Public Meeting
Norwalk River Site 2
Dam Rehabilitation Project

February 27, 2020

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Schnabel Engineering

Today's Objectives

- Review Key Findings to Date
- Discuss Alternatives Evaluated and Analyzed
- Present the "Preferred Alternative" and Potential Impacts
- Review Overall Planning Schedule
- Encourage Input and Feedback from the Public

Roles / Responsibilities

- Dam Owner– CT DEEP

What CT DEEP Provides

- Owner of the Dam
- 35% of Total Project Costs
  - Cash
  - In-Kind Credit
- Secure Needed Land Rights and Permits
- Continue to Operate and Maintain the Rehabilitated Dam or Other Measures

Roles / Responsibilities

- Owner– DEEP
- Technical and Contracting Support – NRCS
  - Natural Resources Conservation Service, an agency of the US Department of Agriculture

What NRCS Provides

- 100% of Cost to Develop a Rehabilitation Plan
- If Funded After The Plan is Developed:
  - 100% of Design Cost
  - 65% of total project cost or 100% of actual construction cost (whichever is less)
- 100% of NRCS technical assistance costs
- Upgrade entire structure for 50-100 years

Roles / Responsibilities

- Owner – DEEP
- Technical and Contracting Support – NRCS
- Technical Contractor – GSFW Joint Venture
  - GSFW JV = Golder Associates, Schnabel Engineering, Freese and Nichols, and Wilson and Company
  - Schnabel Engineering is the technical lead

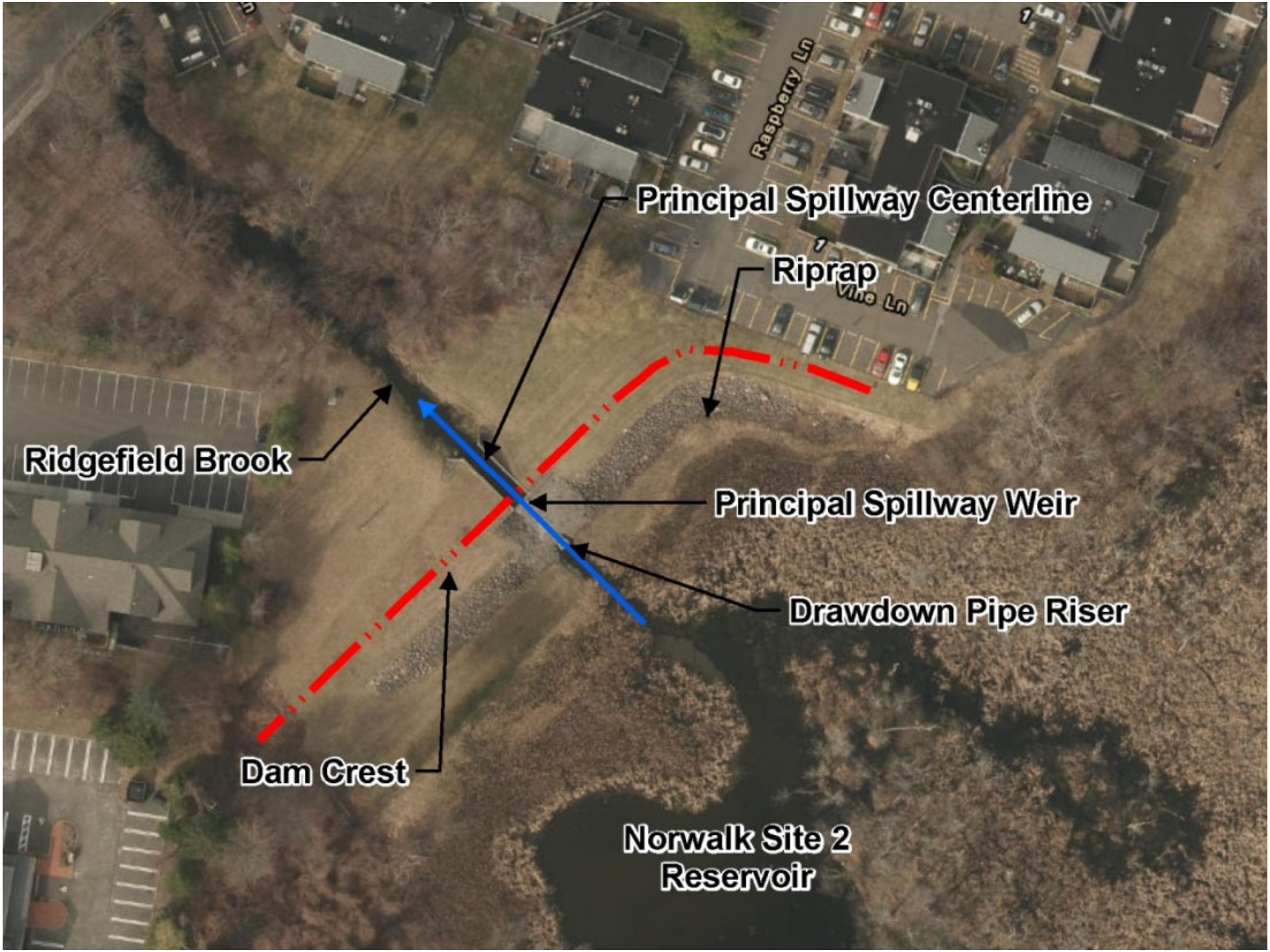
Schnabel Subcontractors

- Wade Biddix – Planning Team Leader
- James Featherston - Economist
- Anthony Russo - ASA Analysis and Communications, Inc.
  - Eugene Boesch – PhD Archaeologist

Recent History

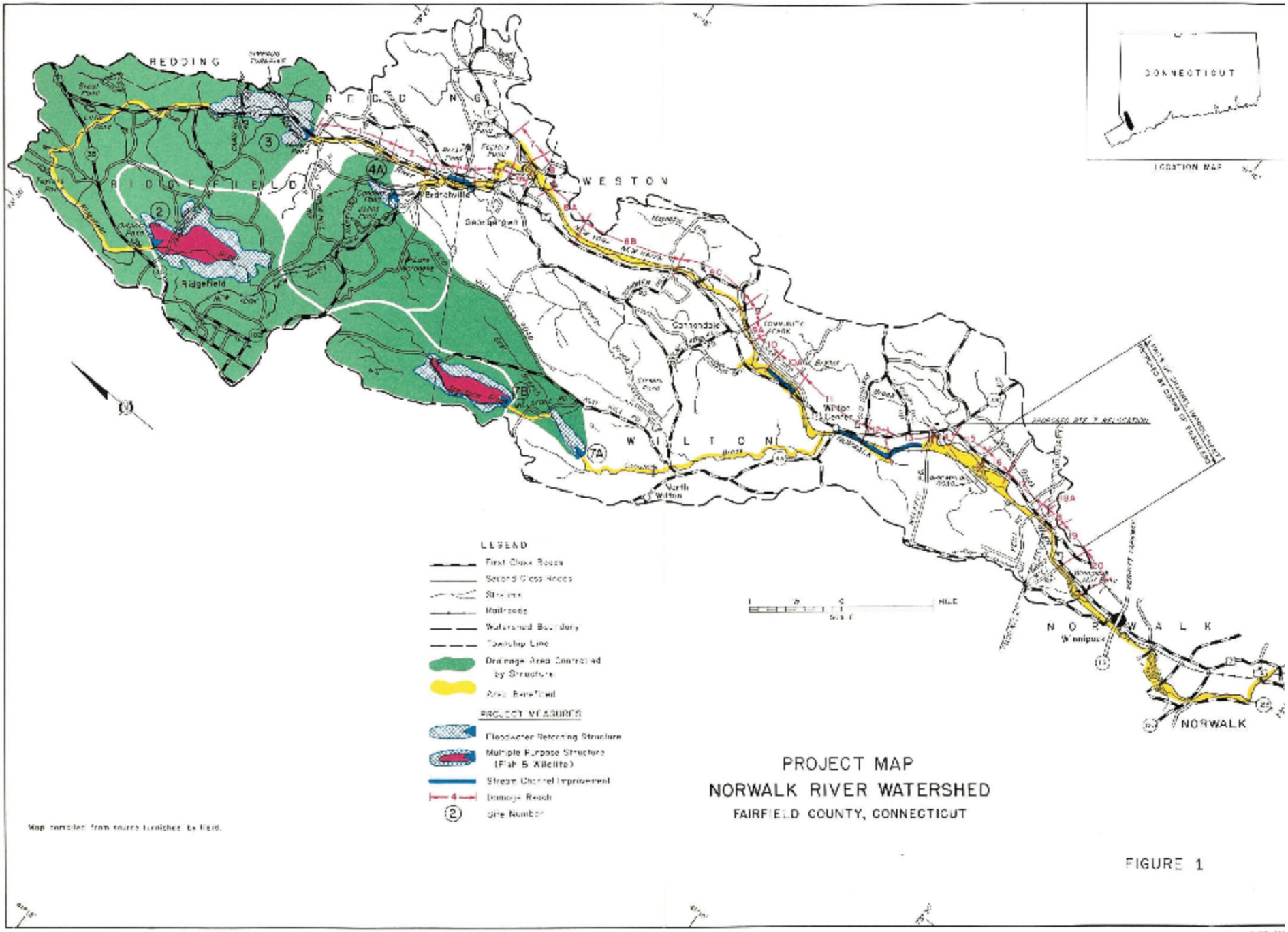
- CT DEEP and NRCS reclassified the dam from “Significant” to “High” hazard potential in 2004
- NRCS conducted assessment of the condition of the dam in September 2011.
- CT DEEP Requested Federal Assistance With Dam Rehabilitation Program in July 2014.
- Planning contract awarded in November 2017.

Norwalk River Site 2 Dam


Raspberry Ln
Principal Spillway Centerline
Riprap
Vine Ln
Ridgefield Brook
Principal Spillway Weir
Drawdown Pipe Riser
Dam Crest
Norwalk Site 2
Reservoir

Dam No. 2 Statistics

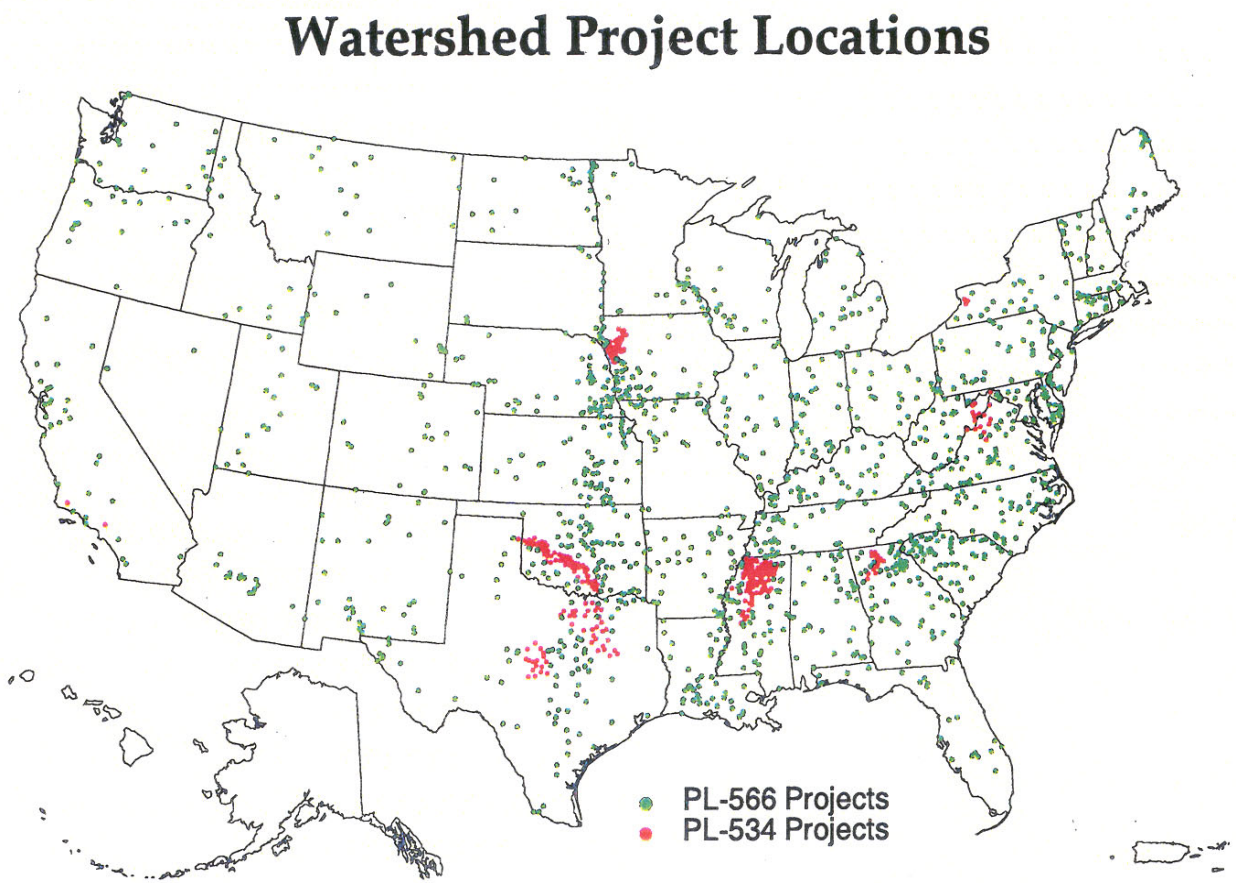
- Built in 1979
- Drainage area = 1,628 acres
- Design high water = 267 acres behind dam
- Top of dam = 336 acres
- Wetland wildlife habitat area = 87 acres
- Embankment Length = 440 feet
- Embankment Height = 10 feet
- Constructed as a “Significant” hazard dam



Map compiled from source furnished by field.

