

BUFFALO

SEWER AUTHORITY

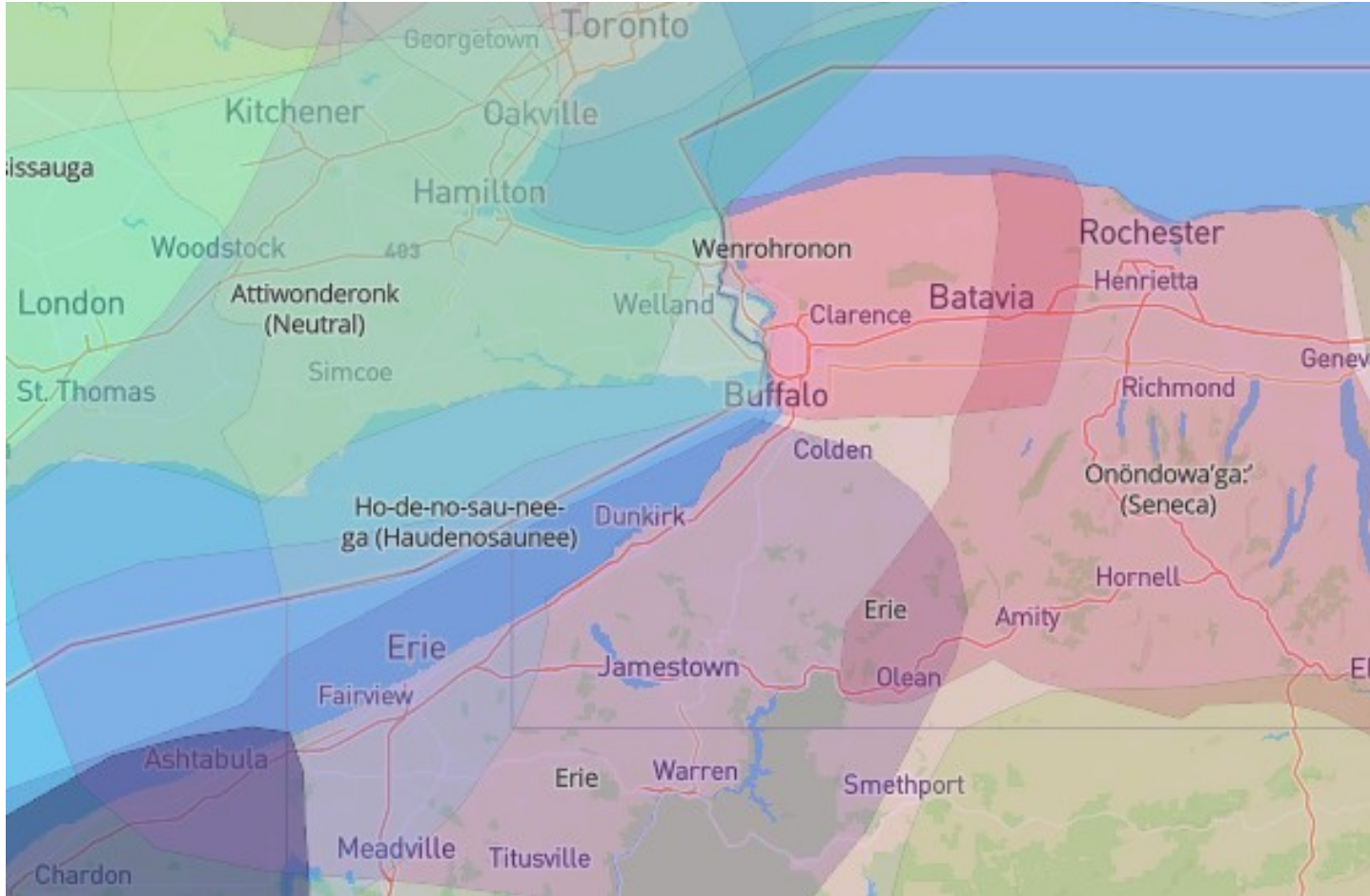
Building a Resilient City at the Place of the Basswood Trees

Rosaleen B. Nogle, PE, BCEE, BC WRE, CFM

M.S., B.S. Civil Engineering; M. Public Affairs (Public Admin Focus)

M.A. Pastoral Ministry, M. Div., B.A. Anthropology

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Land Acknowledgement

I would like to acknowledge the land on which the City of Buffalo is located, which is the territory of the Seneca Nation, a member of the Haudenosaunee/Six Nations Confederacy. This territory is covered by The Dish with One Spoon Treaty of Peace and Friendship, a pledge to peaceably share and care for the resources around the Great Lakes. It is also covered by the 1794 Treaty of Canandaigua, between the United States Government and the Six Nations Confederacy, which further affirmed Haudenosaunee land rights and sovereignty in the State of New York. Today, this region is still the home to the Haudenosaunee people, and we are grateful for the opportunity to live, work, and share ideas in this territory. In this acknowledgement, I hope to demonstrate respect for the treaties that were made on these territories and remorse for the harms and mistakes of the far and recent past; and we pledge to work toward partnership with a spirit of reconciliation and collaboration.

