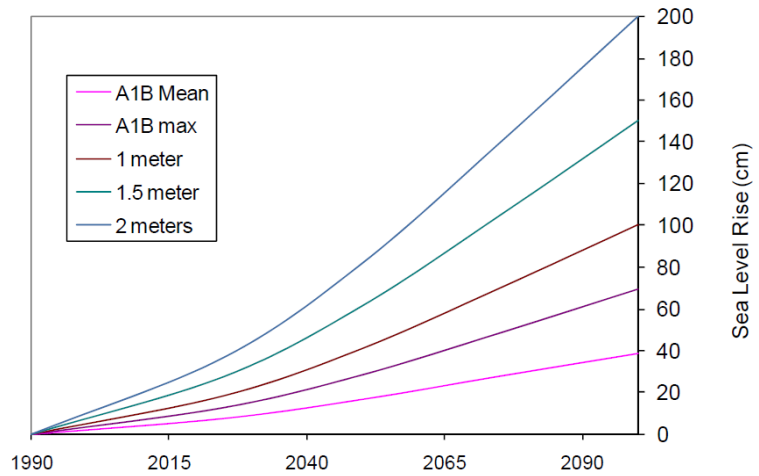
Table 3-4. Priority Habitats and Their Potential Limiting Factors at John Heinz NWR.

Habitat Type	Reasons for Priority Ranking	Limiting Factors/Threats
<b>Highest Priority Habitats</b>		
Freshwater Tidal Marsh	Supports a globally rare and regionally endangered plant community (ranked S1/G3); supports federal trust fish and wildlife species, state listed endangered species as well as many other species labeled as high priority species in BCR 30 and State Wildlife Action Plan. Last intact example of unique remnant natural community in state of Pennsylvania. Supports wetlands, a federal trust resource, and original purpose of Refuge.	Altered hydrology; water quality degradation and contamination; invasive species; sea level rise.
Coastal Plain Forest	Supports a globally rare and regionally endangered plant community (ranked S1/G3); Important habitat for species labeled as priority species in BCR 30. Supports wetlands, a federal trust resource, and state endangered species.	Excessive deer browse; invasive species;
Floodplain Forest	Important habitat for species labeled as priority species in BCR 30 and unique community (ranked S1/G3). Supports wetlands, a federal trust resource, and state endangered species.	Excessive deer browse; invasive species;
Impoundment/Open Water	Important habitat for species labeled as priority species in BCR 30 and as a foraging stopover along Atlantic flyway. Supports wetlands, a federal trust resource, and original purpose of Refuge.	Requires intensive management and maintenance for optimal ecological benefits; invasive species; inadequate water control structure for water level manipulation



# SLAMM Analysis

- Modeling Loss/Alteration of Freshwater Tidal Marsh
  - Measured historic SLR rate = 2.79mm/year
  - Projections for SLR
    - A1B = 4mm/year (0.21-0.48mm/year) (IPCC 2007)
    - Upper Limit = 9.0-13.0 mm/year (Grinsted et. al. 2009)
  - Measured average accretion rates in Delaware Estuary are 4mm/year.
  
- Predicts loss rate of 15% to 92% for tidal marsh once scenarios exceed 0.39 meters of eustatic SLR.
- Some updated data available – revised analysis coming soon.



*Climate change scenarios and sea level rise projections utilized in the John Heinz NWR SLAMM analysis. From Clough, J.S. and Larson, E.C. 2009.*

SLR by 2100 (m)	0.39	0.69	1	1.5	2
Undeveloped Dry Land	12%	25%	41%	57%	64%
Tidal Fresh Marsh	-1%	5%	16%	39%	68%
Inland Fresh Marsh	-1%	0%	2%	3%	4%
Tidal Swamp	3%	13%	22%	36%	66%
Developed Dry Land	1%	4%	9%	20%	35%
Inland Shore	28%	38%	79%	88%	93%

**Predicted Loss Rates of Land Categories by 2100 Given Simulated Scenarios of Eustatic Sea Level Rise**





# Moving Forward

- Monitoring for sea level rise and marsh accretion.
- Detailed topographic surveys and plant community analysis
- Setting up long-term monitoring stations.



*Fresh deposition on marsh surface.*



*Long-term monitoring  
will be critical to SLR  
adaptation.*

*Photo: L. Woodward,  
USFWS*





# Moving Forward

## Control Invasive Exotic Species

- Preserve intact communities first.
- Eradicate small populations next.
- Control larger colonies.