FIGURE 1

Small Watershed Program



NRCS has assisted communities build more than 11,000 dams since 1948

Dam Rehabilitation Legislation

“The Small Watershed Rehabilitation Amendments”

(Public Law 106 - 472; Sec. 313)

Enacted November 9, 2000

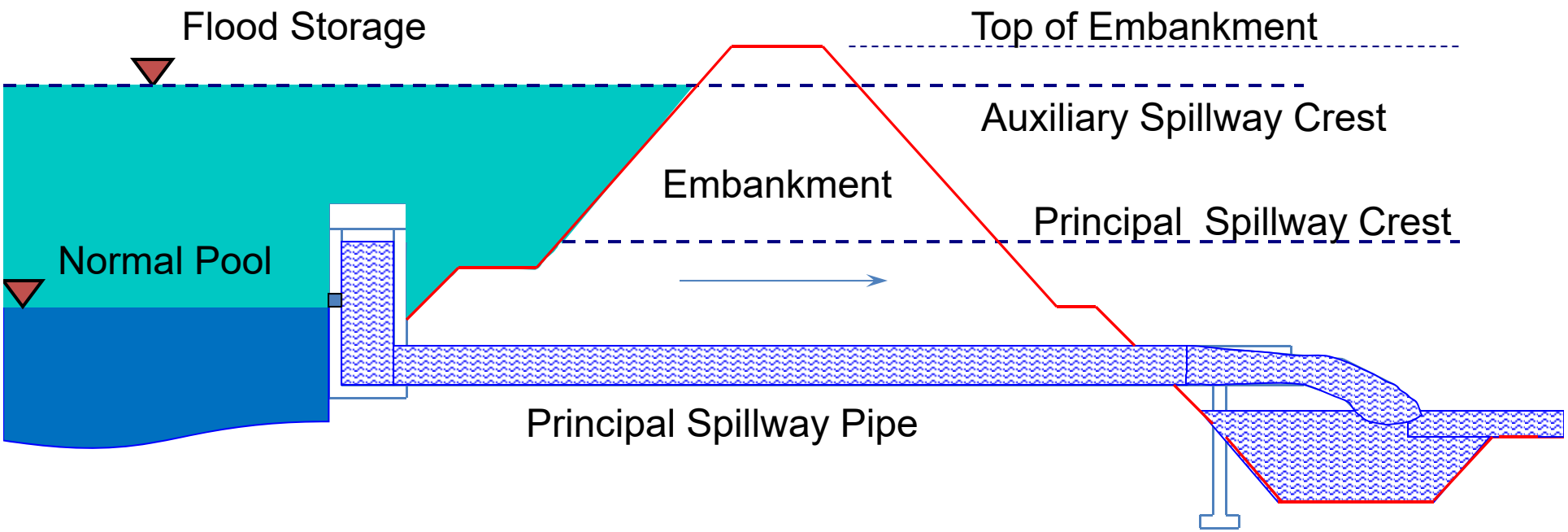
Rehabilitation Goals

- Extend service life of dams
- Meet applicable safety & performance standards
- Prolong beyond original economic life span
- Repair after catastrophic events
- Upgrade to meet dam safety regulations

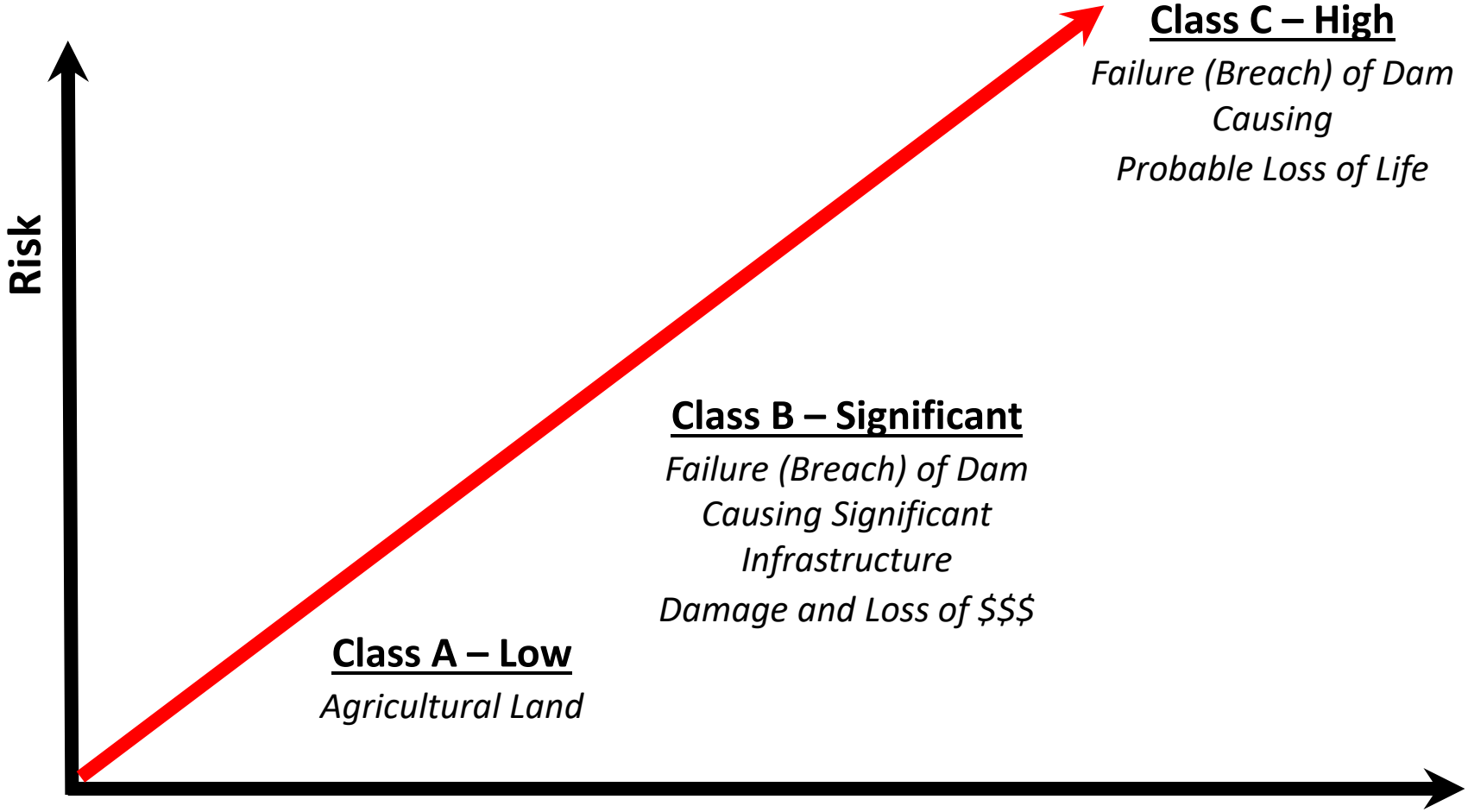
Types of Rehabilitation

- Structural
  - Upgrade dam
- Non-Structural
  - Don’t upgrade dam
  - Protect downstream properties
  - Prohibit downstream development
- Decommissioning
  - Remove dam
  - Mitigate increased flooding

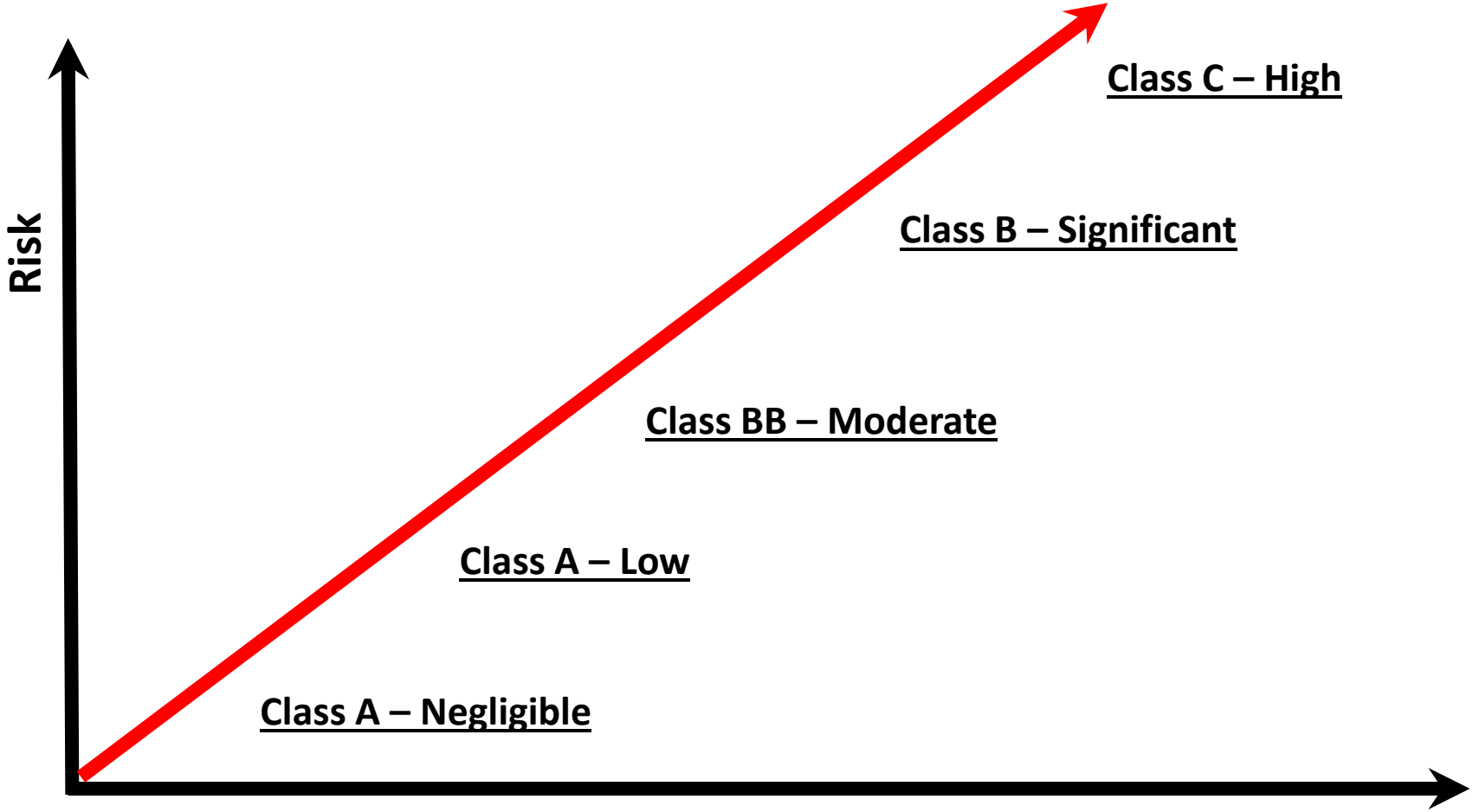
Cross-Section of a Typical Floodwater Retarding Structure



NRCS Hazard Classes of Dams



CT DEEP Hazard Classes of Dams



Purpose and Need for Action for Norwalk Dam No. 2

- Comply with applicable design, performance and safety standards by reducing the potential for flood damages and loss of life from a catastrophic breach
- Continue to provide flood damage reduction as designed for the 100-year, 24-hour recurrence interval flood event downstream
- Maintain existing wetland wildlife habitat and recreational values

Norwalk River Site 2 Dam

- **Dam needs to be upgraded to meet current safety and performance criteria** - Does not meet current NRCS design storm criteria. Dam was built in 1979 as significant hazard. It has been reclassified as high hazard.
- **High hazard dam with 24 people at risk downstream** – Based on breach inundation map, one residence, one business, and 6 roads and bridges would be impacted by a breach.

Norwalk River Site 2
Information and Photos

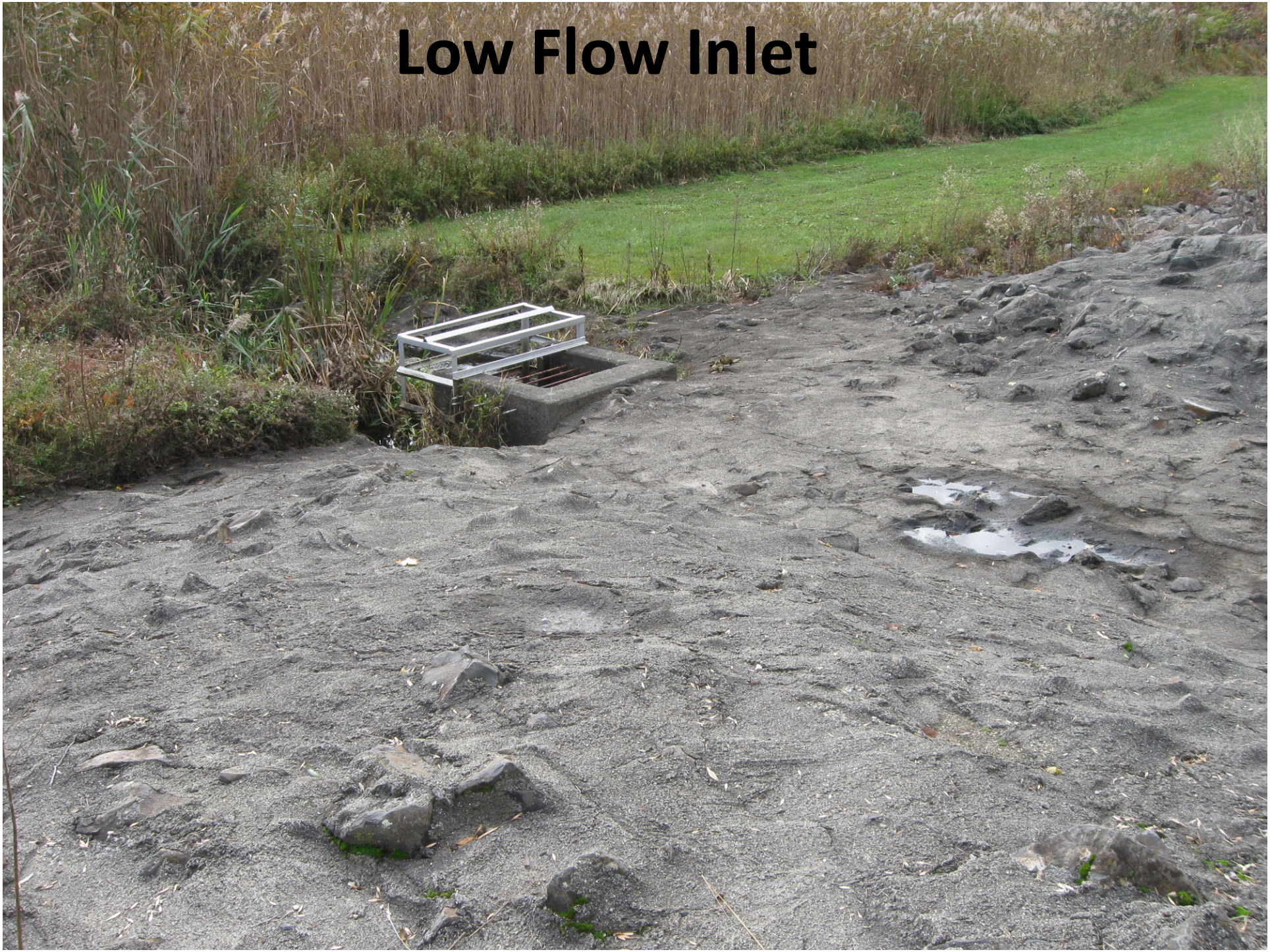

Principal / Auxiliary Spillway
Embankment

Upstream Embankment – Looking From Right Abutment

Principal/Auxiliary Spillway – Left Side

Principal/Auxiliary Spillway – Looking Downstream

Low Flow Inlet



General Condition of the Dam

- Inspected annually
- Regularly mowed and maintained
- Overall good condition
- High hazard classification now (Significant when constructed)
- The dam assessment performed by NRCS in 2011 indicates inadequate auxiliary spillway capacity
- This study confirmed inadequate capacity

NRCS and CT DEEP

- As Federal Agency and Owner
  - Consider Potential Effects of Rehabilitation Project and all alternatives on environmental, human, social, and economic resources.
  - Satisfy environmental analysis and documentation requirements of the National Environmental Policy Act of 1969 (NEPA).