Buffalo's waterways



Niagara River



Scajaquada Creek



Black Rock Canal



Buffalo River

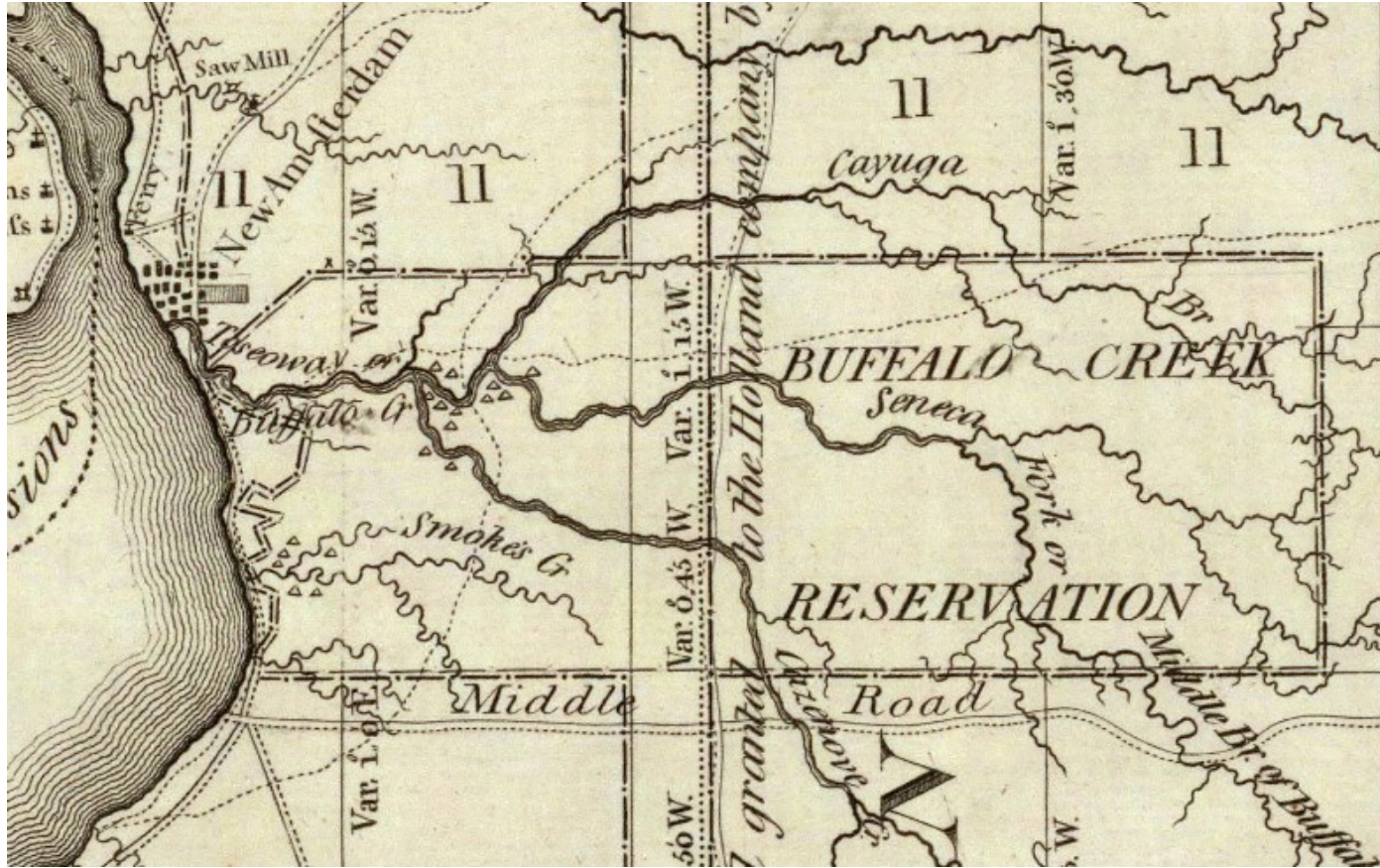


Cazenovia Creek



Lake Erie

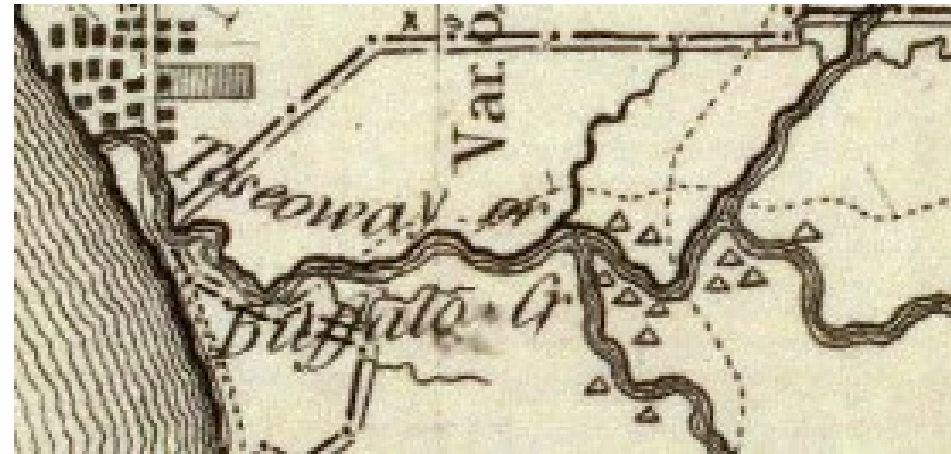




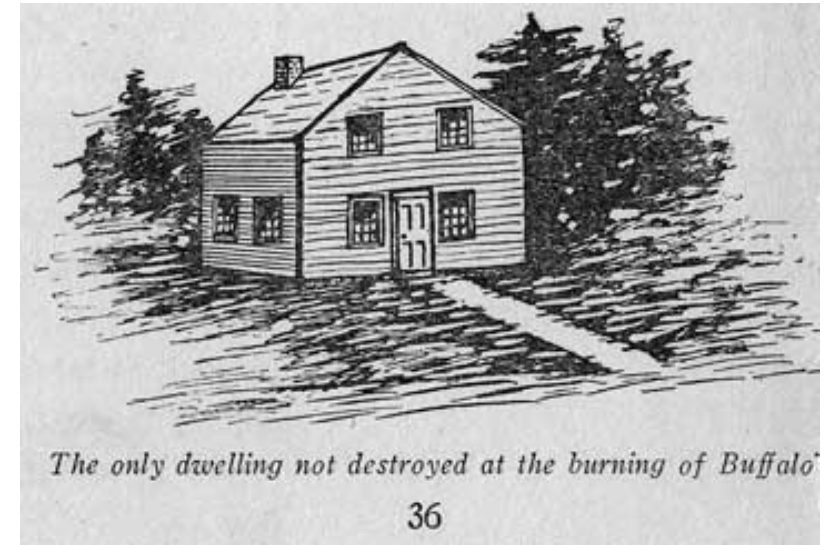
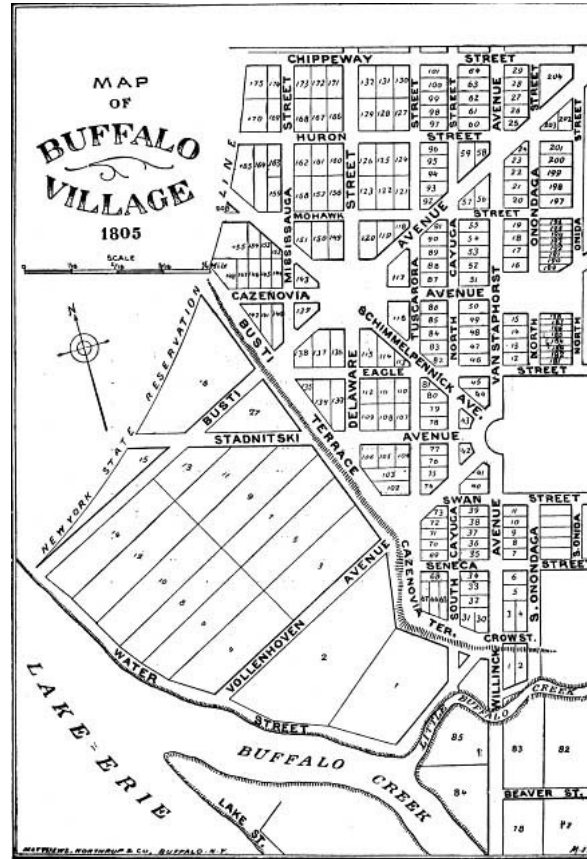
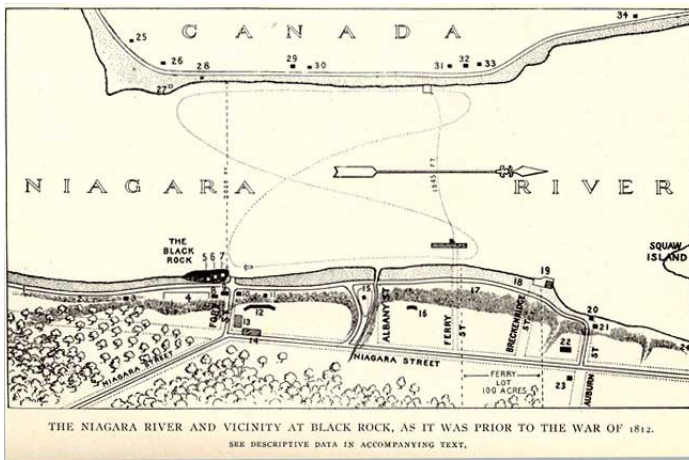
Pre-1785: Frontier Villages and Native Lands

Buffalo's Name

- Big Buffalo Creek
- Buffalo
 - “Tick-e-ack-gou”
- Place of the Basswoods
 - “To-se-o-way”

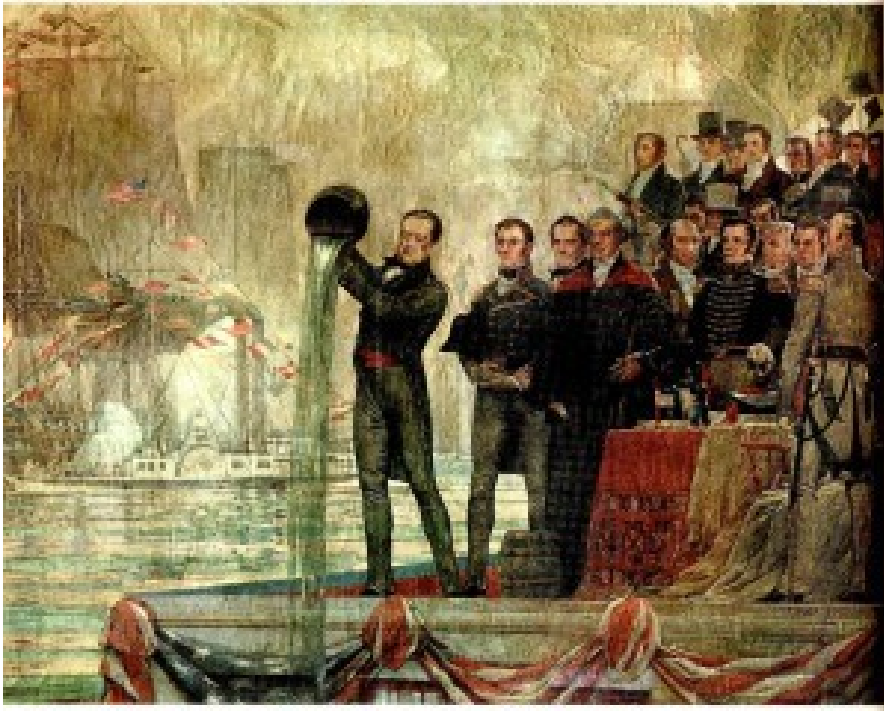


1785-1825: Early Years



Big Buffalo and Little Buffalo Creek



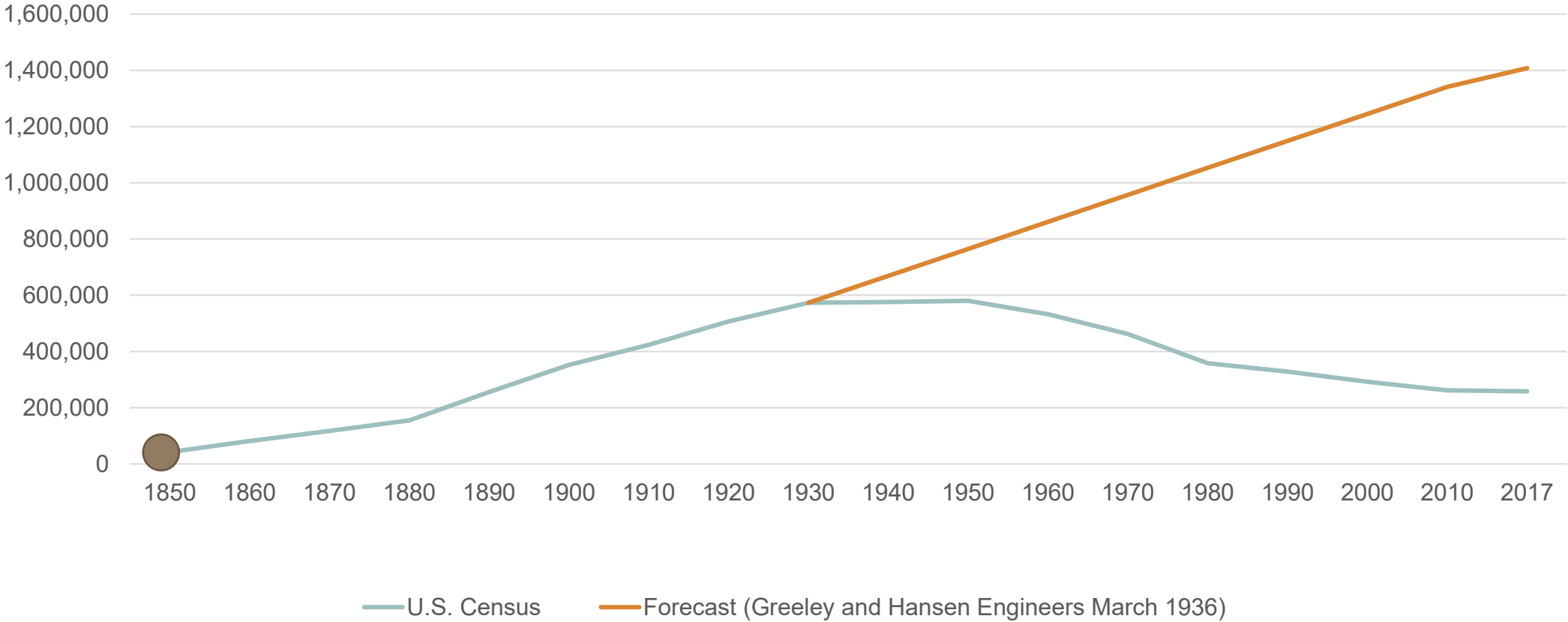


1825-1848: Early Canal Years

- Drain to nearest water way
- Cholera epidemic 1832
- Private construction
- Oak Street 1834-1835
 - Dry brick
 - Board bottom
 - Triangular

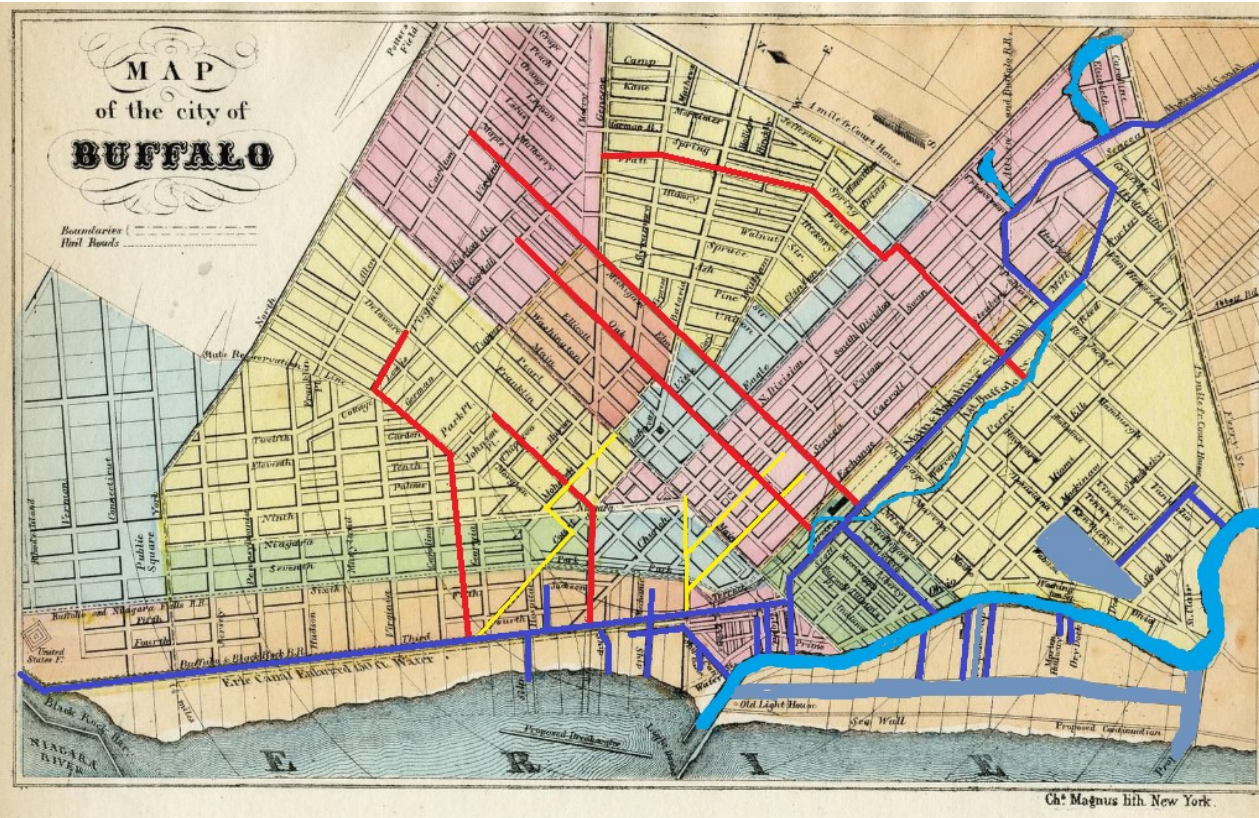


1825-1848: Early Canal Years



1848-1861: Later Canal Years

- Report of Committee on Sewers
 - 2/15/1848
 - Basis of design report
 - Property owners and taxes
- Cholera epidemics 1849, 1854
- 1852 Water Works Company
 - Bathing
 - Indoor toilets