Table 2. Prioritized List of Invasive Species

Species	Ranking	Impact	Extent	Management Difficulty	Control Priority and Focus
Mile-a-minute <i>Polygonum perfoliatum</i>	1	●	○	○	High Eradicate Localized Occurrences
Japanese knotweed <i>Polygonum cuspidatum</i>	2	●	○	●	
Porcelainberry <i>Ampelopsis brevipedunculata</i>	3	○	○	○	Prevent New Introductions
Common Reed <i>Phragmites australis</i>	4	●	○	●	Medium Reduce Size of Existing Populations
Purple Loosestrife <i>Lythrum salicaria</i>	5	●	○	●	
Japanese honeysuckle <i>Lonicera japonica</i>	6	●	○	●	
Norway maple <i>Acer platanoides</i>	7	○	○	●	
Oriental bittersweet <i>Cephalanthus orbiculatus</i>	8	○	○	○	
Japanese stiltgrass <i>Microstegium vimineum</i>	9	●	●	○	Eradicate Localized Occurrences
Tree-of-heaven <i>Ailanthus altissima</i>	10	○	○	○	
Japanese hops <i>Humulus japonica</i>	11	○	○	○	
Bush honeysuckle <i>Lonicera maackii</i>	12	○	○	○	
Garlic mustard <i>Allaria petiolata</i>	13	●	●	●	Low Focus Primarily on Smaller Populations (<0.5 Ac) or Areas of Conservation Significance
Multiflora rose <i>Rosa multiflora</i>	14	○	○	○	
Reed canarygrass <i>Phalaris arundacea</i>	15	○	○	○	
European privet <i>Ligustrum arvense</i>	16	○	○	○	Remove as Warranted with Control of Higher Priority Species
Mugwort <i>Artemisia vulgaris</i>	17	○	○	○	

● = High  
○ = Medium  
○ = Low

Figure 5. Quadrat Displaying Invasive Species Control Prioritization Rationale

<u>High</u> Intact Community/ High Potential for New Invasion	<u>Medium</u> Impacted Community/ Moderate Potential for New Invasion
<u>Medium</u> Intact Community/ Moderate Potential for New Invasion	<u>Low</u> Impacted Community/ Low Potential for New Invasion