Alternatives Analysis

- Decommission Dam
  (removal)
- Nonstructural Measures
  (protect downstream properties)
- Structural Rehabilitation of the Existing Dam

Environmental Resources Evaluated for Existing Conditions

- Soils and Geology
- Water – including Wetlands
- Climate
- Air Quality
- Terrestrial Vegetation
- Animals
- Cultural Resources
- Land Use
- Recreation
- Visual/Aesthetics
- Scenic Beauty

Historic Properties in Area

- Two National Register listed Historic Districts and three National and State Register listed properties near project area
- Construction will not adversely affect these properties

Archaeological Resources

- No previously recorded archaeological sites in Areas of Potential Effect.
- Three previously recorded camp sites located within ½ mile of site.
- Nine other similar sites (camps, fishing camp, lithic workshops, and mortuary site) located within 2.5 miles of the site.
- Most of the dam site and adjoining area is already disturbed.

Federally Listed Species

- Northern long-eared bat (*Myotis septentrionalis*)
  - All of CT is within range.
  - No known NLEB hibernacula or maternity roost trees have been designated or recorded within the Town of Ridgefield or neighboring areas.

CT Natural Diversity
Species and Their Status

- Appalachian blue (azure) butterfly (*Celastrina neglectamajor*) - Endangered
- Beck's water-marigold (*Bidens beckii*) - Special Concern
- Wood turtle (*Glyptemys insculpta*) - Special Concern
- Eastern box turtle (*Terrapene carolina carolina*) - Special Concern

Hydrology and Hydraulics

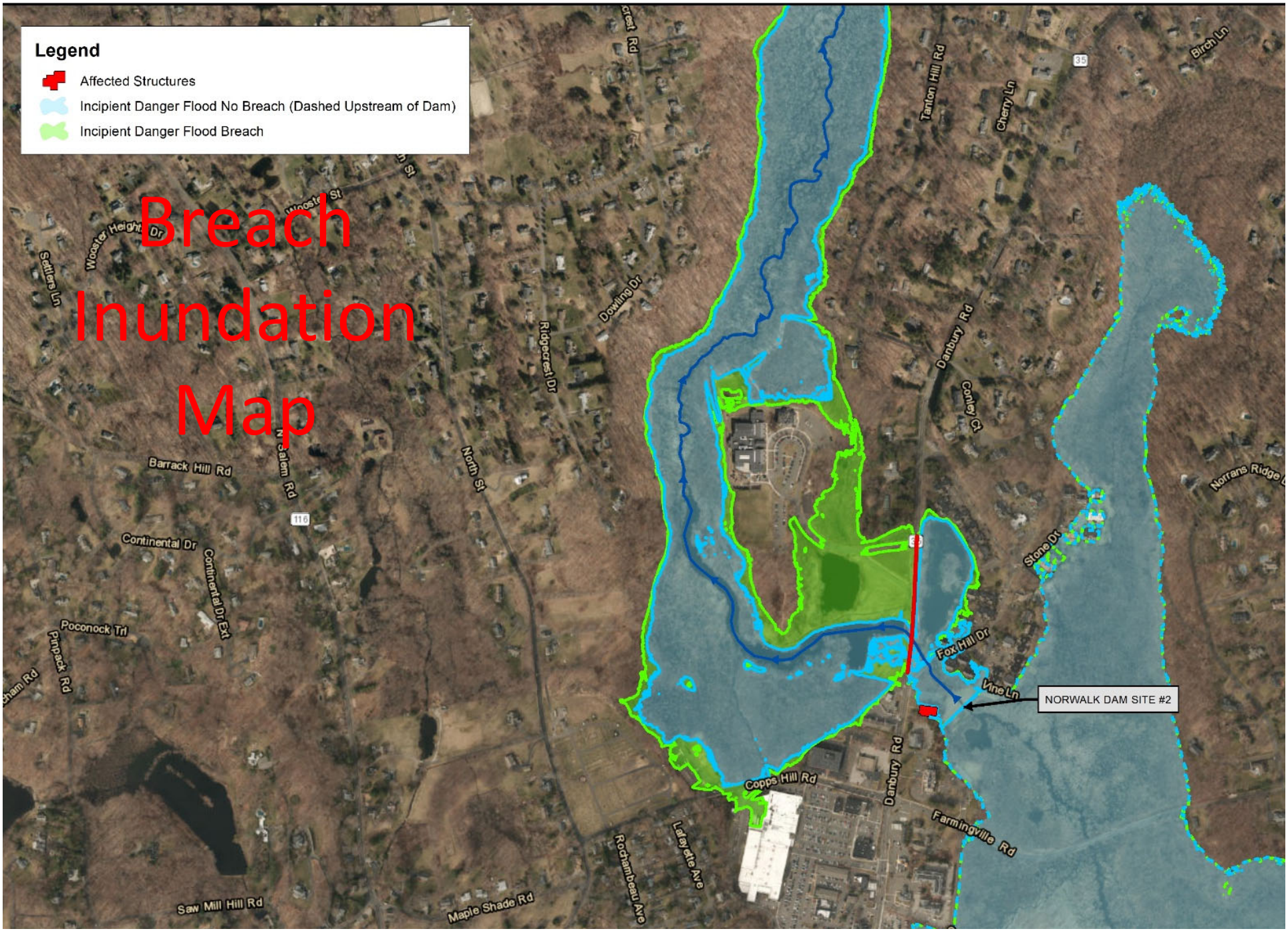
- Developed hydrologic parameters using latest available data
  - Field surveys and reconnaissance
  - Aerial photos
  - Light Detection and Ranging (LiDAR)
  - Local future land use maps
  - Land cover by manually digitizing watershed and cover types from aerial photographs

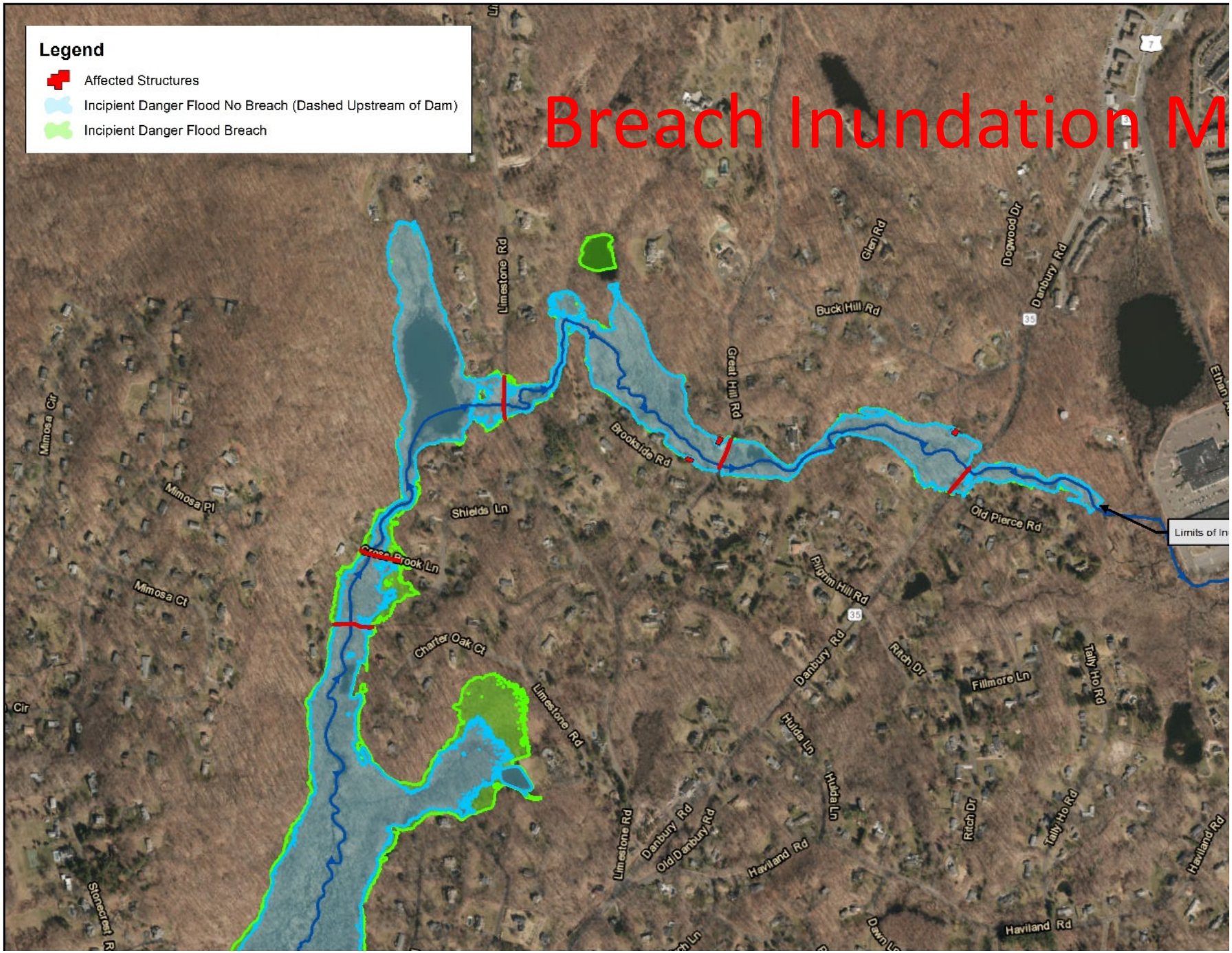
Hydrology and Hydraulics Modeling

- Evaluated impact of dam on flooding
  - 2-year through 500-year frequency storms
  - With and Without Dam scenarios
- Evaluated impacts caused by breach of existing dam
- Evaluated impact of alternatives on flooding

Socio-Economic Impacts

- Evaluated Damages from Various Storm Events (2, 5, 10, 25, 100, and 500-yr.) and the Breach
  - Residential Properties
  - Public Properties
  - Commercial and Industrial Properties
  - Roads, Bridges, etc.
- Evaluated Benefits and Costs of Alternatives
- Evaluated Social and Cultural Impacts
- Evaluated Environmental Justice / Civil Rights


Legend
Affected Structures
Incipient Danger Flood No Breach (Dashed Upstream of Dam)
Incipient Danger Flood Breach
Breach Inundation Map
NORWALK DAM SITE #2
Barrack Hill Rd
Continental Dr
Continental Dr Ext
Poconock Trl
Pinpack Rd
N Salem Rd
North St
Ridgecrest Dr
Dowling Dr
Danbury Rd
Conley Ct
Tanton Hill Rd
Cherry Ln
Birch Ln
Stone Dr
Fox Hill Dr
Vine Ln
Copps Hill Rd
Farmingville Rd
Lafayette Ave
Rochambeau Ave
Maple Shade Rd
Saw Mill Hill Rd
Settlers Ln
Norrans Ridge
35
116


Legend
Affected Structures
Incipient Danger Flood No Breach (Dashed Upstream of Dam)
Incipient Danger Flood Breach
Breach Inundation M
Limestone Rd
Glen Rd
Dogwood Dr
Danbury Rd
Buck Hill Rd
Great Hill Rd
Brookside Rd
Old Pierce Rd
Limits of In
Mimosa Cir
Mimosa Pl
Shields Ln
Mimosa Ct
Charter Oak Ct
Pilgrim Hill Rd
Danbury Rd
Rich Dr
Fillmore Ln
Tally Ho Rd
Limestone Rd
Hulda Ln
Old Danbury Rd
Haviland Rd
Haviland Rd

Dam Failure (Breach) Summary

Item	Location of Water	Breach Impact (ft)	Estimated Flood Damages
Urban Properties			
Residential (3)	Basement	0.3 - 0.5	$13,400
Commercial (1)	First floor	0.4	$14,900
Other (i.e. vehicles, clean-up)	-	-	$381,200
Total Urban			**$409,500**
Stream Crossings [1/]			
Route 35 Bridge - Danbury Road		1.7	$138,600
Shields Lane Extension - Shields Brook Ln		1.6	$13,600
Cross Brook Lane		2.6	$39,300
Limestone Rd.		1.7	$15,500
Great Hill Rd.		2.1	$27,500
Rte. 35 - Danbury Road 2		1.8	$56,100
Total Roads and Bridges			**$290,600**
Grand Totals			**$700,100**

[1/] Other crossings experienced <1.0 feet flooding (eg. crossing at Fox Hill Dr.). However, according to NRCS policy, crossings with flood depths <1.0 feet were not included in the analysis.

Properties in the Breach Inundation Zone

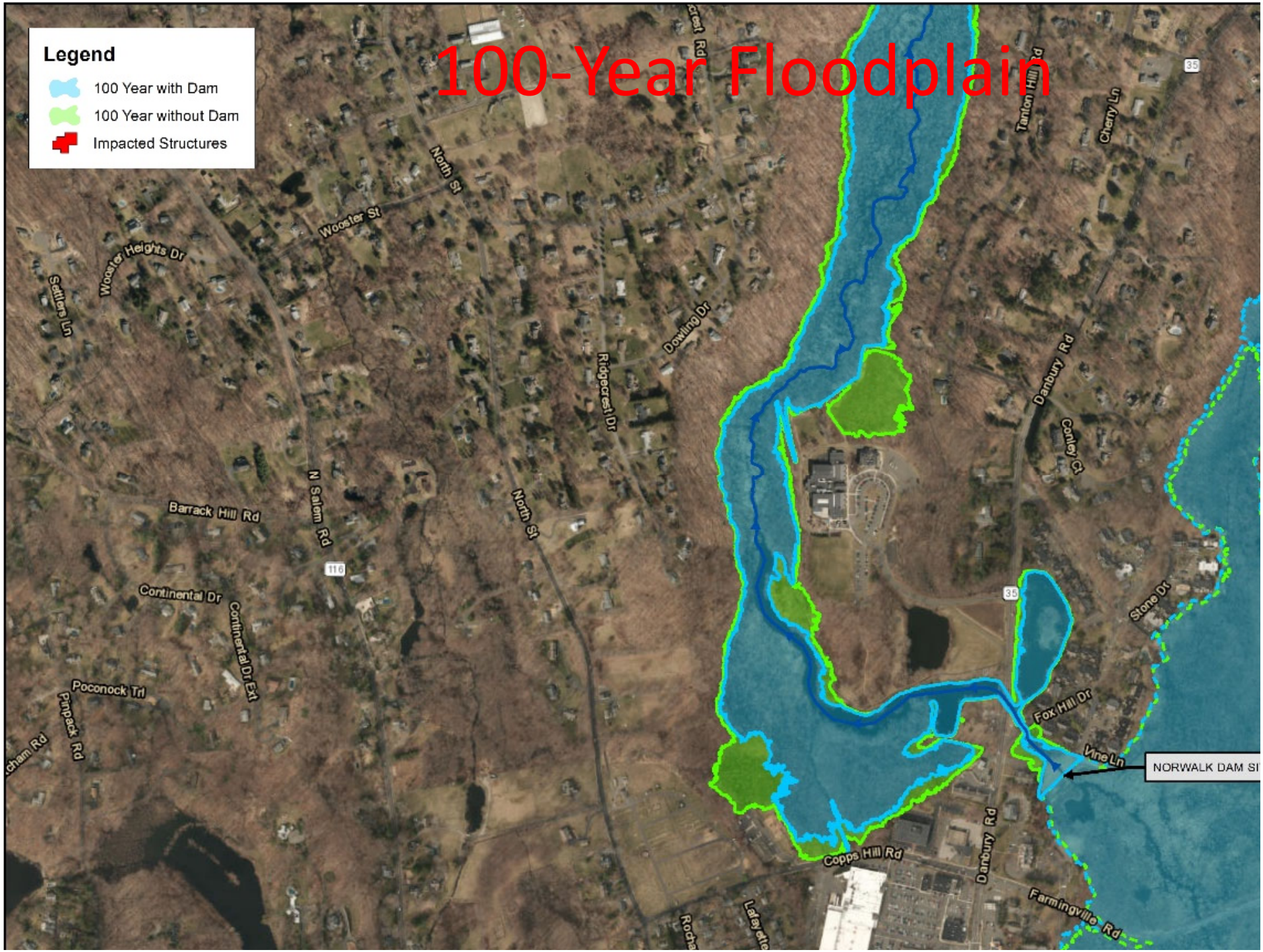
- Three Homes
- One Business, and
- Six Roadway Crossings