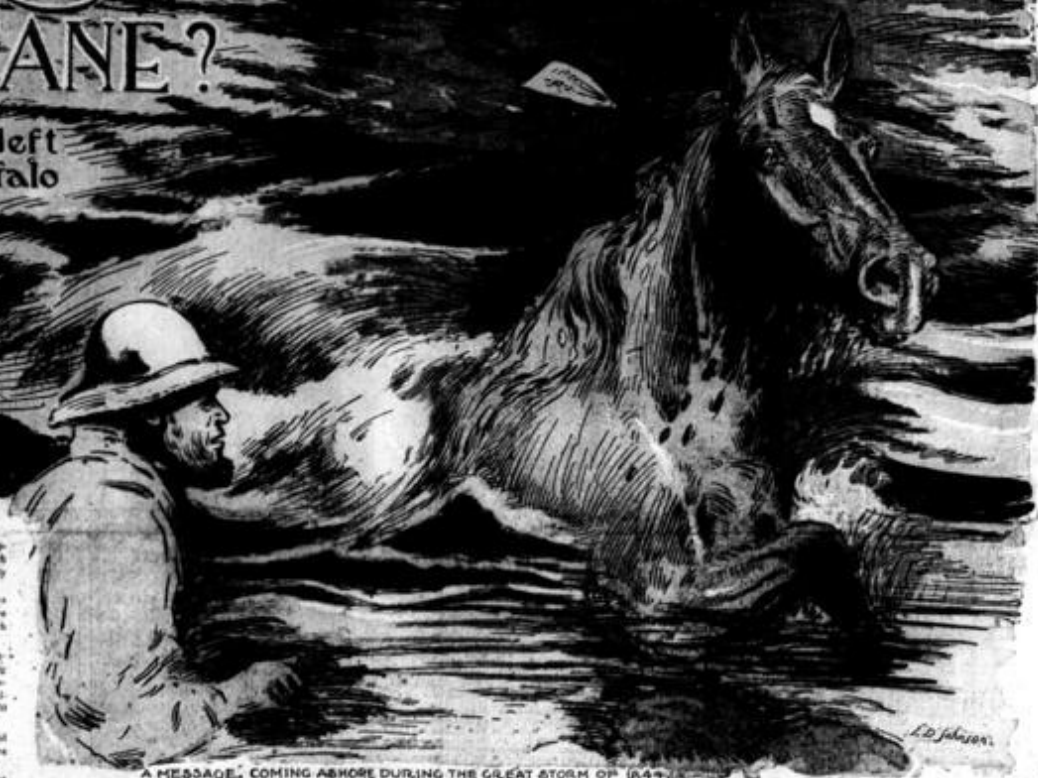


AUGUST 9, 1914

NEED BUFFALO FEAR TIDAL WAVE, EARTHQUAKE OR HURRICANE?

Great flood of 1844 left
suspicion that Buffalo
is not out of
"Calamity Belt."

EARTHQUAKES, sand storms, hurricanes, volcanic eruptions—we read about these unavoidable calamities which occur almost daily in some quarter of the globe and naturally think one starts that we live in a "Calamity Belt."
But fitting as our prayers of thanksgiving may be, not always has nature drawn a charmed circle about our city, for there are still people alive who recall with horror the flood of 1844 which ranks in awfulness with any of the above mentioned disasters.
Had one possibly who has not lived through a flood can conceive the horror of being trapped in a wild swirl of swirling black waters, sweeping along so swiftly as to leave no time for escape. Nevertheless it comes very close to some of us when we realize that such was the experience of relatives and friends who only 50 years ago made up a fraction of the population of our city.
Then, at once, Buffalo was visited by her peribolical wind storms—the kind of storms in which only the strong limbed venture out and even then only under stress of necessity.
A few days before this particular one a strong northeast wind had been driving the water on the lake, but on the morning of



A MESSAGE COMING ASHORE DURING THE GREAT STORM OF 1844.

1844 Flood

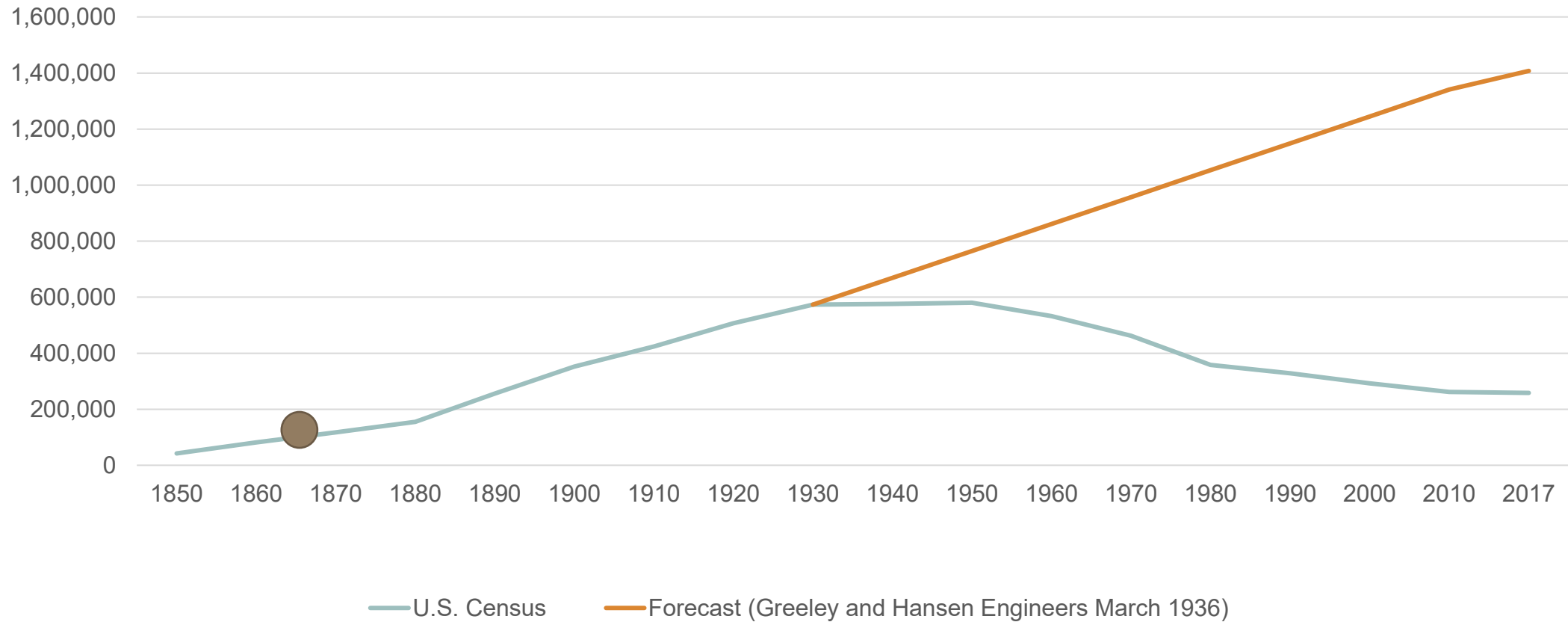
- 78 Dead
- October 18, 1844
- Main and Ohio Streets six feet deep
- Michigan and Exchange Streets five feet deep

1861-1865: The Civil War

- The Civil War
 - Halt in construction
 - Materials and manpower needed for war
- Presentation to Historical Society Club
 - Oliver G. Steele, Esq. in 1866
 - Leader of 1848 Sewer Committee
 - Warned of need for more work
 - Issue of lack of proper traps
 - Too few catch basins and manholes