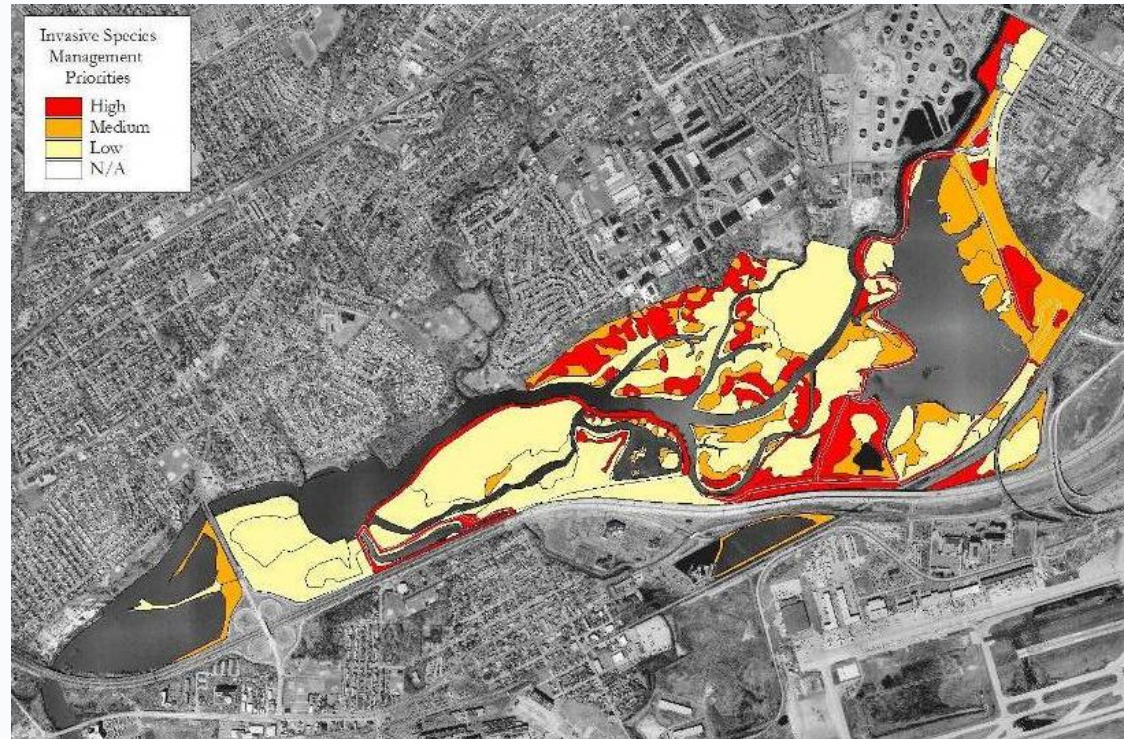






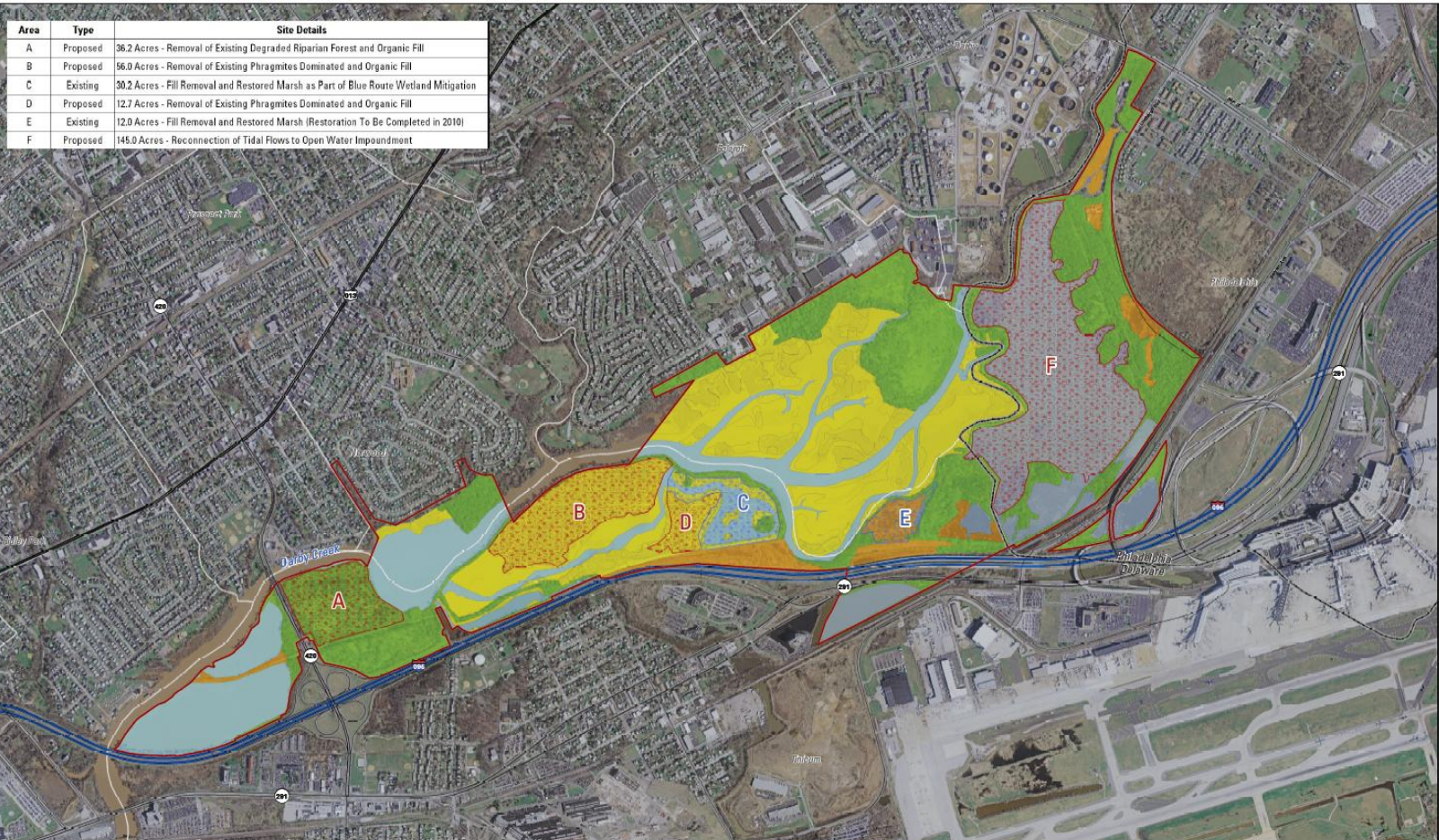
# Restoration Prioritization

- Management units divide the refuge into manageable components to guide staff and volunteers.
- Invasive species were prioritized based on ecological impact, distribution, and management difficulty.
- Combination of all variables yielded management priorities for each management unit and sub-components.