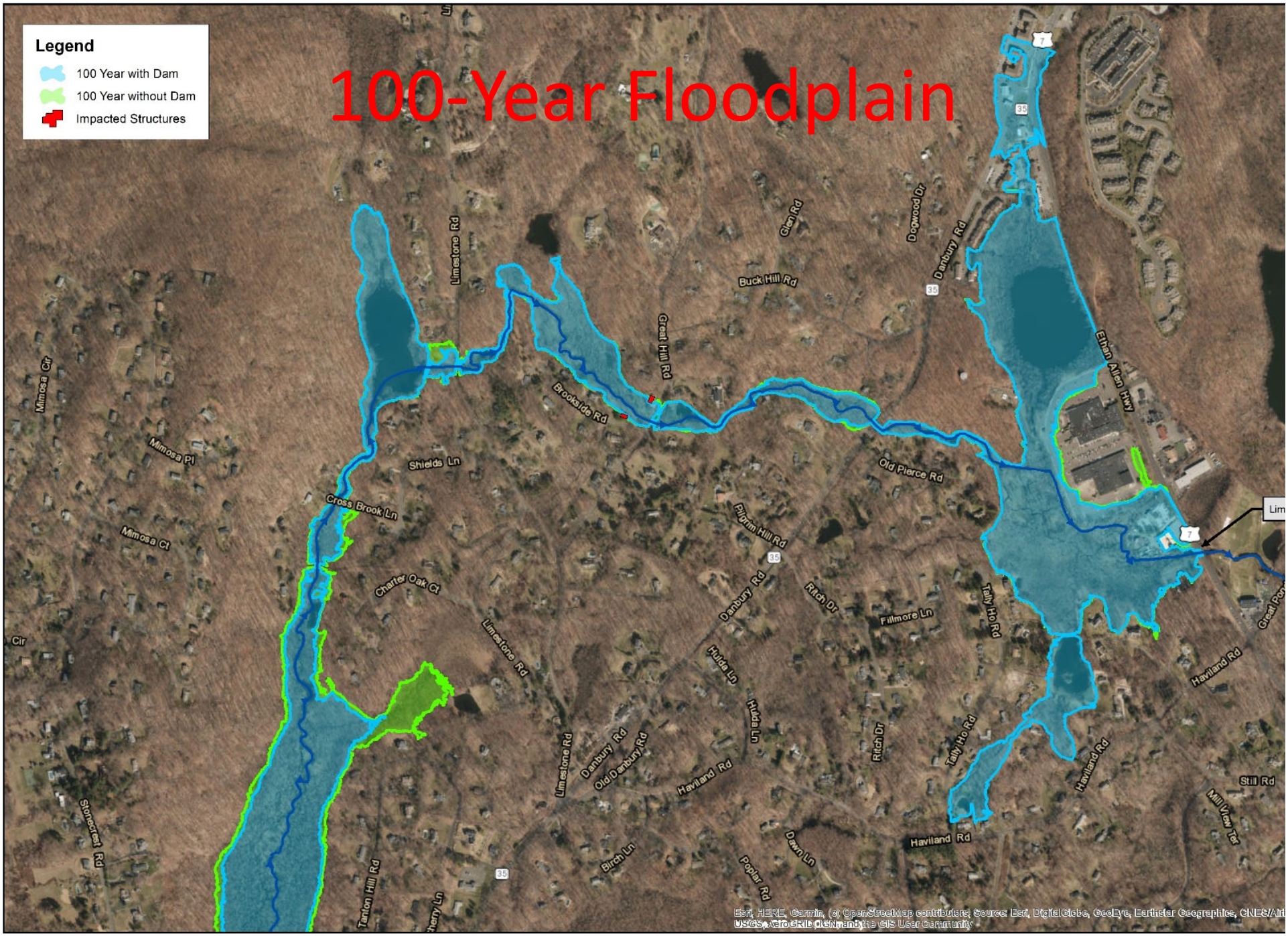
Daily Traffic Counts

- In 2013, the average daily traffic count from the Connecticut Department of Transportation was approximately 15,000 – 19,000 vehicles daily on Route 35 (Danbury Road) just below the dam; Shields Lane; Cross Brook Lane; Limestone Road; Great Hill Road, and Route 35 (Danbury Road) farther downstream of the dam.

Estimated Risks and Damages

- For these 6 roadways, it was estimated that 16 motorists would be at risk if the dam fails.
- 3 residents in one house and 5 people in one business would be at risk from a dam failure.
- Total population at risk would be 24.
- Total estimated damages from a dam failure would be about $700,000.


Legend
100 Year with Dam
100 Year without Dam
Impacted Structures
100-Year Floodplain
North St
Wooster St
Wooster Heights Dr
Settlers Ln
Dowling Dr
Ridgecrest Dr
Danbury Rd
Conley Ct
Cherry Ln
Barrack Hill Rd
N Salem Rd
Continental Dr
Continental Dr Ext
Poconock Trl
Pinpack Rd
Stone Dr
Fox Hill Dr
Vine Ln
NORWALK DAM SI
Copps Hill Rd
Farmingville Rd
116
35


Legend
100 Year with Dam
100 Year without Dam
Impacted Structures
100-Year Floodplain
Limestone Rd
Glen Rd
Dogwood Dr
Danbury Rd
Buck Hill Rd
Great Hill Rd
Ethan Allen Hwy
Mimosa Cir
Brookside Rd
Mimosa Pl
Shields Ln
Old Pierce Rd
Cross Brook Ln
Pilgrim Hill Rd
Mimosa Ct
Charter Oak Ct
Ritch Dr
Fillmore Ln
Tally Ho Rd
Haviland Rd
Hulda Ln
Old Danbury Rd
Still Rd
Mill View Ter
Stonecrest Rd
Tanton Hill Rd
Birch Ln
Dawn Ln
Poplar Rd
Esri, HERE, Garmin, (c) OpenStreetMap contributors, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USGS, AeroGRID, IGN, and the GIS User Community

Flooding Effects of Dam

Stream Crossing	Depth of 100-Year Floodwaters (ft.)		
	Without Dam	With Dam	Difference
Fox Hill Drive	0.0	0.0	0.0
Rte. 35 – Below Dam	0.0	0.0	0.0
Shields Brook Lane	0.0	0.0	0.0
Cross Brook Lane	0.5	0.0	0.5
Limestone Road	0.5	0.3	0.2
Great Hill Road	0.8	0.4	0.4
Rte. 35 – Danbury Road	0.0	0.0	0.0
Rte. 7 – Ethan Allen Hwy. 1	11.3	11.3	0.0

Floodwater Damages/Benefits Summary – Without Dam vs. With Dam

Item	Average Annual Damages		Average Annual Benefits
	Without Dam	With Dam	
Urban Properties			
Residences [1/]	$41,800	$36,100	$5,700
Commercial [1/]	[2/]	[2/]	[2/]
Roads, Bridges	[2/]	[2/]	[2/]
Totals	**$41,800**	**$36,100**	**$5,700**

[1/] For residential properties, floodwater depths were estimated from estimated basement floor elevation. For commercial buildings, depths were estimated from estimated first floor elevations.

[2/] Floodwater damages were negligible.

Alternatives Considered (with Federal Assistance)

- Decommissioning (removal)
- Nonstructural
- Rehabilitate to current criteria

Alternatives Evaluated in Detail

1) Structural Rehabilitation with Federal Assistance – Decommissioning
2) Structural Rehabilitation with Federal Assistance – Roller Compacted Concrete (RCC) Auxiliary Spillway and Localized Downstream Flood Protection.

Introduce Melinda Dirdal

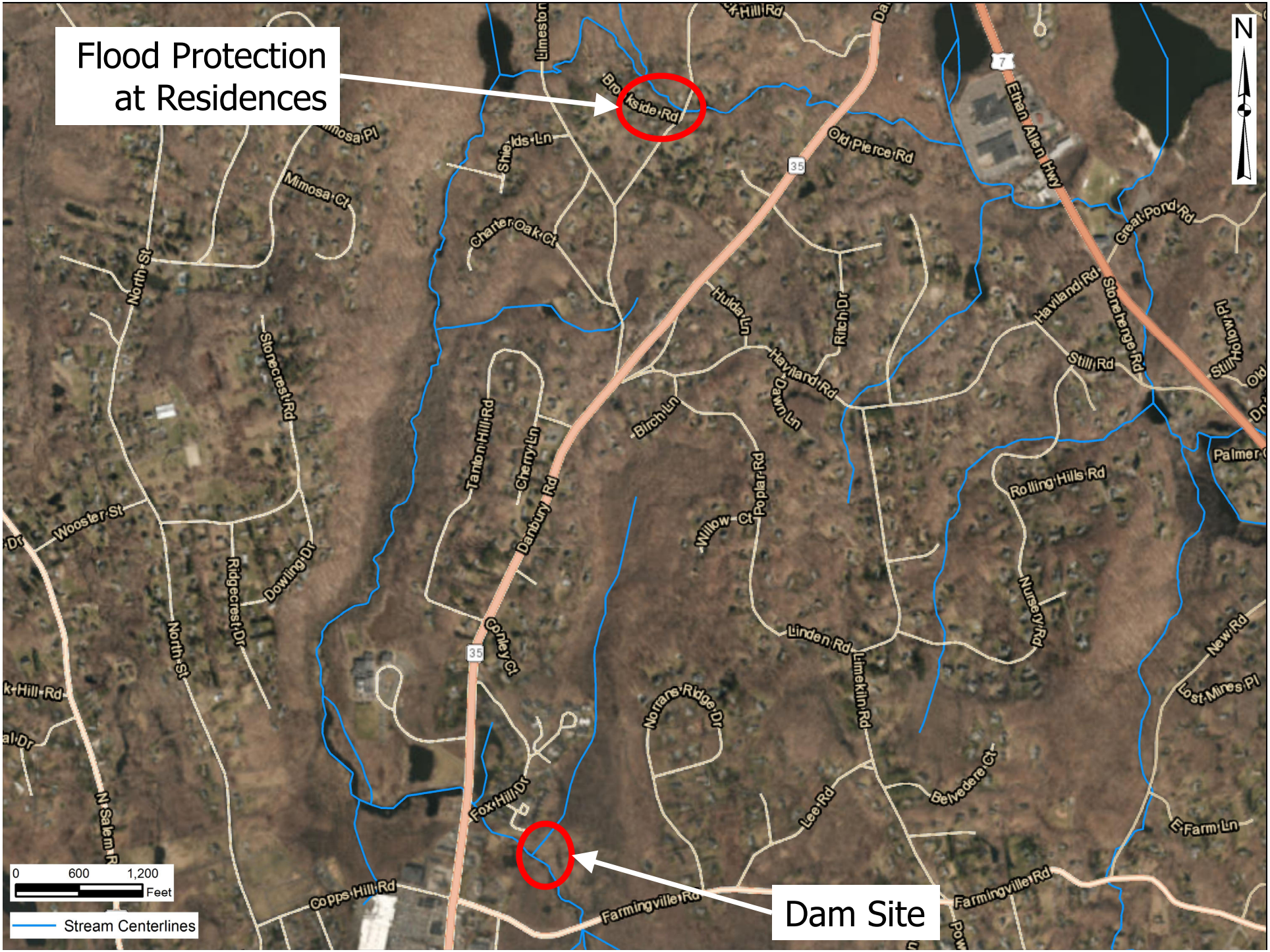
Decommissioning Alternative

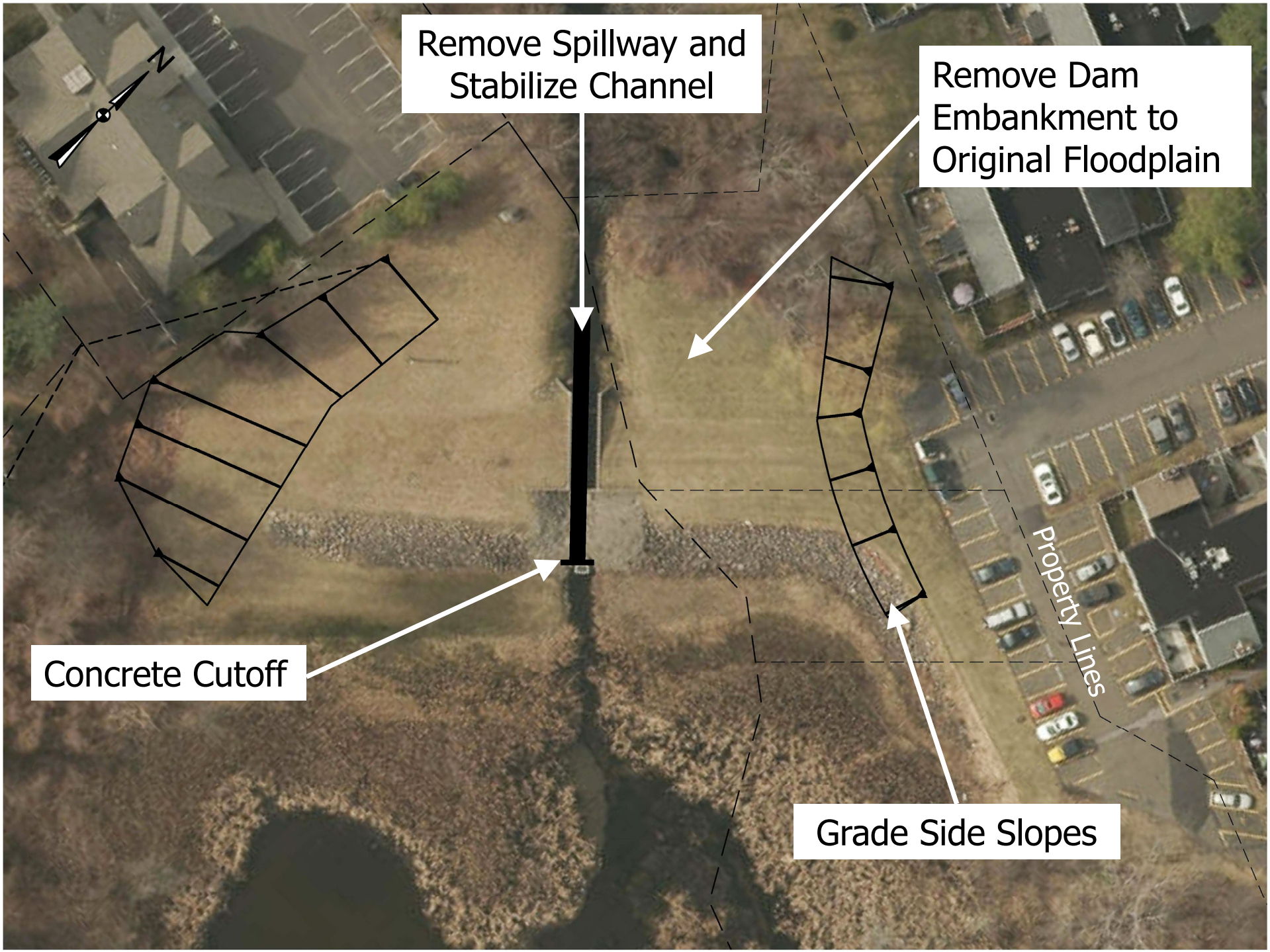
Structural Rehabilitation with Federal Assistance – Decommissioning

- Remove the dam spillway and embankment down to the valley floor and reconnect the stream channel and floodplain.
- Localized flood protection of two single-family residences downstream of dam.