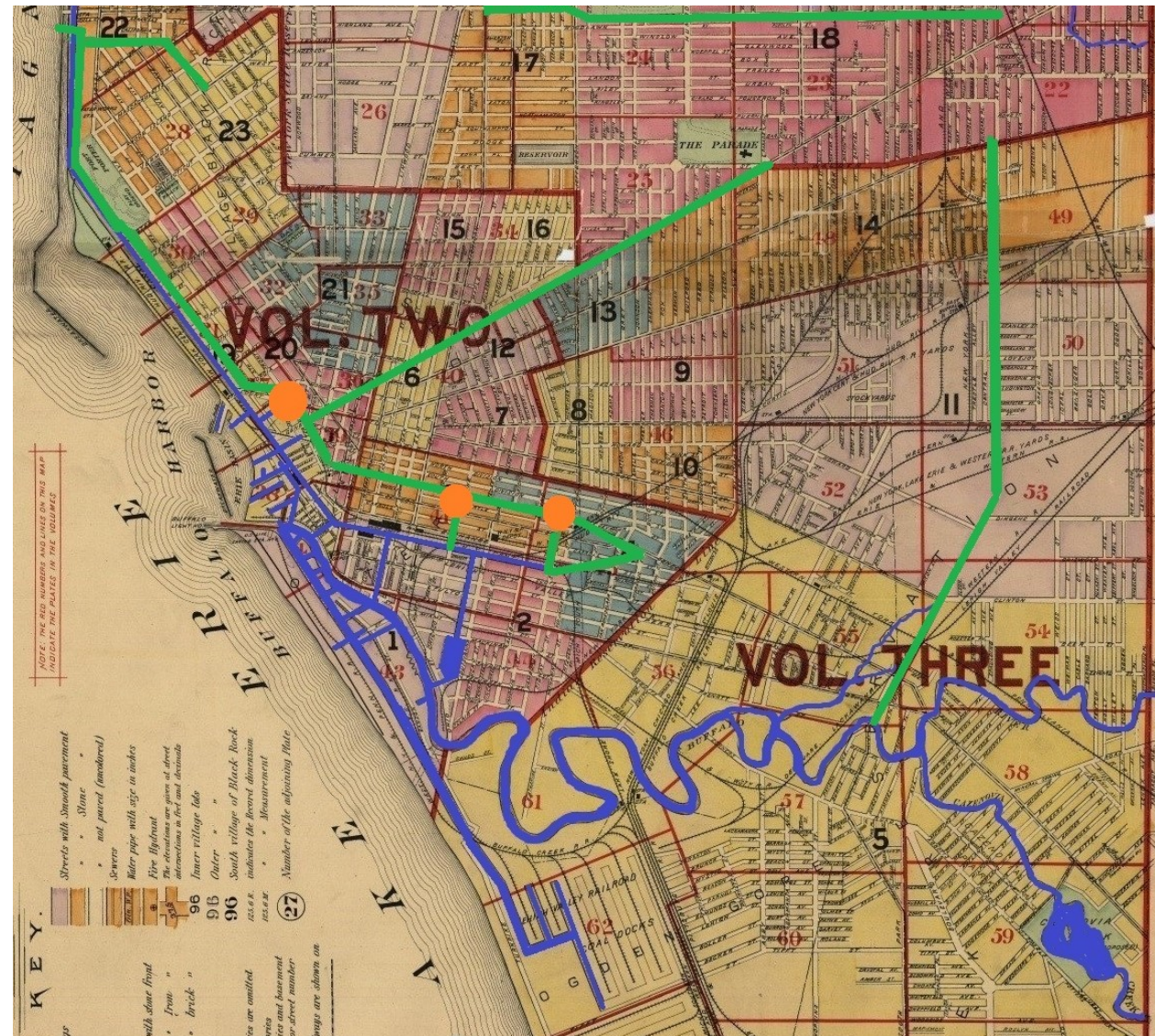


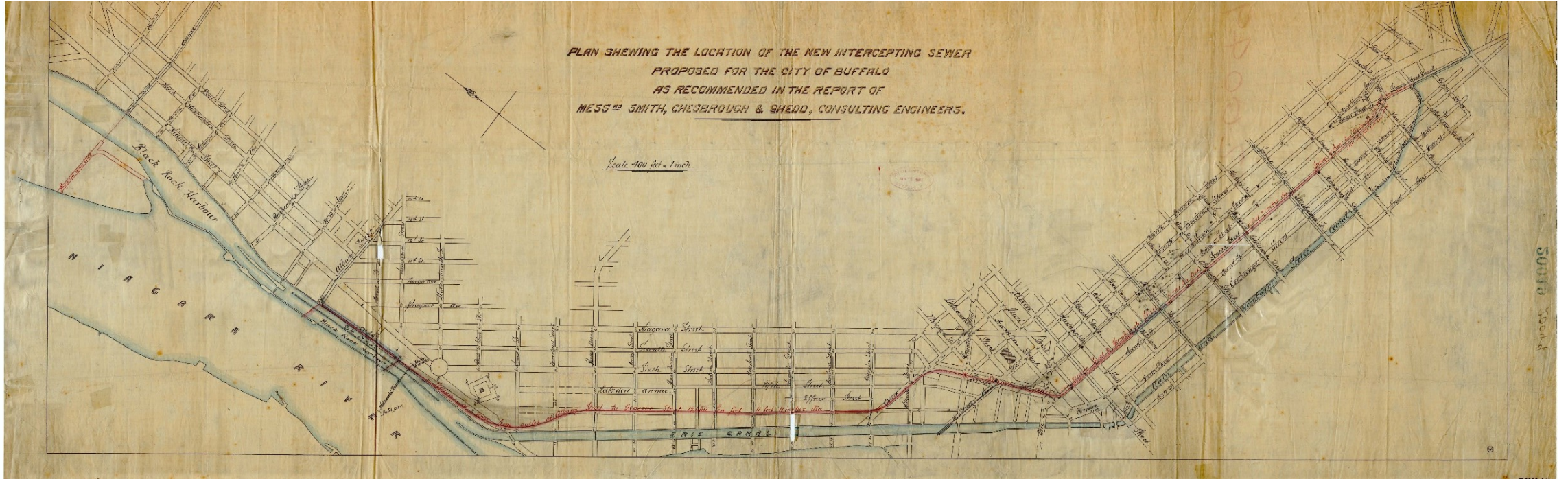
1861-1865: Civil War



1867-1899: Industrial Revolution

- George E. Waring, Jr. 1884
- Separate sewers and treatment considered, but not pursued
- Trunks
 - Genesee, Bird-Ferry, Hertel, Bailey, Mill Race
 - Swan
 - 3 Flushing gates
 - Main and Hamburg canal and Wilkenson Slip putrid
 - 90 degree turn at Albany Street



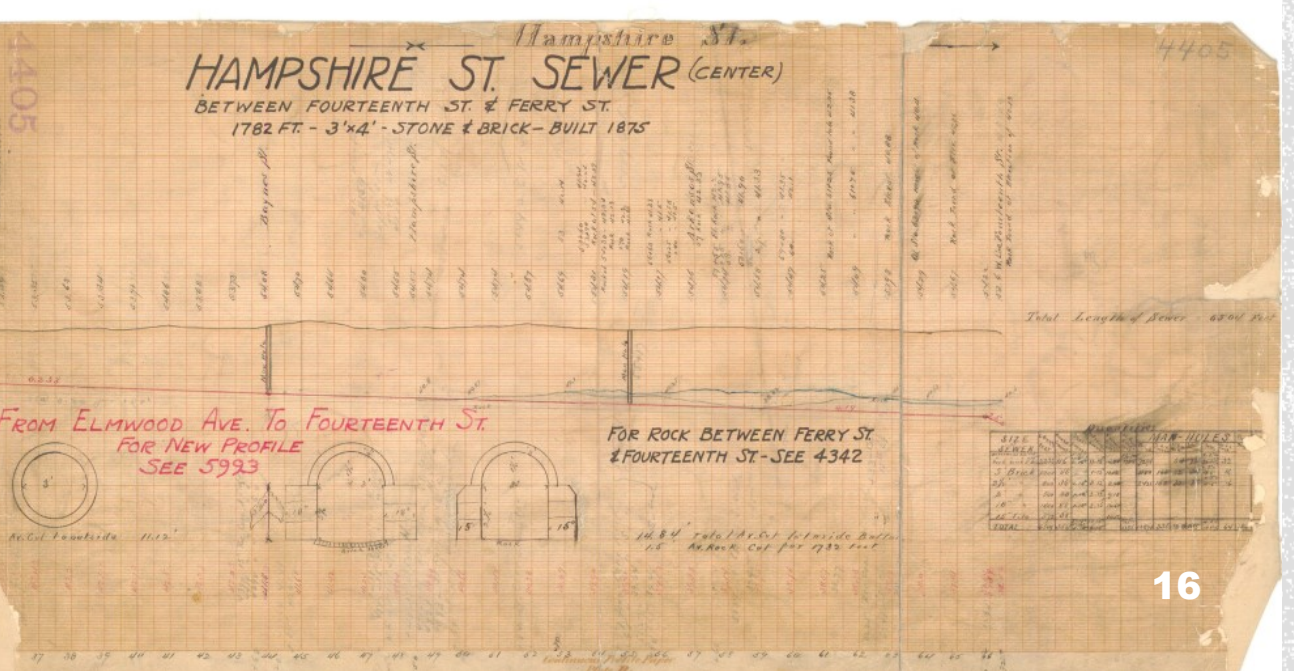
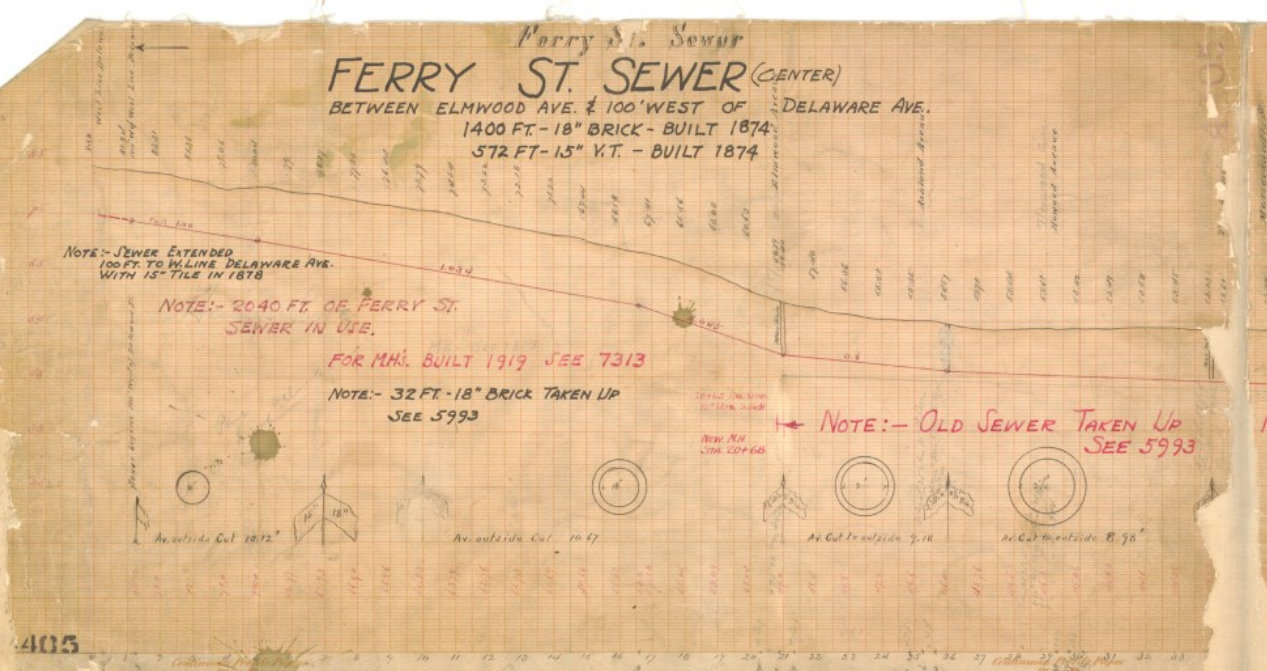