# Marsh Restoration





# Other Information Available

2005 Restoration  
Management Plan

Sept/Oct 2008  
Journal of Ecological Restoration

John Heinz Comprehensive  
Conservation Plan Website

**Restoration Management Plan  
For the Lower Darby Creek**  
*with recommendations for the John Heinz  
National Wildlife Refuge at Tinicum*



**SPECIAL THEME: URBAN ECOLOGICAL RESTORATION**

## Developing an Ecological Restoration Management Plan: John Heinz National Wildlife Refuge, Philadelphia

Dan J. Salas

**ABSTRACT**

Planning is the first step toward efficient ecosystem restoration. Friends of the John Heinz National Wildlife Refuge near Philadelphia, Pennsylvania, was awarded funding through the National Fish and Wildlife Foundation's Delaware Estuary Grant Program to develop a restoration plan for the lower reaches of Darby Creek, which runs through the refuge. Managed by the U.S. Fish and Wildlife Service, the refuge was established by an act of Congress in 1972 to protect the last 81 hectares of freshwater tidal marsh in Pennsylvania. The Delaware Riverkeeper Network was hired in 2005 to carry out an integrated planning effort. The resulting *Restoration Management Plan for the Lower Darby Creek*, completed in May 2006, combined historical research, aerial photo and map analysis, personal interviews, stakeholder feedback, field research, and data management. The creation of the plan offers a case study to inform other restoration planning efforts for large, diverse areas.

**Key words:** Delaware Riverkeeper Network, Heinz National Wildlife Refuge, restoration planning and prioritization, urban ecological restoration

Located near the southwest bound-  
ary of Philadelphia, Pennsylvania,  
the John Heinz National Wildlife  
Refuge at Tinicum harbors roughly  
405 hectares of freshwater tidal and  
nontidal wetlands, rivers, streams,  
upland grasslands, and mixed hard-  
wood forests near the confluence of  
Darby Creek and the Delaware River.  
In 2005, the National Fish and Wild-  
life Foundation awarded funding to  
the nonprofit support group Friends  
of the Heinz Refuge to develop a  
restoration management plan for lower  
Darby Creek. Friends of the Heinz  
Refuge hired the Delaware River-  
keeper Network, a regional nonprofit  
organization that had successfully  
completed several watershed plans and  
restoration projects in the region.

In preparation for this task, the  
plan authors and staff of the Delaware

Riverkeeper Network, Dan Salas,  
David M. Williams, and Richard C.  
Albert, reviewed existing restoration  
planning documents for other large-  
scale, multiuse sites with a range of  
ecological conditions (Horwitz et al.  
1999, Meyers-Rice and Tu 2001). We  
also looked at guidance documents  
on ecosystem assessment and restora-  
tion planning (Morise et al. 2004a).  
Many plans for large sites offer gen-  
eral conclusions about the types of  
management actions required, but  
lack specific guidance on where these  
should occur and what areas are of  
greatest importance. Our goals were  
to develop a plan that would be *useful*  
to all parties involved in manage-  
ment: land managers, laborers, volunteers,  
and funders. We also aimed to provide  
a detailed and prioritized assessment  
of the site's greatest ecological issues,  
along with management alternatives  
that would support decisions on where  
and what actions should occur.

We kept in mind the idiom that a  
"plan is only useful if it is taken off the

shelf." Much of the plan consists of  
"management unit profiles" detailing  
recommendations and prioritizations  
for each portion of the refuge. Our  
intent was that these should stand  
alone as guidance documents for land  
managers and field crews involved in  
implementation. The emphasis of the  
plan was not only on accurately char-  
acterizing the ecological issues of the  
site, but also providing specific prac-  
tices for dealing with these issues. We  
reviewed regional and global issues  
directly impacting the refuge (such as  
urbanization, watershed-based pollu-  
tion, historic and current species in-  
troductions, and sea level rise). Reviewing  
myriad degradation issues on a large,  
diverse site can be overwhelming to  
managers, and we were committed  
to providing specific and achievable  
management actions.

Whether focused on 0.5 or 10,000  
hectares, restoration efforts almost  
always face fiscal and labor shortages  
relative to a site's needs. A final objec-  
tive of the plan involved identifying

*Ecological Restoration* Vol. 26, No. 3, 2008  
ISSN 1522-4740 E-ISSN 1543-4079  
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University of Wisconsin System.



<http://www.fws.gov/northeast/planning/John%20Heinz/ccphome.html>





# Questions and Comments

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