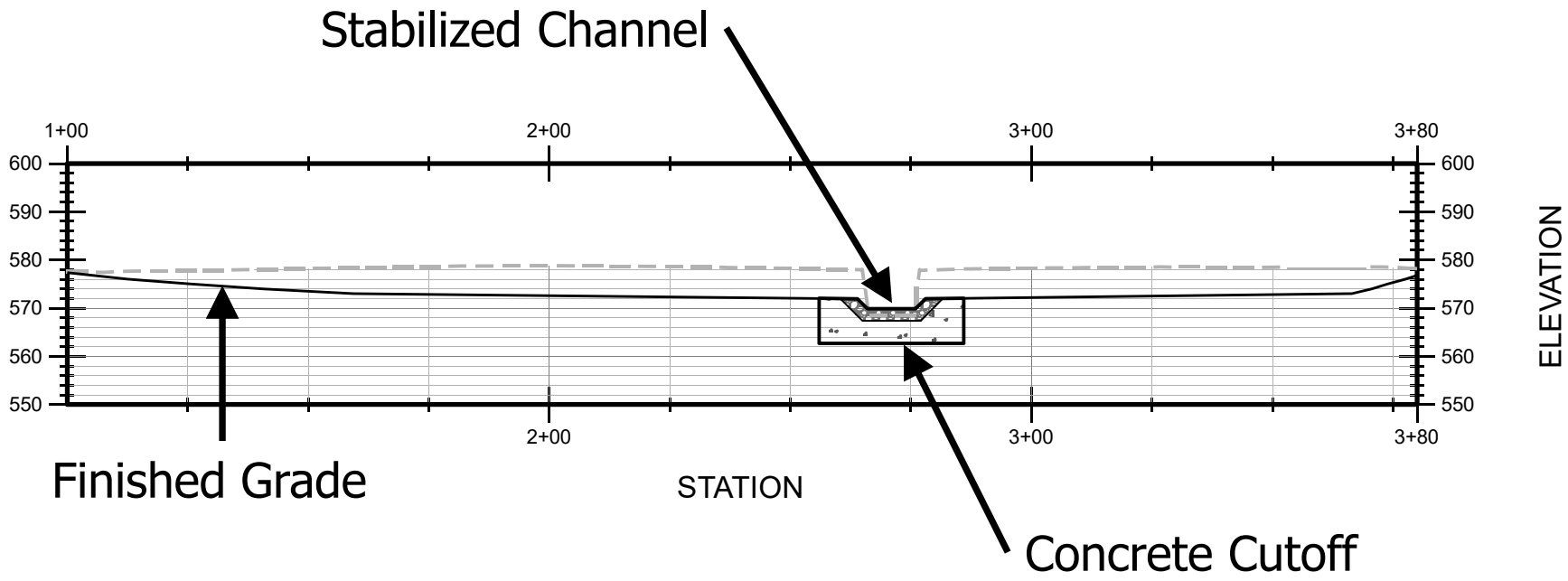
Decommissioning Alternative (Cont.)

- Armor the stream channel with a 10-foot bottom width to control erosion within footprint of existing dam.
- Install a concrete cutoff at the upstream end of the stream armor to prevent downcutting and to maintain the water and sediment capacity of the small pool and Great Swamp wetlands upstream of the embankment.

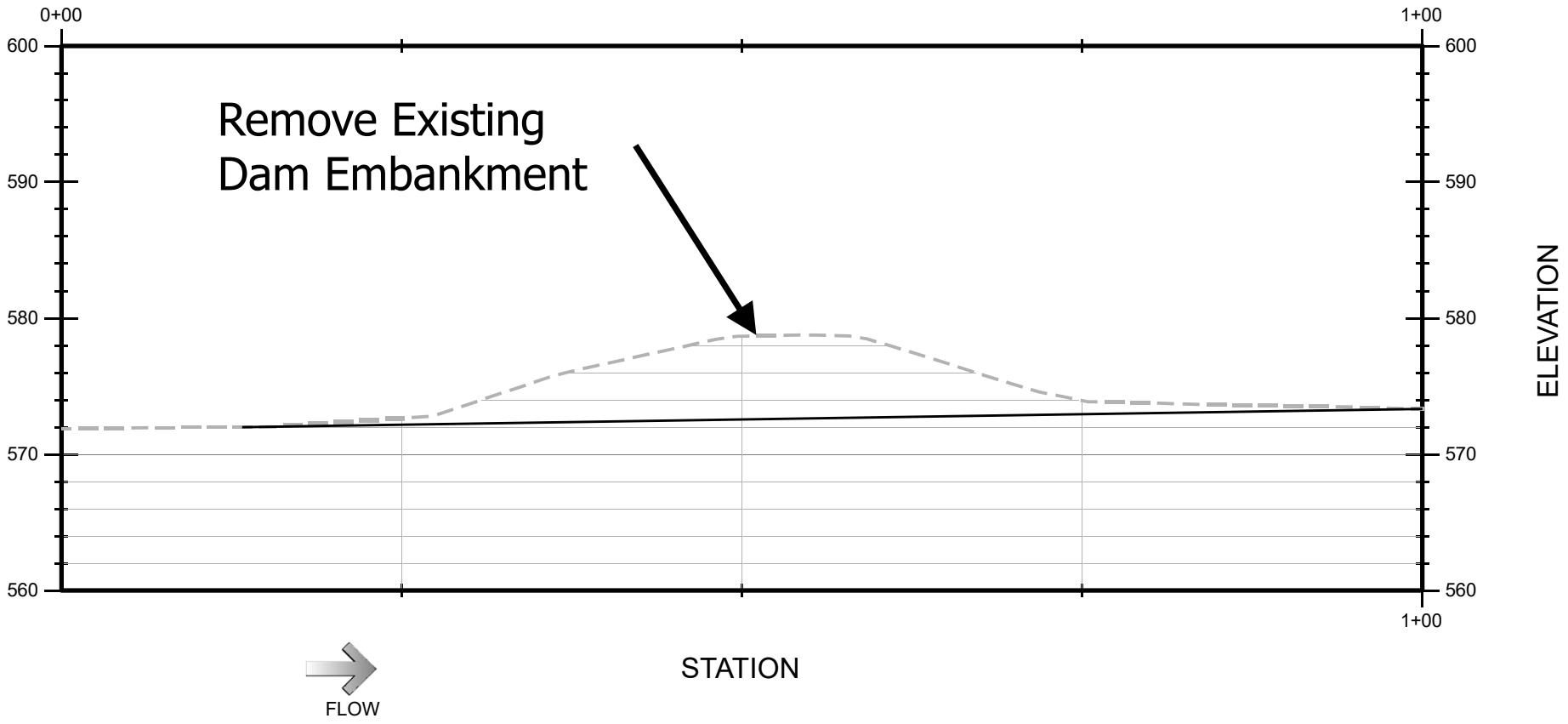

Flood Protection at Residences
Dam Site
N
0
600
1,200
Feet
Stream Centerlines
Old Pierce Rd
Ethan Allen Hwy
Great Pond Rd
Stonehenge Rd
Still Rd
Haviland Rd
Rolling Hills Rd
Danbury Rd
Tanton Hill Rd
Cherry Ln
Birch Ln
Poplar Rd
Willow Ct
Linden Rd
Limekiln Rd
Nursery Rd
New Rd
Lost Mines Pl
Mimosa Ct
Mimosa Pl
Chanter Oak Ct
Hulda Ln
Ritch Dr
Stonecrest Rd
North St
Wooster St
Ridgecrest Dr
Dowling Dr
Corley Ct
Notrans Ridge Dr
Fox Hill Dr
Lee Rd
Belvedere Ct
E Farm Ln
Farmingville Rd
Copps Hill Rd
N Salem Rd
Limestone
Brookside Rd
Shields Ln
35
7


Remove Spillway and Stabilize Channel
Remove Dam Embankment to Original Floodplain
Concrete Cutoff
Grade Side Slopes
Property Lines
N