The Swan Trunk

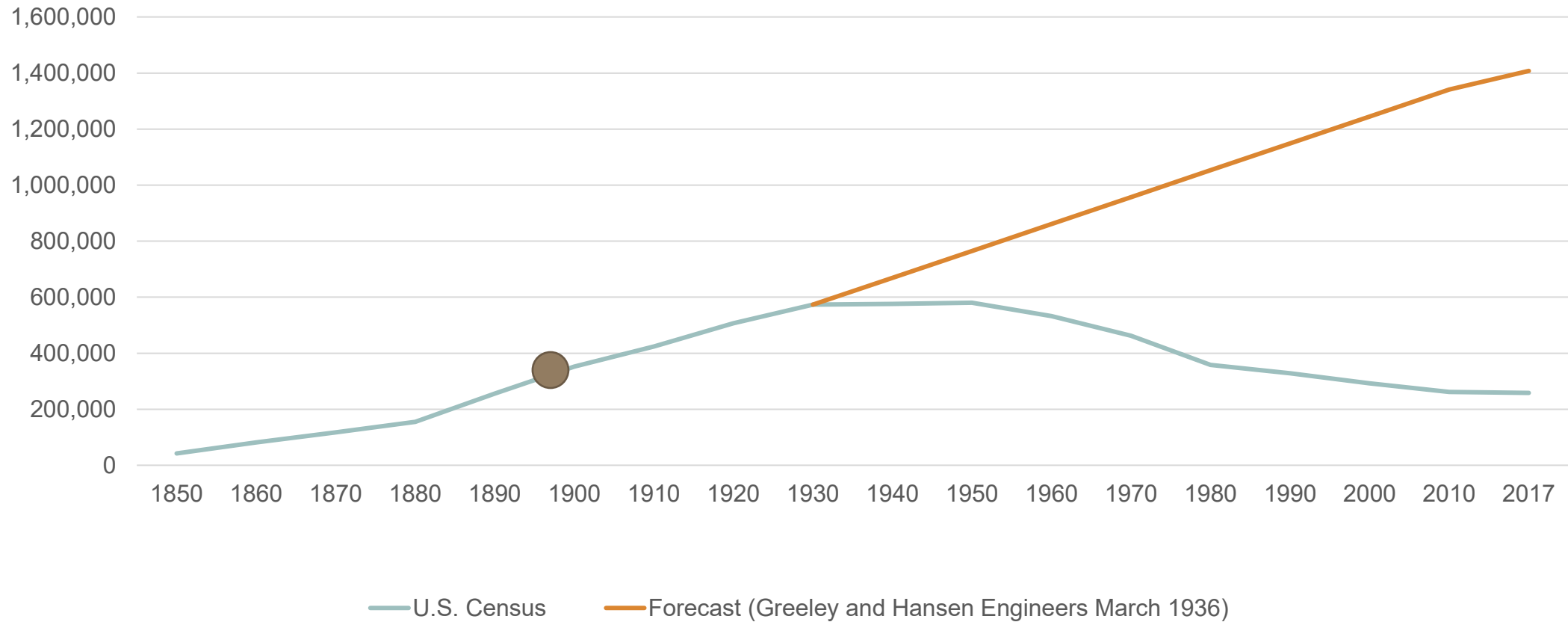


1867-1899: Industrial Revolution

- Majority of existing system
- Hundreds of miles of pipe
- Brick 24"+
- Vitrified Tile Pipe (VTP) 8"-21"



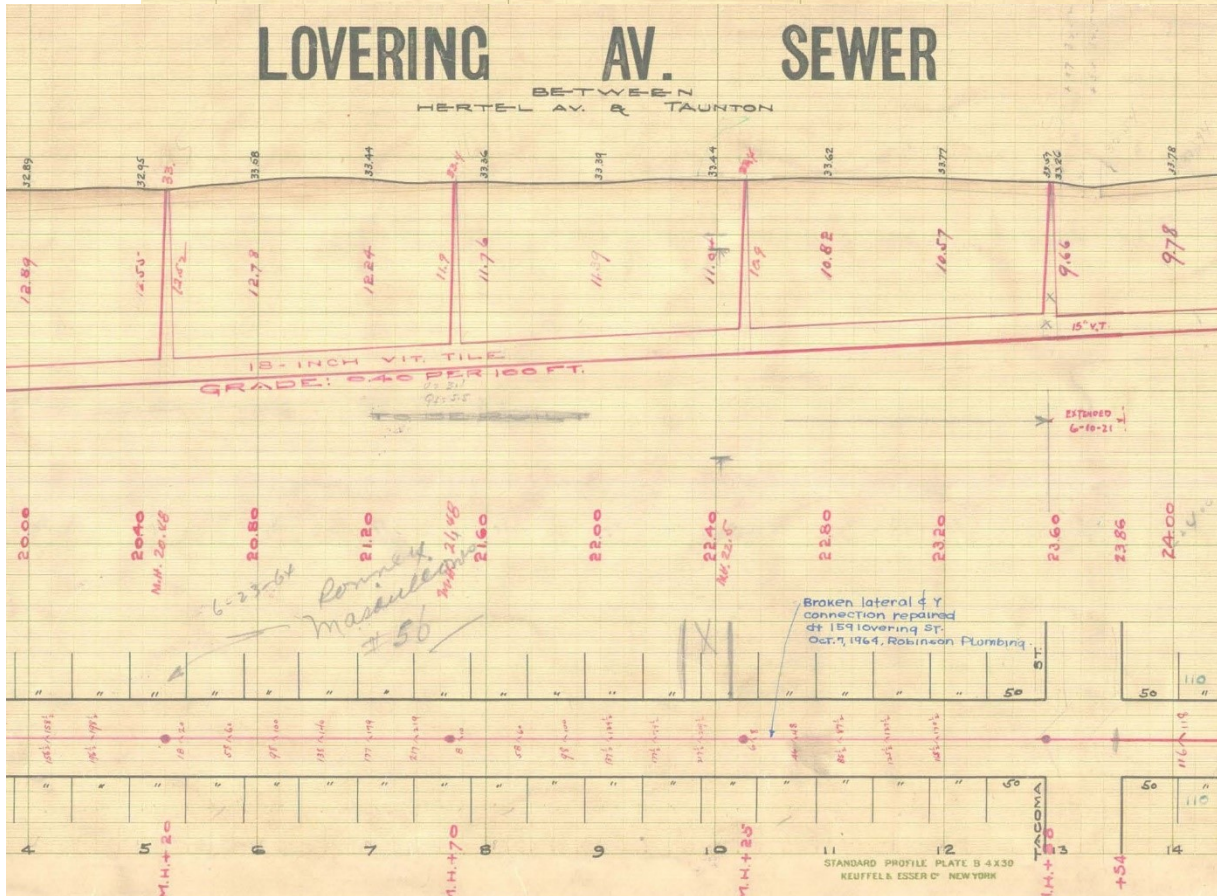
1867-1899: Industrial Revolution



QUANTITIES		BETWEEN STA 12+88 & 13+54 QUANTITIES		QUANTITIES BETWEEN STA. 13+54 & 24+05			
KIND	YIT TILE	KIND	YIT TILE	KIND	YIT TILE	TOTAL	
SIZE	18"	SIZE	15"	SIZE	15	12	
LENGTH	129.2'	LENGTH	66'	LENGTH	601	450	1051
HOUSE CONN. 6" y.s.	48	AVER. EARTH EXC.	9.81	HOUSE CONNS-6" y.s.	24	18	42
MANHOLES-PLAN I.	5	BUILT BY PRIVATE PARTIES.		MANHOLES-PLAN I	3	2	5
AVER. EARTH EXC.	12.60			AVER. EARTH EXC.	10.60	8.90	

OAKUM, SAND & CEMENT.
INSPECTOR \$3.80 PER DAY OF 8 HOURS
COMPLETED IN 20 WORKING DAYS.

1900-1929: N. Buffalo & Burying of Waters



OAKUM, SAND, CEMENT
TILE TO BE EMBEDDED IN
1:12 CONC. ON BOTH SIDES
OF EXCAVATED TRENCH
& UP TO SPRINGING LINE.
INSPECTOR \$5.50 PER DAY OF 8 HR
WORK TO BE COMPLETED IN
WORKING DAYS

DEPARTMENT OF PUBLIC WORKS,
BUFFALO, N. Y.

BUREAU OF ENGINEERING

CITY ENGINEER: _____
DATE: _____ 1911

APPROVED _____
OF PUBLIC WORKS

DATE: _____ 1911

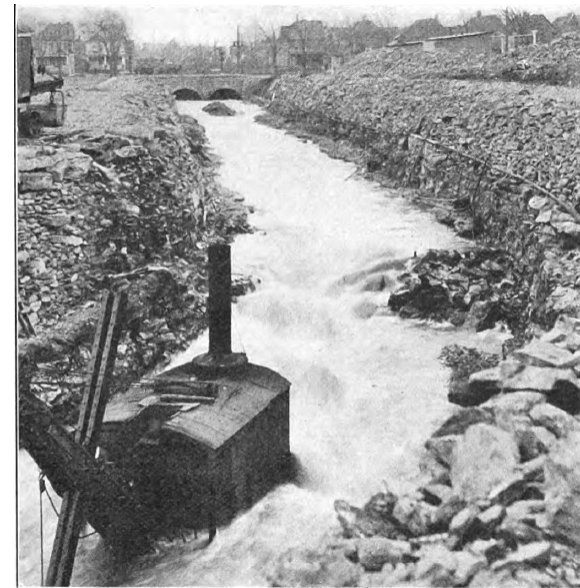
WORK COMMENCED: JUNE 28, 1922
COMPLETED: JULY 6, 1922
ENGINEER IN CHARGE: C. L. HOWELL
CONTRACTOR: DARK & CO
INSPECTOR: F. E. DEFOREST
STANDARD PROFILE KEUFFEL & ESSER CO.

Sewers installed in North Buffalo for intra-city suburban developments

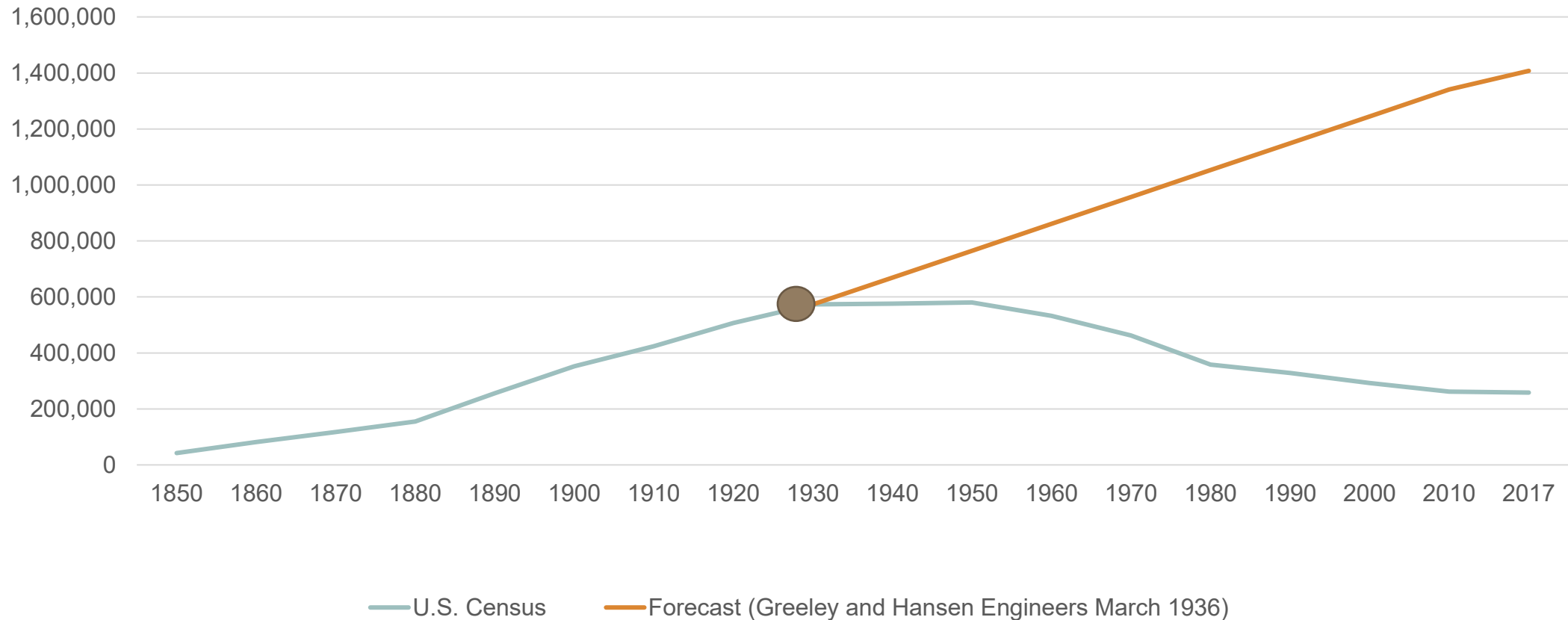
- Sandy soils
- Need to tie into former Cornelius Creek
- Into rock
- Laterals plunge suddenly into main