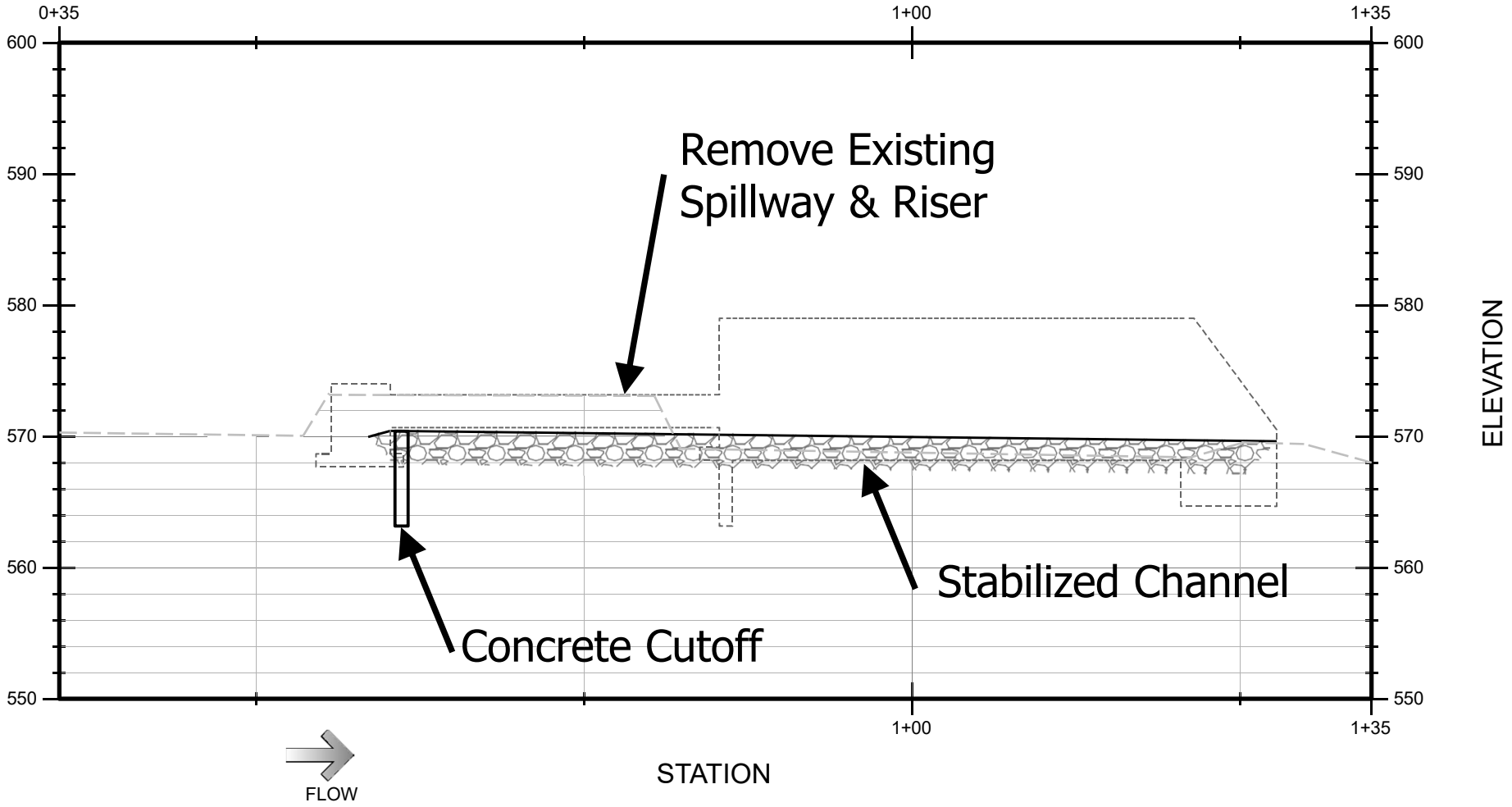
Dam Profile

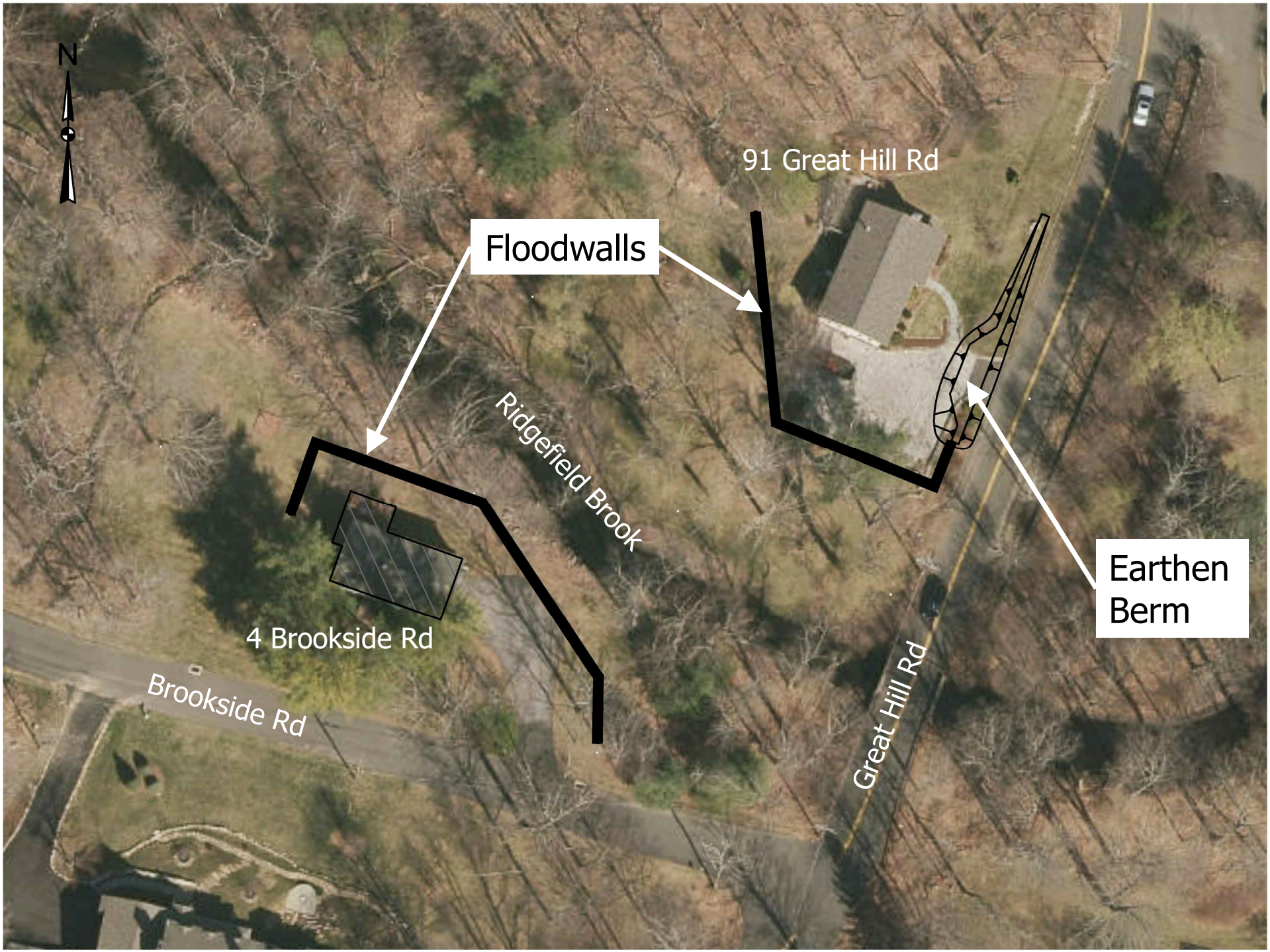

Stabilized Channel
1+00
2+00
3+00
3+80
600
590
580
570
560
550
ELEVATION
STATION
Finished Grade
Concrete Cutoff

Dam Section Through Floodplain

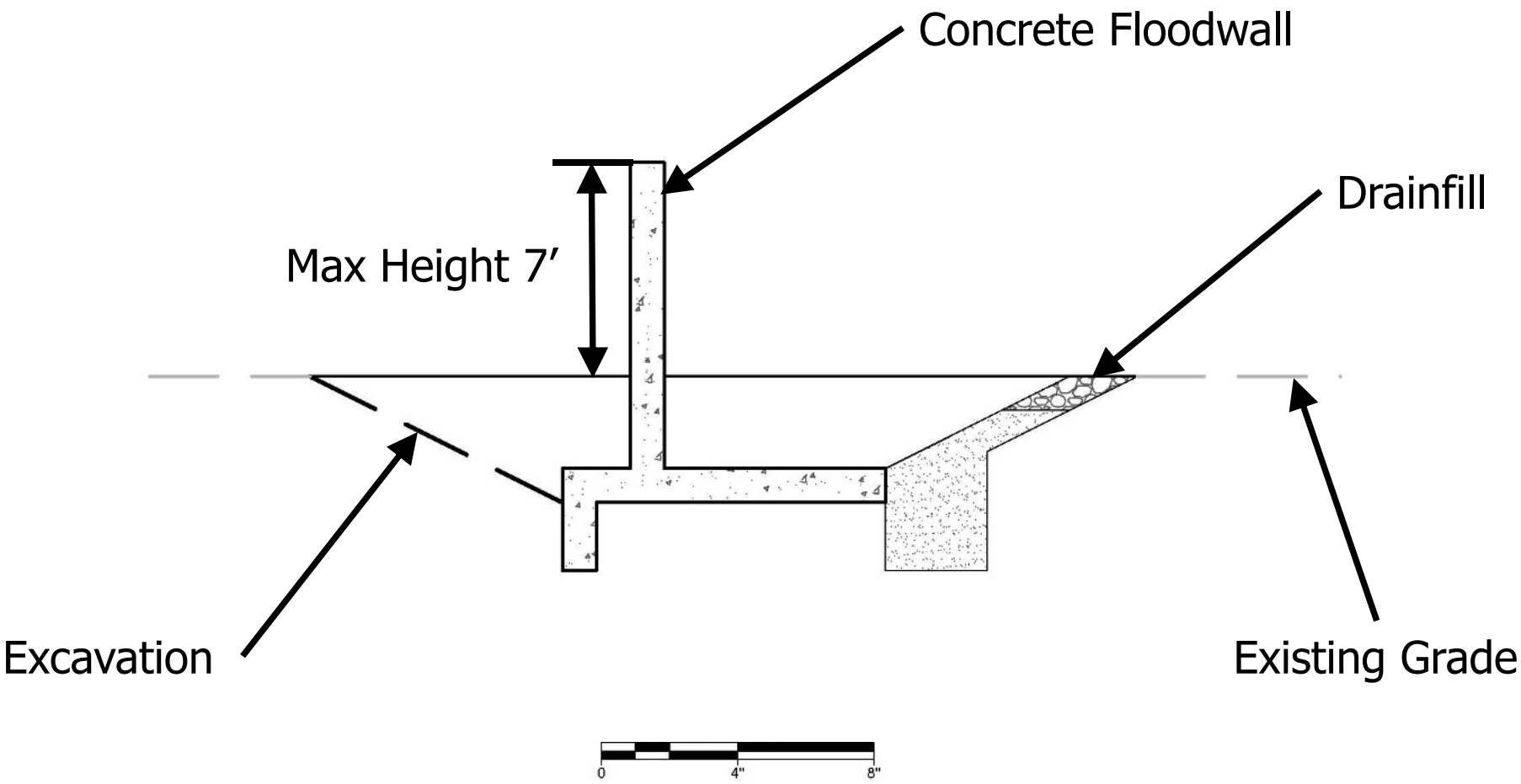


Dam Section Through Spillway




N
91 Great Hill Rd
Floodwalls
Ridgefield Brook
Earthen Berm
4 Brookside Rd
Brookside Rd
Great Hill Rd

Typical Floodwall Section



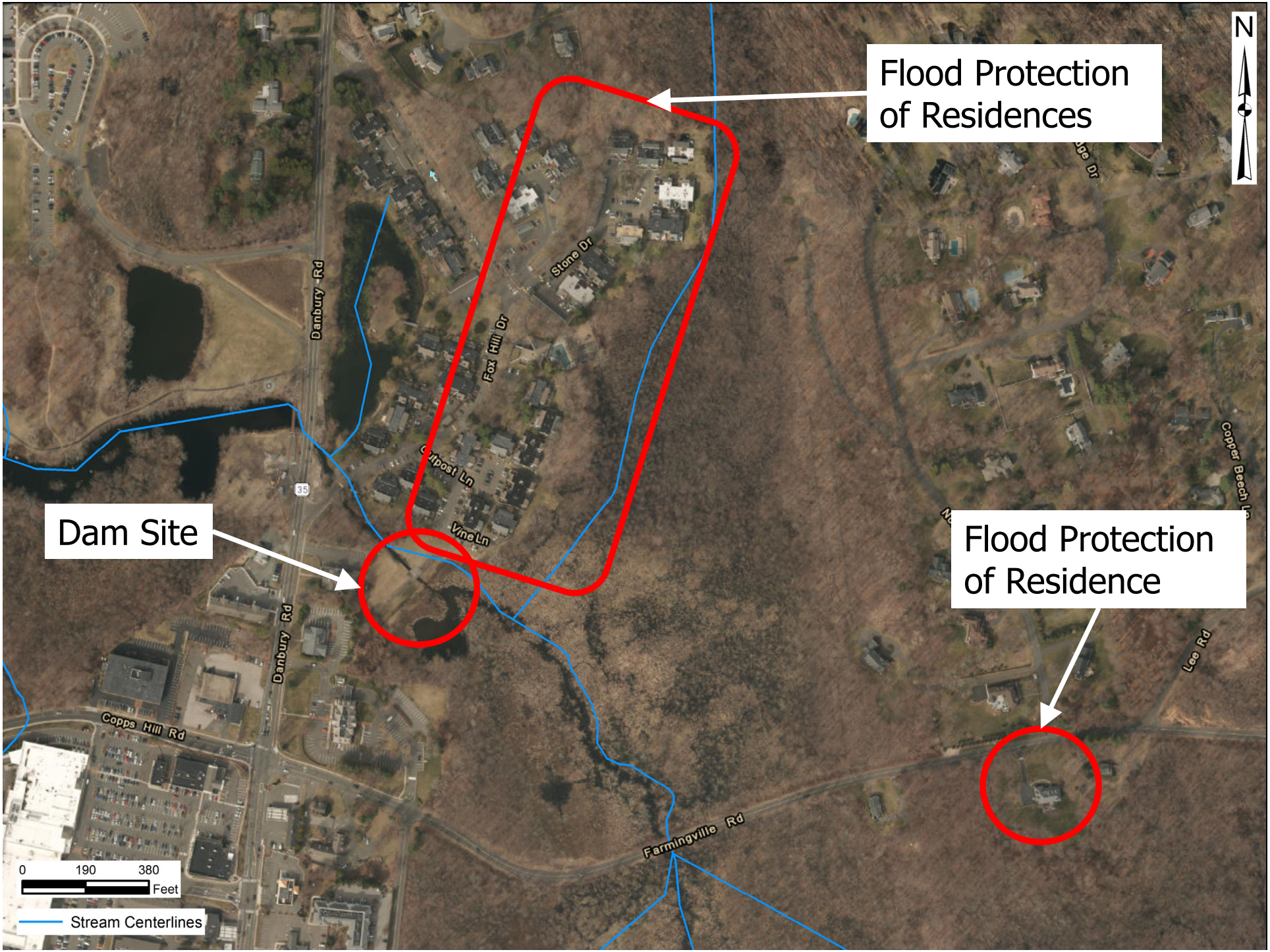
Structural Rehabilitation Alternative

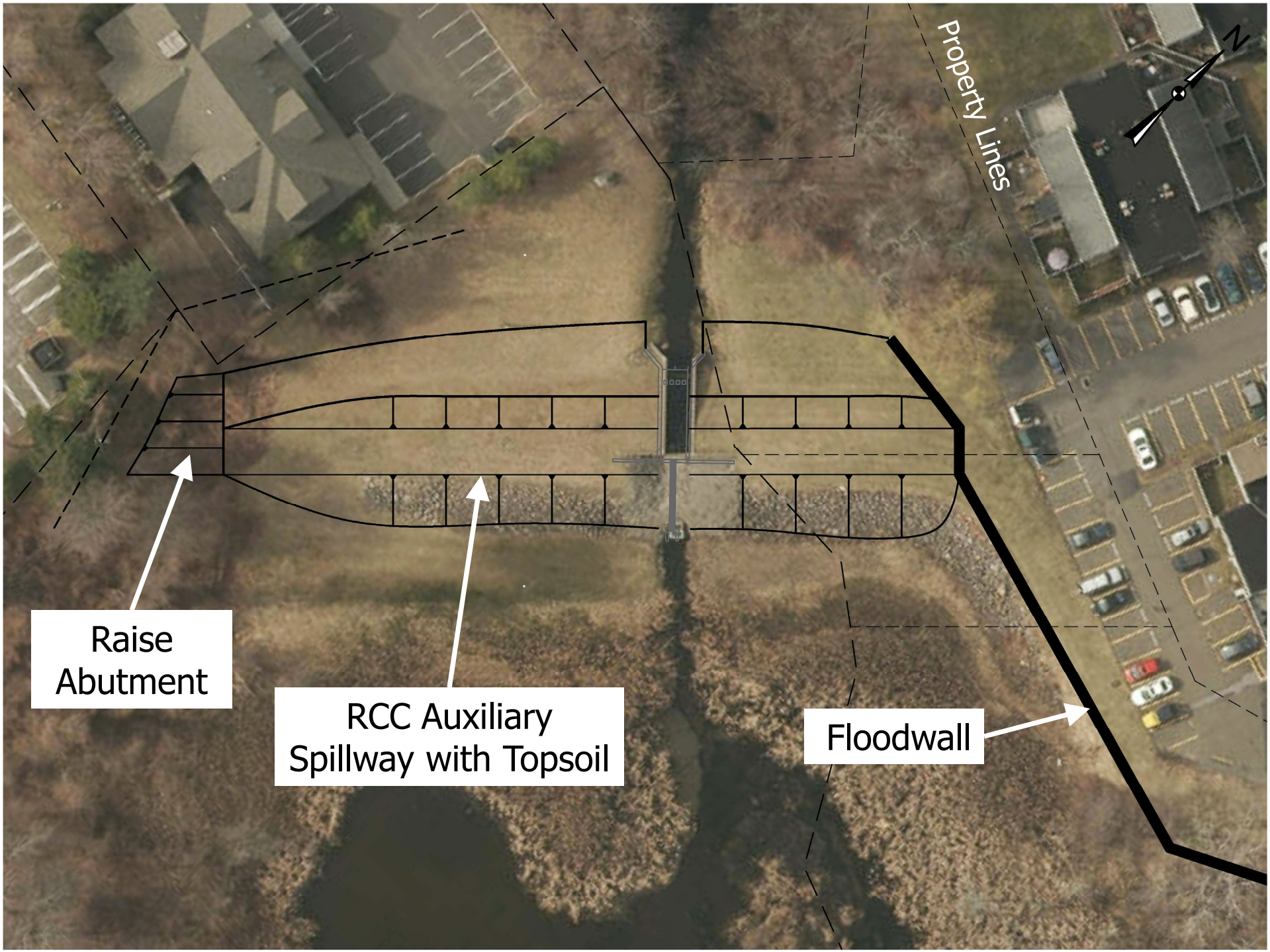
Structural Rehabilitation with Federal Assistance – Roller Compacted Concrete (RCC) Auxiliary Spillway and Localized Flood Protection

- Install a 266-foot RCC auxiliary spillway set to EL 577.3, the 500-year pool elevation.
- Raise and armor the left abutment to EL 580.9 and raise the right abutment to EL 580.9 with a parapet wall that would tie into the floodwall.

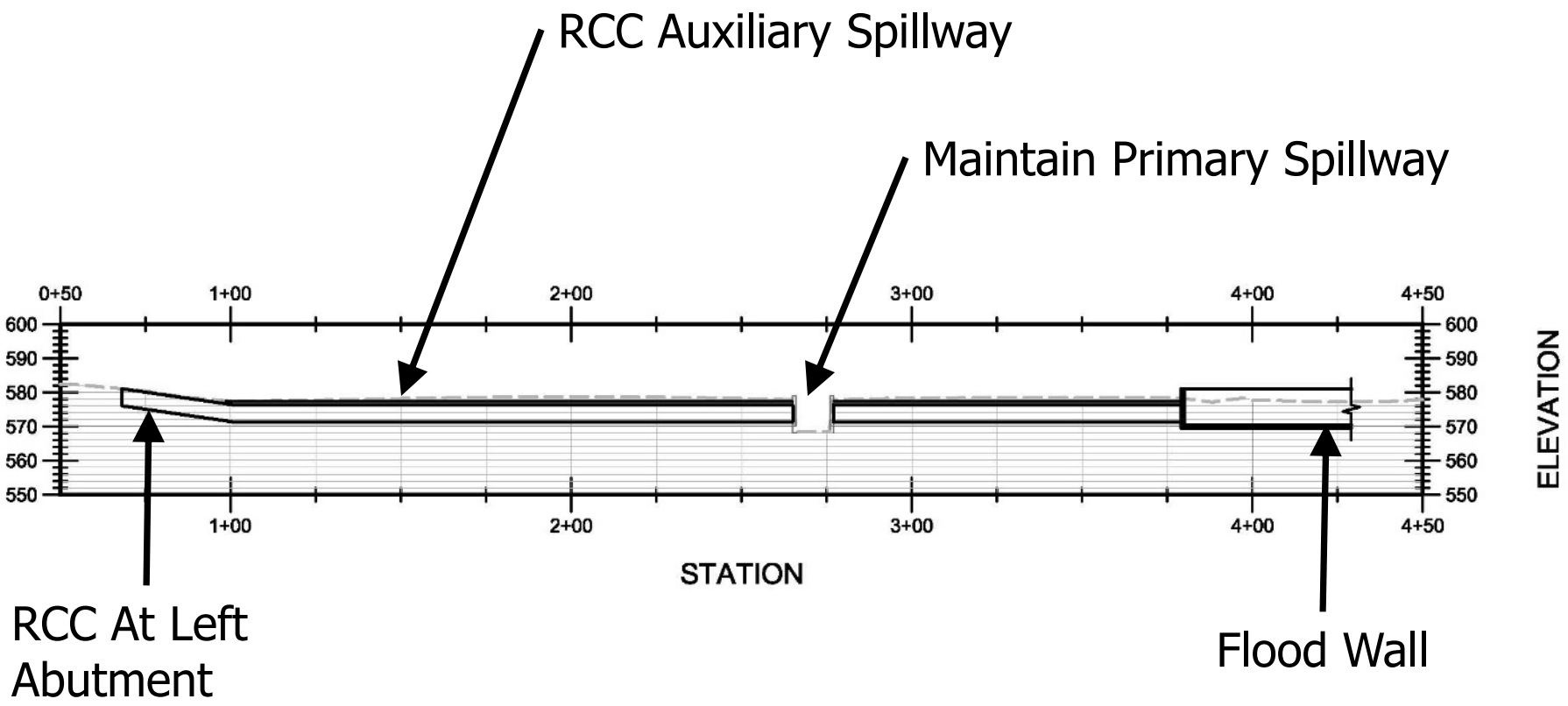
Structural Rehabilitation Alternative (Cont.)

- Install two floodwalls up to EL 580.9 to protect residential structures (adjacent Fox Hill Condominiums) that would be within the flood pool due to the raised dam. Total length = 1,560 ft
- Localized flood protection of one single-family residence in the floodpool.

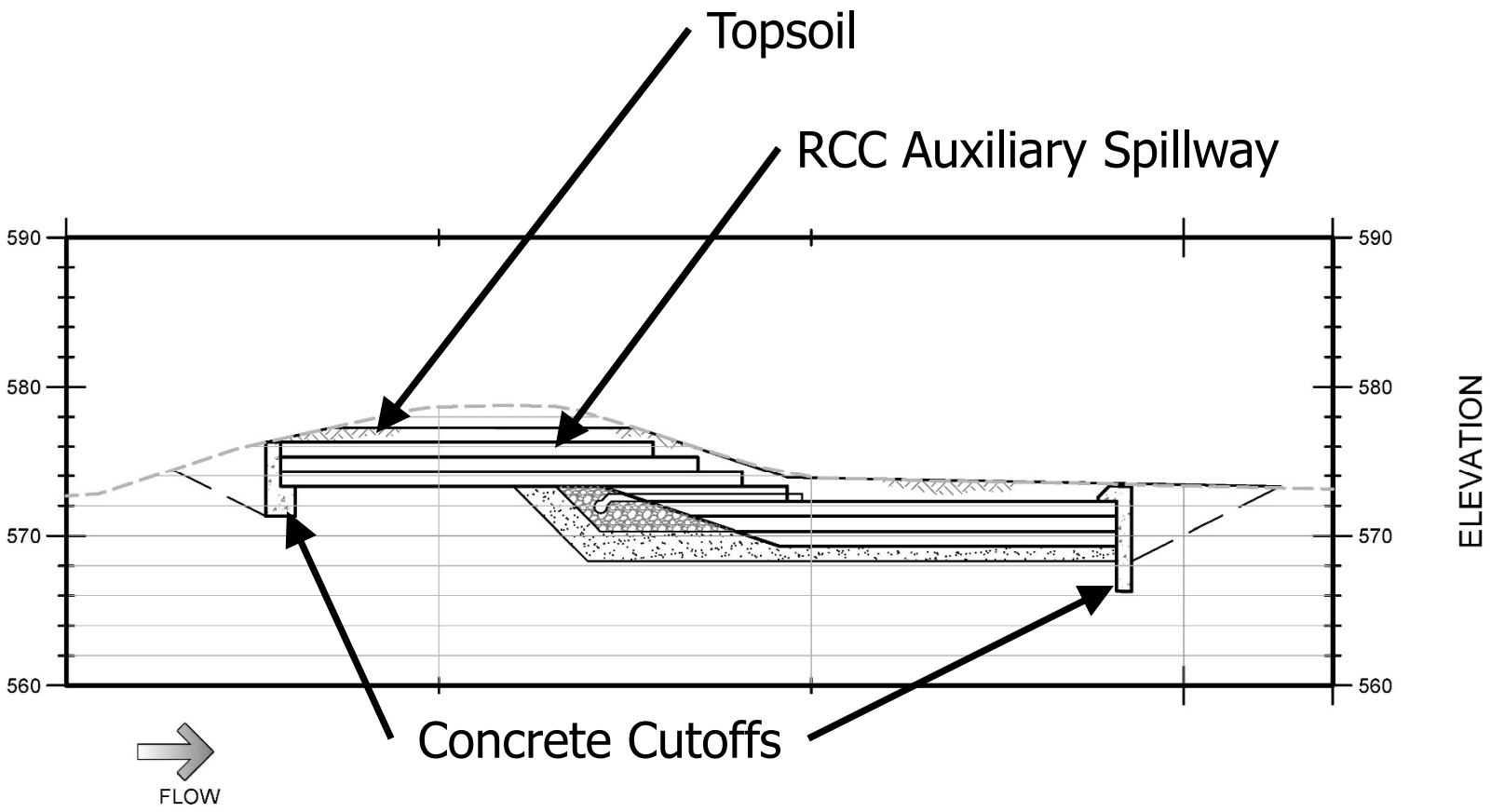

Flood Protection of Residences
Dam Site
Flood Protection of Residence
N
Danbury Rd
Stone Dr
Fox Hill Dr
Vine Ln
Copper Beech Ln
Lee Rd
Copps Hill Rd
Farmingville Rd
35
0
190
380
Feet
Stream Centerlines

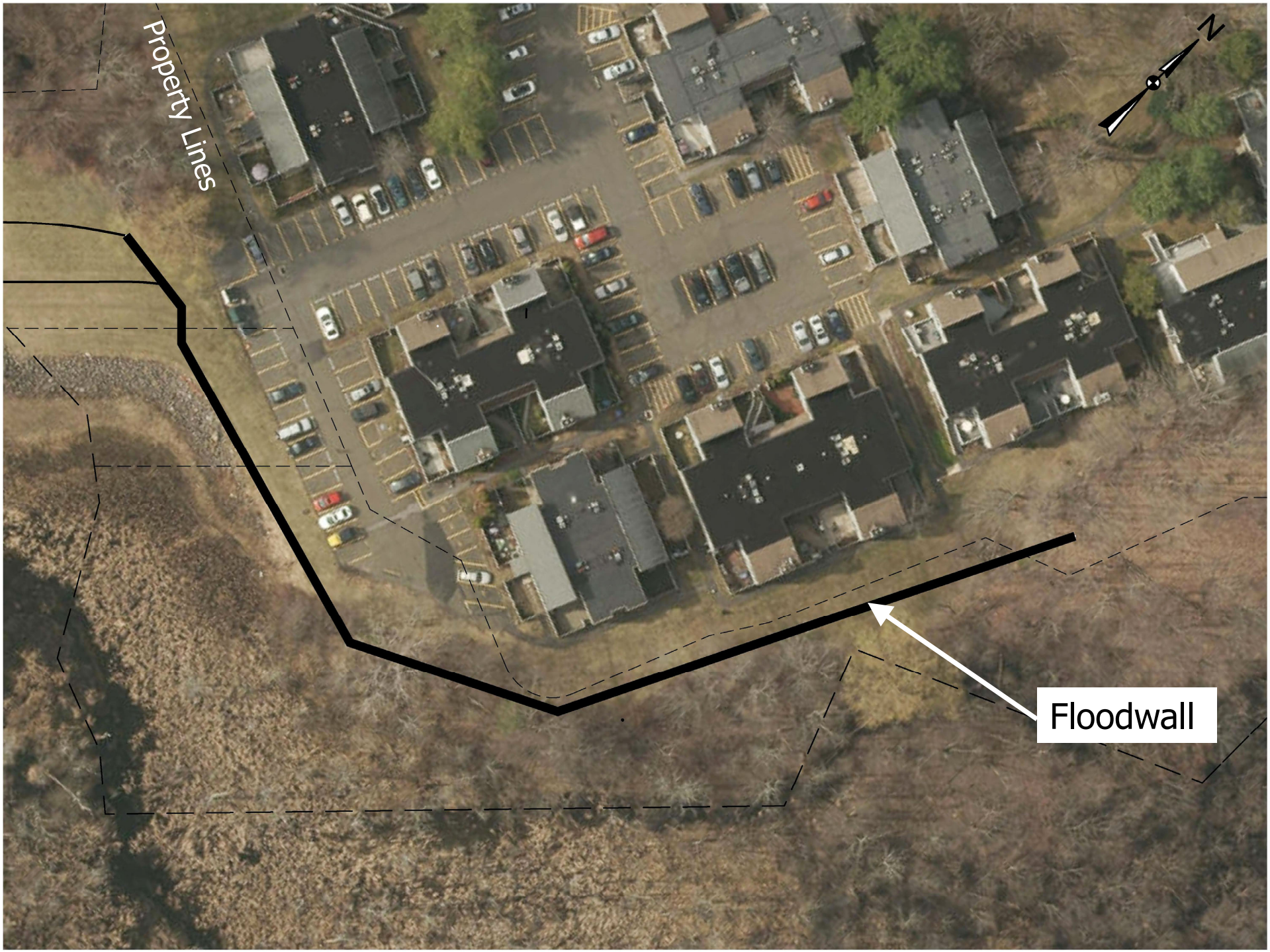

Property Lines
N
Raise Abutment
RCC Auxiliary Spillway with Topsoil
Floodwall

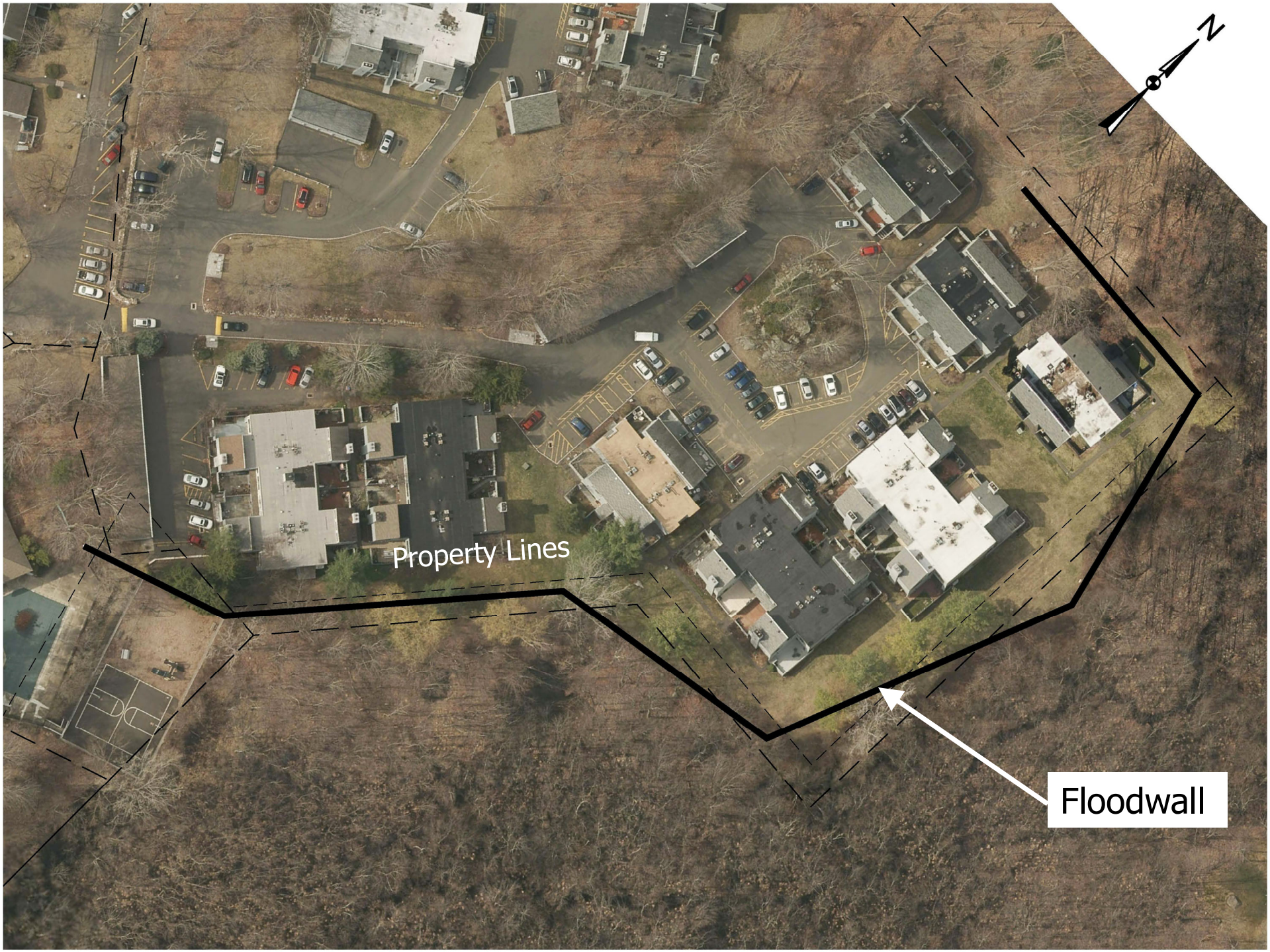
Dam Profile


RCC Auxiliary Spillway
Maintain Primary Spillway
0+50
1+00
2+00
3+00
4+00
4+50
600
590
580
570
560
550
STATION
ELEVATION
RCC At Left Abutment
Flood Wall