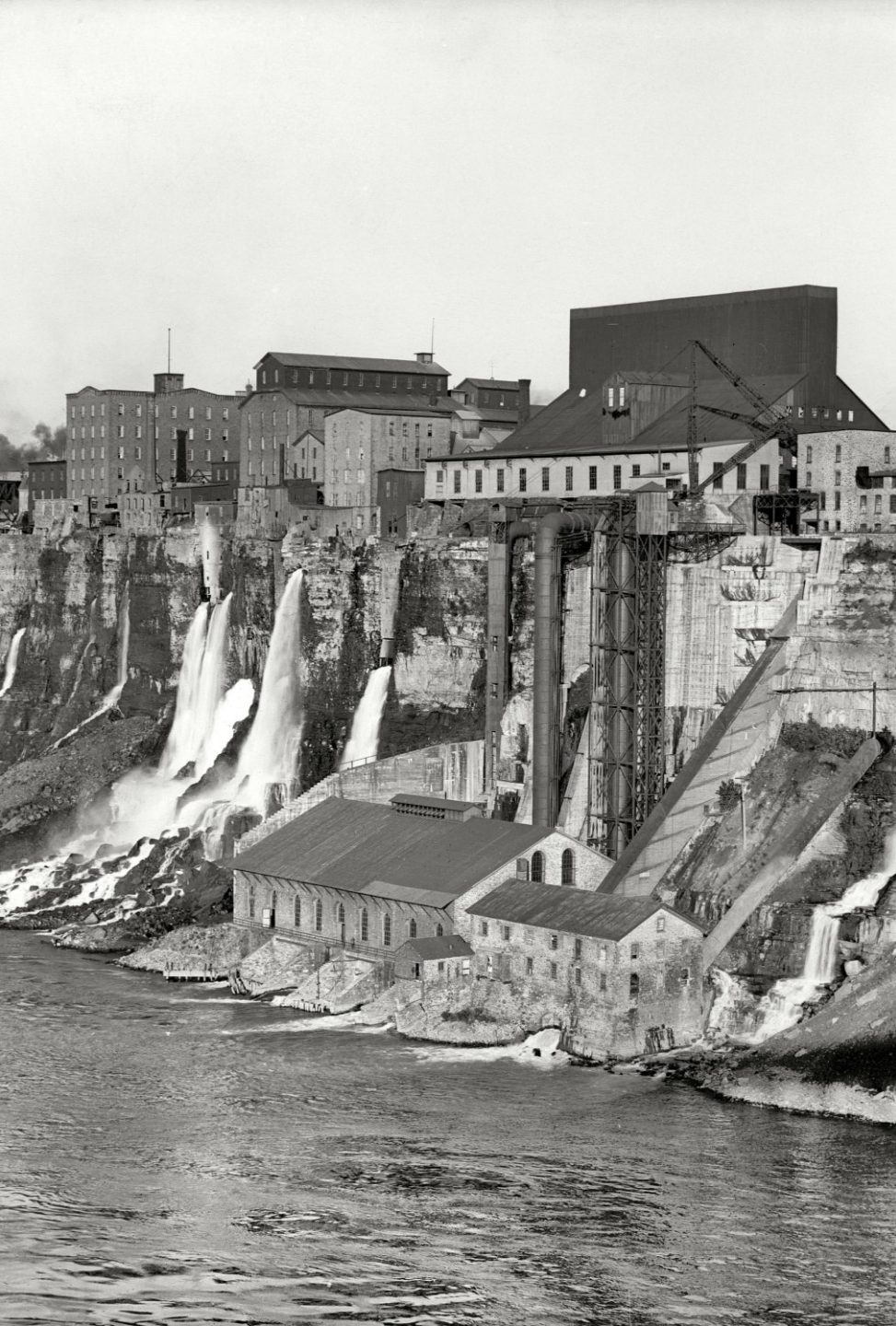
1900-1929: N. Buffalo & Burying of Waters

- Waterways → Sewers
 - Main Hamburg Canal to Hamburg Drain 1901-1903
 - Ohio Basin to Ohio Drain 1902-1904
 - Cornelius Creek to Hertel Avenue Overflow Drain 1914
 - Scajaquada Creek to Scajaquada Drain 1925



History: 1929-1941 Creation of the Buffalo Sewer Authority





1929-1941: The Buffalo Sewer Authority

- 1907 Canadian Public Health Report
 - Niagara Falls, NY typhoid death rate
 - 222.4 deaths/100,000 persons/ year
- Establishment of International Joint Commission
 - January 11, 1909
 - “...boundary waters ...shall not be polluted on either side to the injury of health or property on the other.”

BUFFALO EVENING NEWS: MONDAY, DECEMBER 5, 1927

5 Cents NEW BUFFALO PASTOR Keitzel Assails Buffalo
for 'Bathing in Own Filth'

BUFFALO EVENING NEWS: TUESDAY, SEPTEMBER 24, 1929

HERTEL SEWER TO BE
THRESHED OUT OCT. 7

Date for Hearing on Flood
Relief Set by City Coun-
cil.

To the Finance committee were re-
sented the following:

kins protesting the contemplated pur-
chase of Squaw Island as a site for a

Notified appointments
kolacziak, junior phys

50,000,000 Gallons of Waste
Dumped Daily in Buffalo River

Report to Council by Fisk Stirs Perkins to Demand
Check on Plants.

League Hits Dumping of Sewage

1929-1941: The Buffalo Sewer Authority

1918 Report

- “In the Detroit and Niagara Rivers conditions exist which imperil the health and welfare of the citizens of both countries in direct contravention of the treaty.”
- 80% of pollution of Niagara River originates in Buffalo
- “the sewage of Buffalo is polluting to a serious extent the available water supplies of the two Tonawandas and the city of Niagara Falls, NY”

1929-1941: The Buffalo Sewer Authority

- *Comprehensive Plan of Sewerage for Buffalo, NY*
 - George B. Gascogne, Consulting Engineer
 - May 1930
- 10-12 year plan
- Sewage treatment through construction of 2 WWTFs
 - South-East by Tiff-T-Hopkins WWTF
 - North by Unity Island WWTF
- Construction of sewers
 - Interceptors
 - Swan Trunk extension
 - Storm relief sewers
- \$23,000,000.00 (\$362 M in 2021 dollars)



1929-1941: The Buffalo Sewer Authority

- NYS Dept. of Health mandate
 - March 1935
 - Primary Sewage Treatment Plant
 - Interceptor sewers
- Establishment of BSA
 - April 8, 1935
 - \$15 million bonding capacity (\$287 M in 2021 dollars)
 - After 5 years or after all bonds are paid off, system will revert to city and Buffalo Sewer will dissolve
 - Structures of any public service corporation must be removed at expense of corporation for Buffalo Sewer to construct project





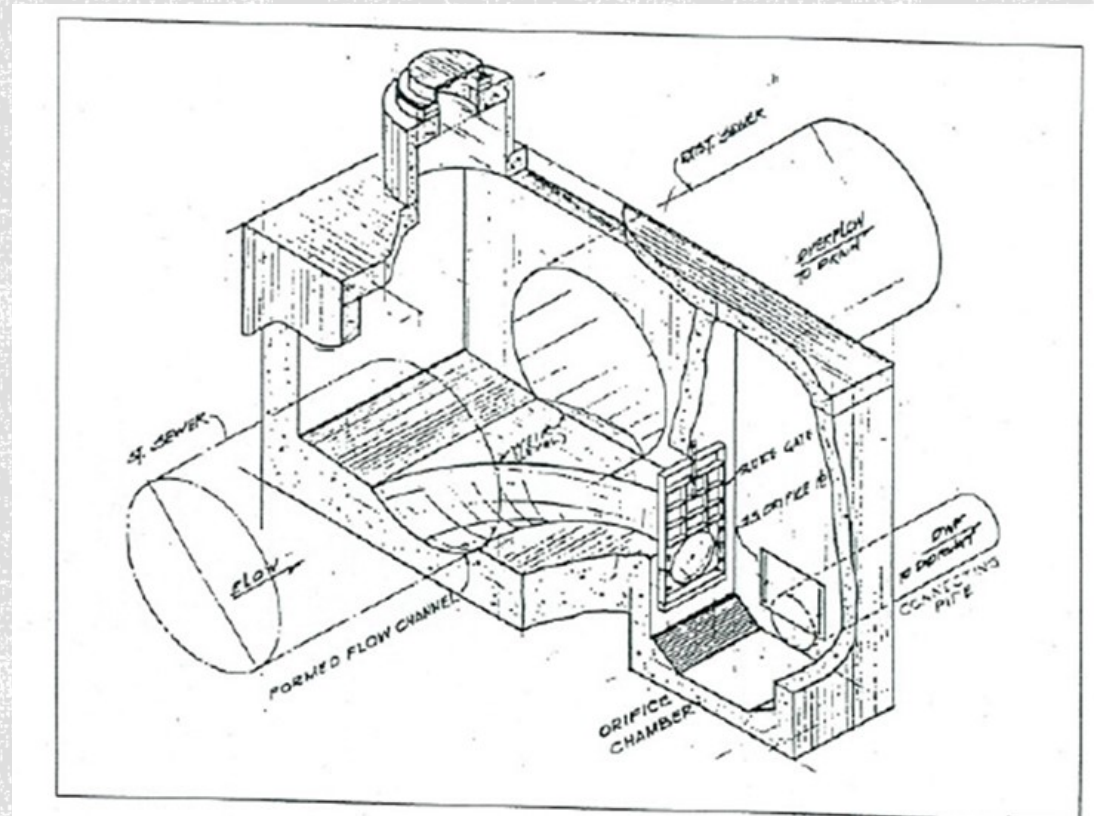
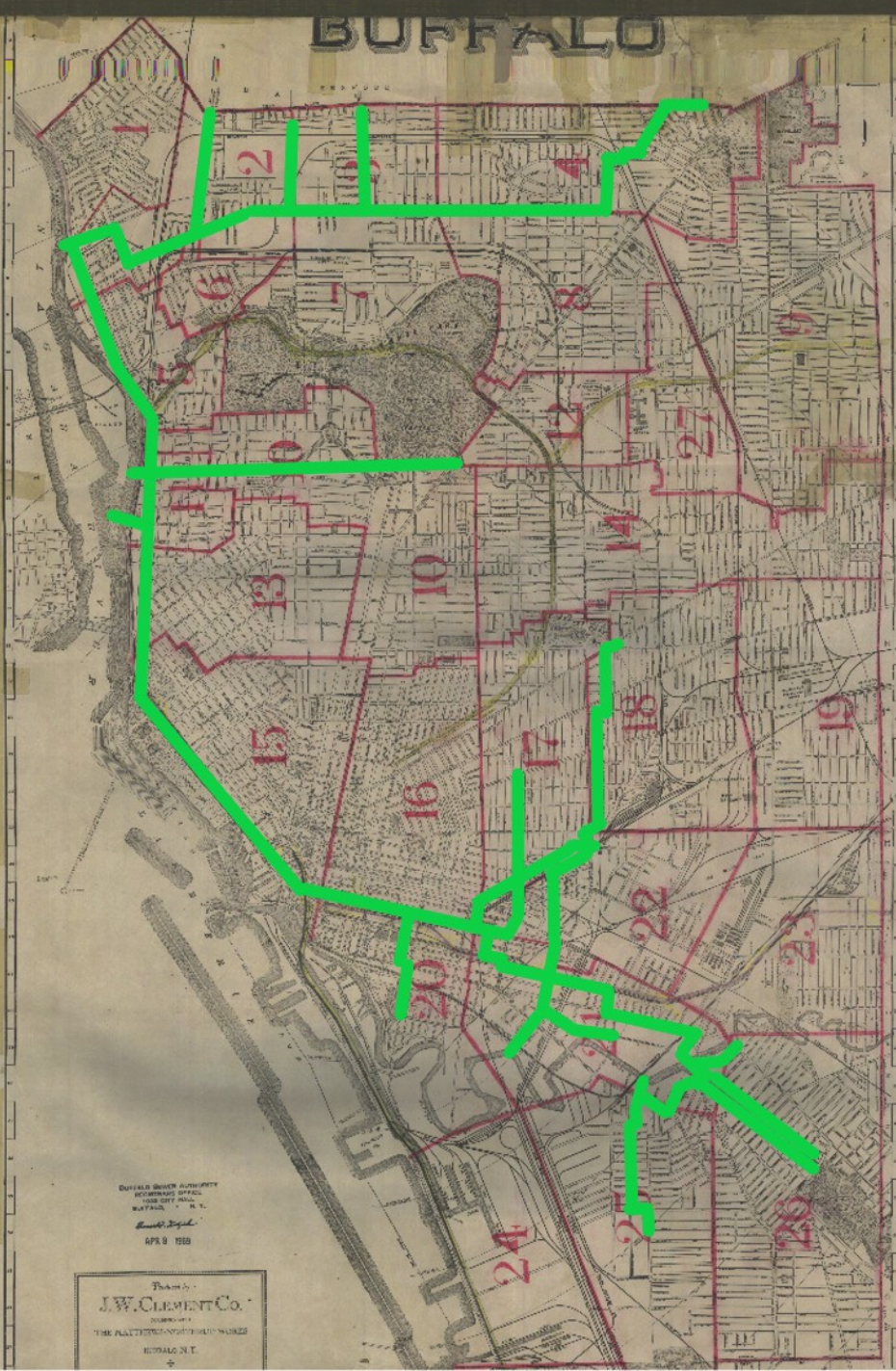
1929-1941: The Buffalo Sewer Authority