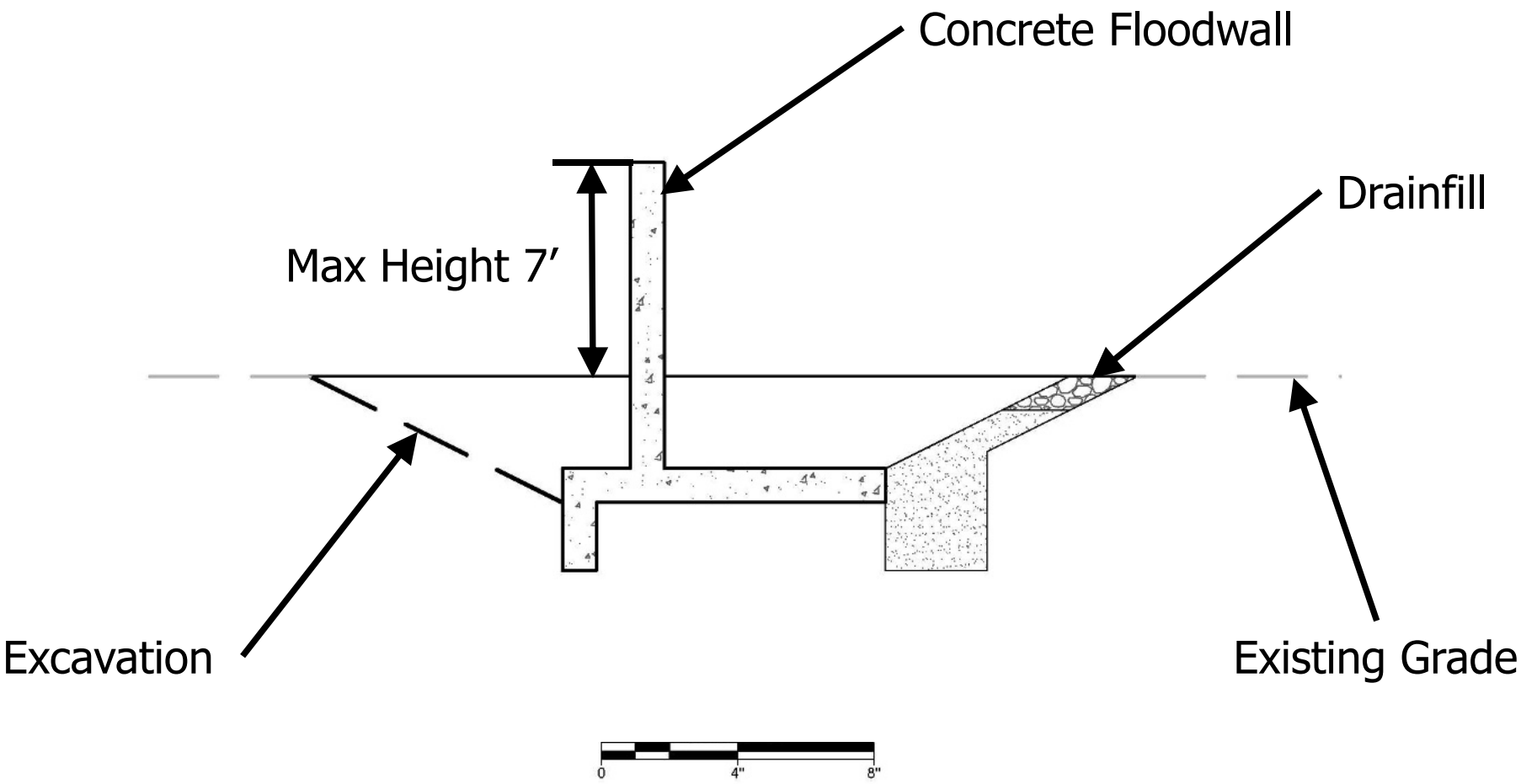
Dam Section

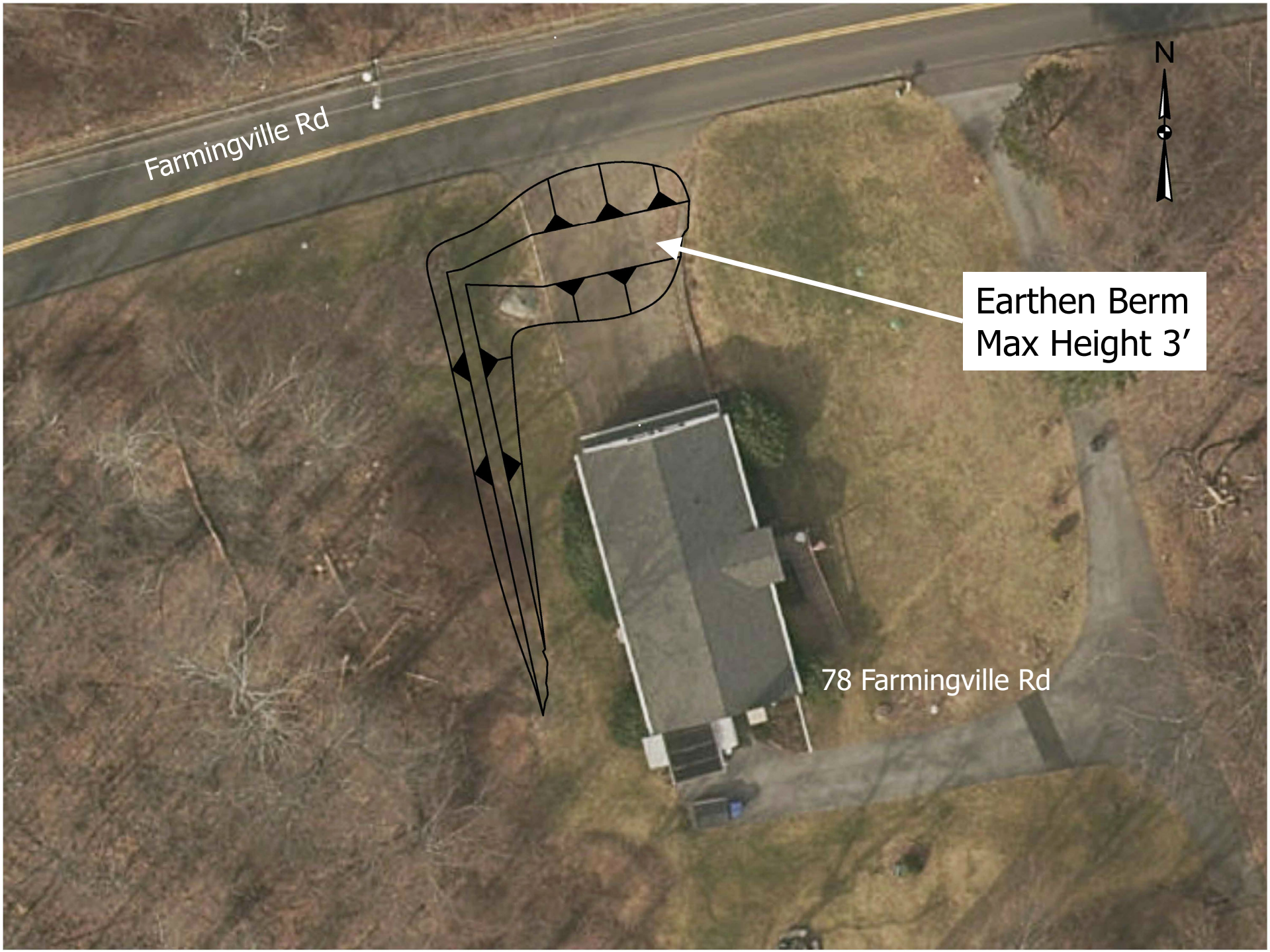

Topsoil
RCC Auxiliary Spillway
590
580
570
560
ELEVATION
Concrete Cutoffs
FLOW


Property Lines
N
Floodwall


N
Property Lines
Floodwall

Typical Floodwall Section




Farmingville Rd
N
Earthen Berm
Max Height 3’
78 Farmingville Rd

Alternatives Considered but Eliminated

- Structural Alternatives:
  1. *Use of Articulated Concrete Blocks for Spillway or Overtopping Protection*
  2. *Use of Labyrinth Spillway for Spillway*
  3. *Armor the Existing Dam & Raise the Remaining Embankment*
  4. *Protect the Dam During Allowable Overtopping*
  5. *Protect the Remaining Embankment During Allowable Overtopping and Provide Additional Spillway Capacity*
  6. *Replacement of Culverts Under Fox Hill Road with Larger Box Culverts*

Alternatives Considered but Eliminated

- Nonstructural Alternatives
  1. *Relocate/Floodproof Structures and Acquire Deed Restrictions*
     - ➢ cost is much greater than upgrading or decommissioning the dam

Limits of Disturbance (LOD)

Decommissioning				**Upgrade Dam**		
Location	**LOD Area (sq. ft)**	**LOD Acres**		**Location**	**LOD Area (sq. ft)**	**LOD Acres**
Dam Only	59,625	1.37		Dam and Floodwall 1	67,485	1.55
4 Brookside Dr	9,668	0.22		Floodwall 2	49,079	1.13
91 Great Hill Rd	10,395	0.24		78 Farmingville Rd	4,376	0.10
Total	**79,688**	**1.83**		**Total**	**120,940**	**2.78**

Comparison of Costs

- Decommissioning
  - $1,605,300
- Structural Rehabilitation with RCC Spillway and Raising Top of Dam
  - $6,275,400

Damages/Benefits Summary – Decommissioning Dam

Item	Average Annual Damages		Average Annual Benefits
	Without Dam	With Decommissioning Dam	
Urban Properties	$41,800	$0	$41,800
Loss of Land Value [1/]	-	($12,500)	($12,500)
Totals	**$41,800**	**($12,500)**	**$29,300**

[1/] For the decommissioning alternative, there would be a 22.4-acre increase in the 100-year floodplain. This would affect 128 residential and commercial parcels along both sides of the tributary for the length of the floodplain, averaging about 0.17 acres per parcel. Using values from the tax assessor's office, it was estimated that the average annual decrease in property values would be about $12,500.

Comparison of Average Annual Costs and Benefits, Decommissioning vs. Rehabiliation of Dam

Item	Total Cost	Average Annual Equivalent Cost [1/]	Average Annual Equivalent Benefits	Net Benefits
Decommission Dam No. 2	$1,605,300	$65,100	$29,300	($35,800)
Upgrade Dam No. 2	$6,275,400	$255,400	$5,700	($249,700)

[1/] Amortized for 52 years @ 2.750%

Rehabilitation Plan
Preferred Alternative
Decommissioning

- Remove the dam.
- Remove the principal/auxiliary spillway and embankment down to the valley floor and reconnect the stream channel and floodplain.
- Provide local flood protection to two downstream residences to prevent induced damages.

Rehabilitation Plan
Preferred Alternative (cont.)

- Armor the stream channel with a 10-foot bottom width to control erosion.
- Install a concrete cutoff wall at the upstream end of the stream armor to prevent downcutting and to maintain the water and sediment capacity of the small pool and Great Swamp wetlands upstream of the embankment.

Environmental Impacts of Decommissioning

- Temporary increase in particulate matter onsite during construction.
- Some alteration of the 87-acre wetland wildlife habitat upstream of the dam.
- Temporary effects to wetlands during construction.
- Mimic typical hydroperiod of a 1- to 2-year flood to minimize potential long-term impacts on flooding, frequency of saturation, and soil wetness in upstream wetlands.

Floodplain Impacts of Decommissioning

- Increase downstream 100-year floodplain by 22.4 acres.
  - on 128 parcels
  - (0.17 acres per parcel)

- Decrease upstream 100-year floodplain by 46.5 acres
  - on 29 parcels
  - (1.55 acres per parcel)

Cost of Decommissioning

- Total Project Costs = $1,605,300
  - Federal Cost = $1,133,100
  - Non-Federal Cost = $472,200

Project Benefits with Decommissioning

- Rehabilitation will allow the dam to meet the NRCS requirements for a high hazard potential dam, reduce the potential for loss of life, continue protection of existing infrastructure downstream of the dam, and maintain the wetland enhancement acreage in the Great Swamp.

Additional Benefits (Cont.)

- Reduces the threat to loss of life to approximately 24 people who live and/or work downstream.
- Protects three houses and one business structure within the breach inundation zone.
- Provides protection for many vehicle occupants who utilize the six roads in the breach inundation zone with a cumulative total average daily traffic count of 15,000-19,000 vehicles.

Additional Benefits (Cont.)

- Eliminates the liability associated with the operation of a dam.
- Maintains most of the existing wetland wildlife habitat and recreational values of the impounded wetland and riparian systems.
- Retains the existing aquatic and terrestrial habitat in and around the Great Swamp.
- Leverages federal resources to install the planned works of improvement.

Conclusions

- In order to bring this dam into compliance with NRCS safety and performance standards for a high hazard dam, the preferred alternative in the rehabilitation plan is to decommission the dam and provide local flood protection for two downstream residences.
- Most of the environmental impacts are short-term (only during construction).

Overall Planning Schedule:

- Collection and Analysis of Data – June 2018
- Formulation and Evaluation of Alternatives
  - January 2019 - March 2020
- Draft Plan – June / July 2020
  - Interagency and Public Review – 30-day Period
- Final Plan Completed > September 2020
- Assuming Federal Funding for Implementation:
  - Design takes about 1.5 years
  - Construction takes about 1.5 years

Public Input

- Community input and feedback is critical throughout the rehab. planning process.
- The plan should be comprehensive and the selected alternative aim to have minimal impact on the communities and resources near the dam.
- As we develop the Draft Plan, we will keep you informed and solicit public participation.

- Stay Tuned!

Points of Contact

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QUESTIONS AND COMMENTS?

Equal Opportunity Employer and Provider