- *Buffalo Sewer Authority General Plan for Collecting and Treating the Sewage of Buffalo*
- Greeley and Hansen Engineers
 - Redid Gascogne's calculations
 - March 1936
- Treatment and conveyance for treatment
 - Single WWTF on Bird Island
 - CSO diversion structures
 - Interceptors
- \$15 million cost

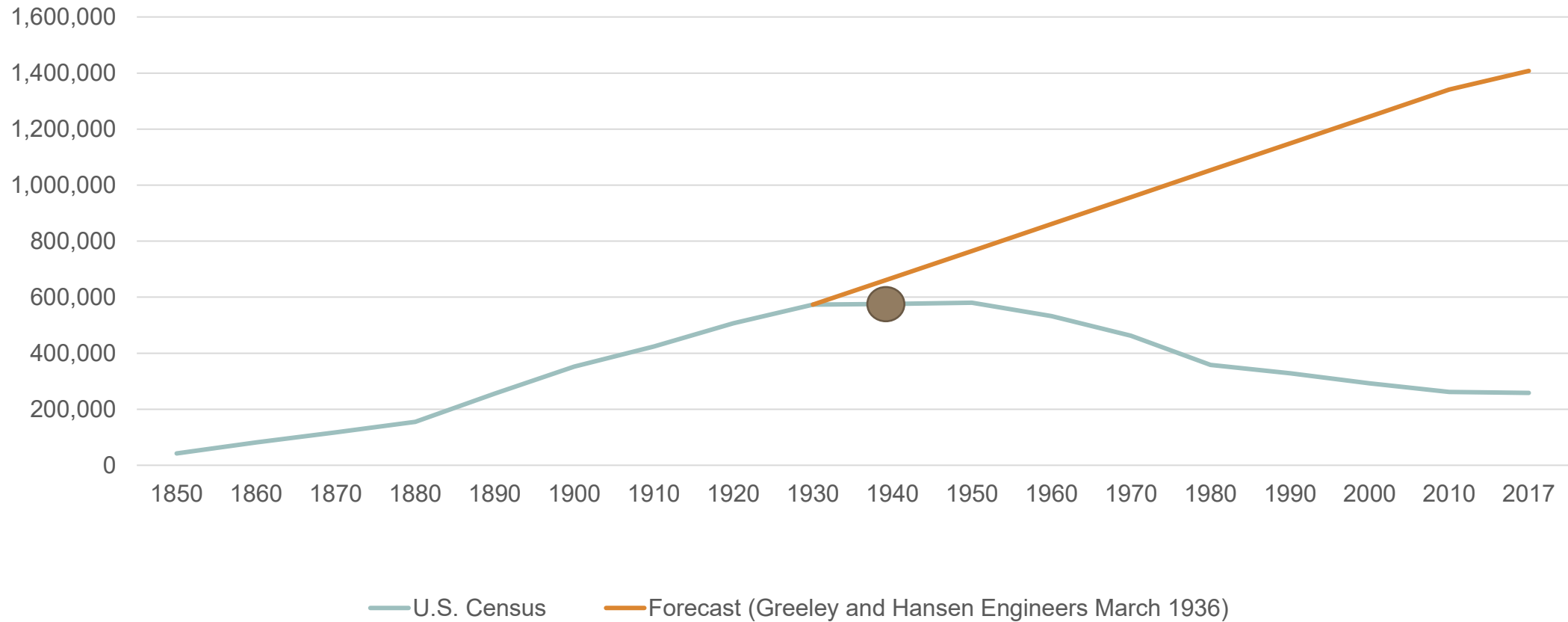


1929-1941: The Buffalo Sewer Authority

1929-1941: The Buffalo Sewer Authority



1941-1970 : Storm Relief and Sprawl





1941-1970: Storm Relief and Sprawl

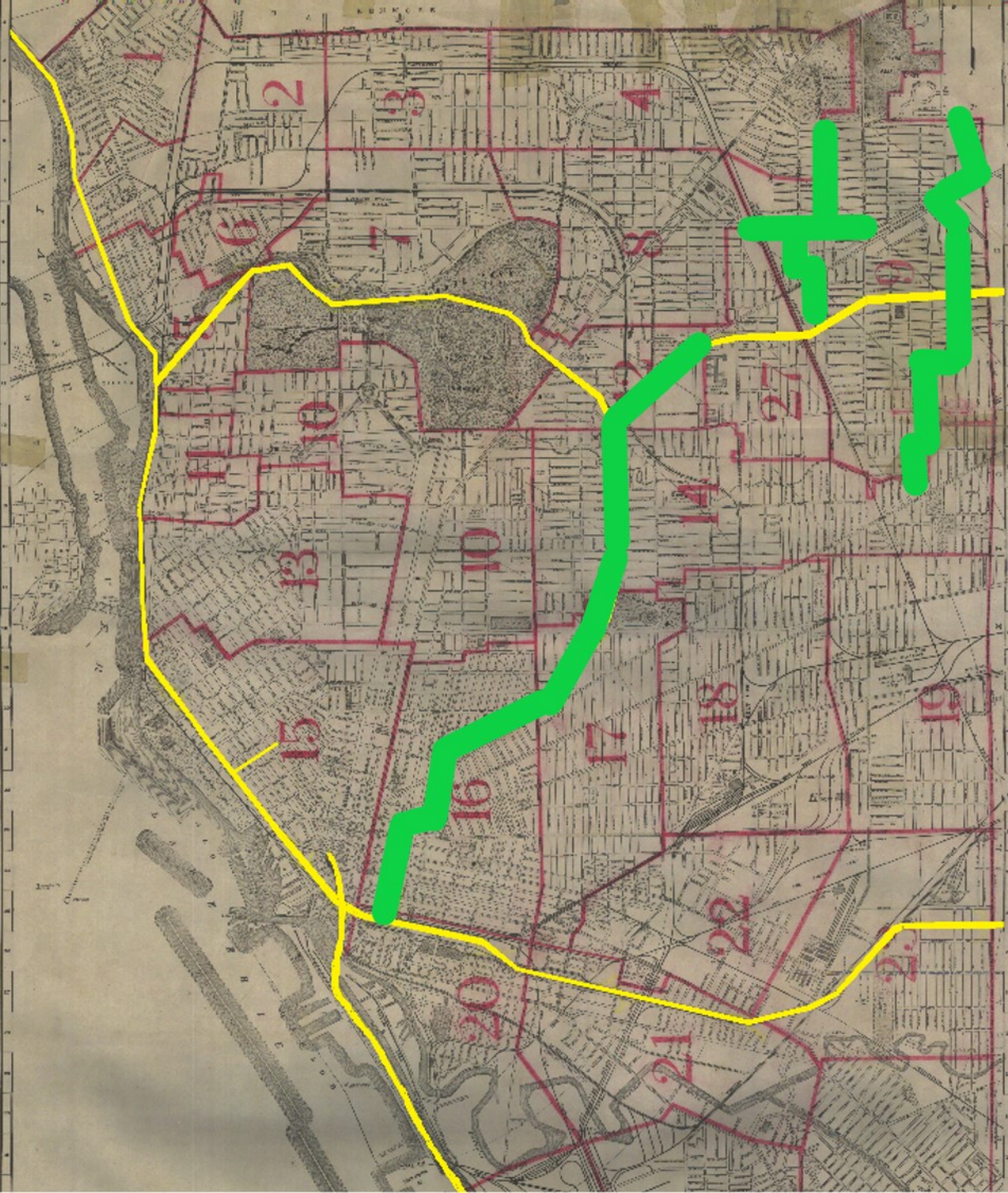
- *Comprehensive Plan for Relief Sewers*
 - February 1941
 - Greeley and Hansen
 - WWTF online as of 1938
- Attack on Pearl Harbor December 7, 1941
- Post-1945 suburban development
- Floods of 1963
 - July 29: 3.8": \$1.5 M (\$12.7 M in 2021 dollars) in damage
 - August 7: 3.88" in 5 hours: \$35 M (\$295.9 M in 2021 dollars) in damage



1941-1970: Storm Relief and Sprawl

- NYS Route 33
 - Severed Bird-Ferry Trunk
 - Stormwater added to system
 - New pump station for stormwater and groundwater
 - New trunk sewers constructed
- I-198
 - New storm sewers
 - Direct discharge to Scajaquada Creek
- I-190
 - Old Erie Canal bed
 - On top of
 - Swan Trunk
 - Interceptors
 - Hamburg Drain

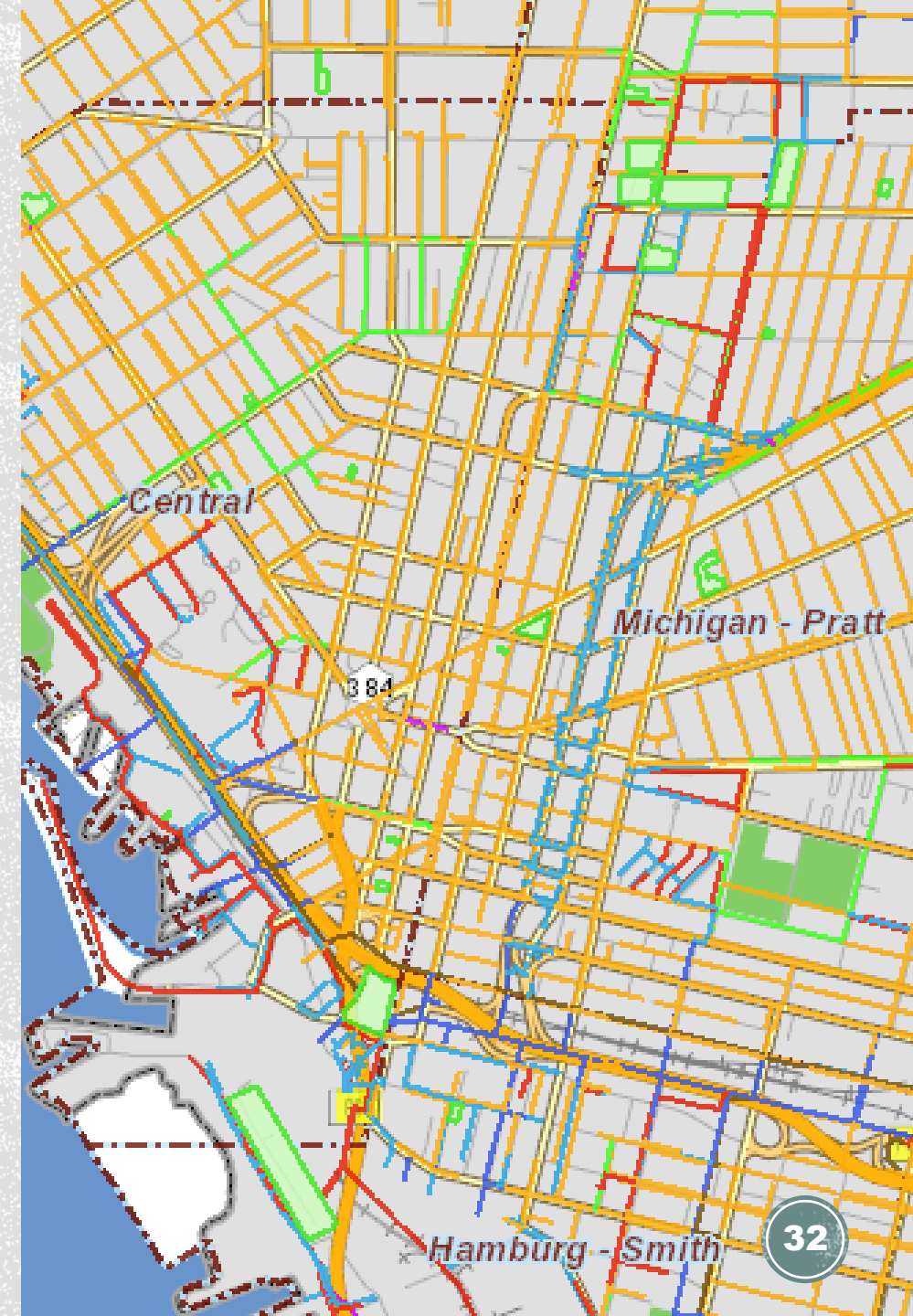




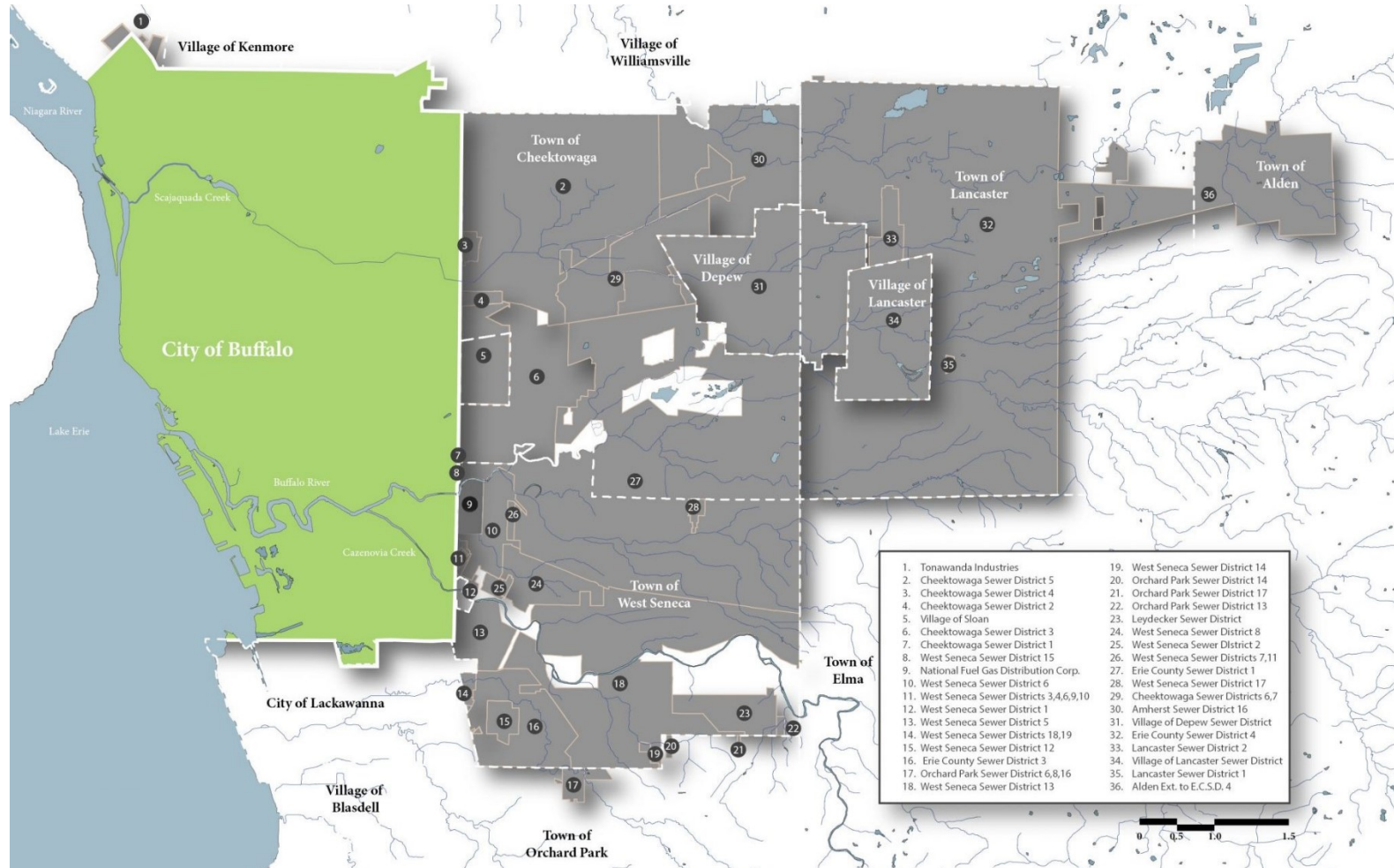
1941-1970: Storm Relief and Sprawl

1941-1970: Storm Relief and Sprawl

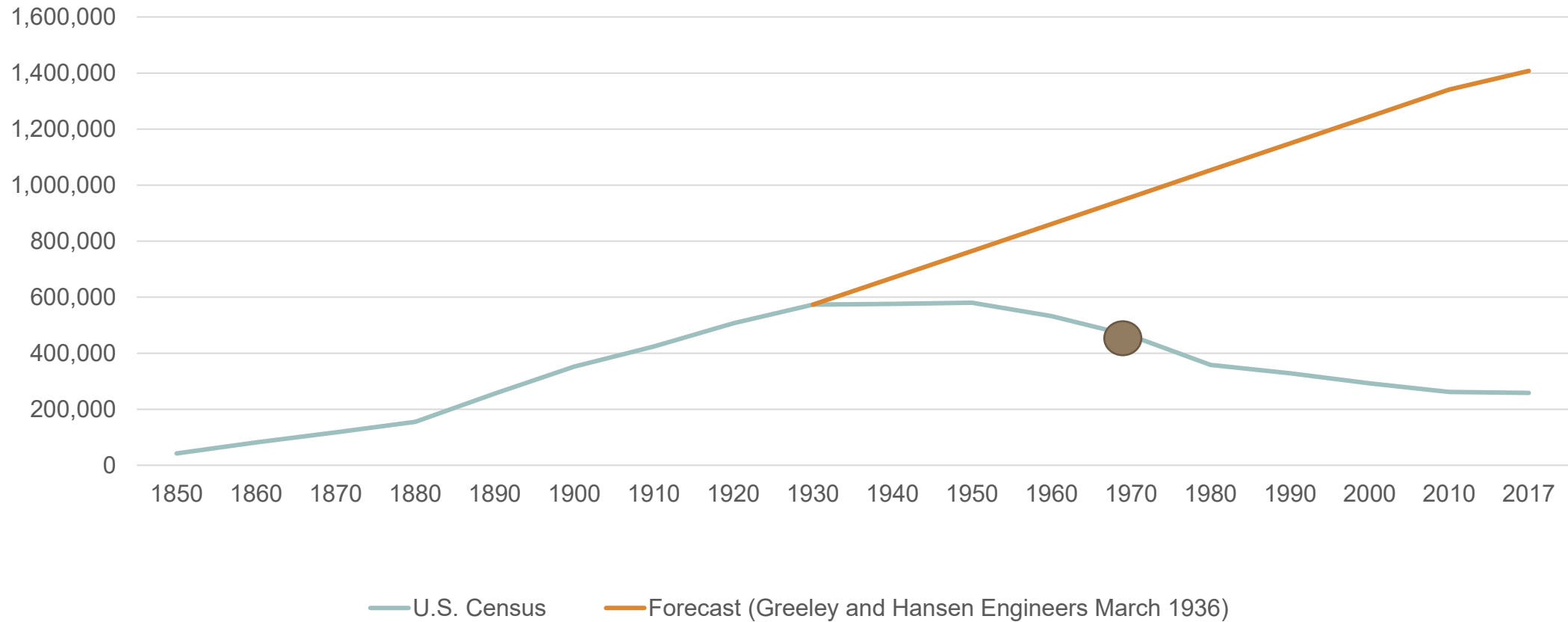
- Urban Renewal 1960-1970
- Demolition of tenement areas
 - Urban core
 - Oldest parts (and oldest sewers) of city
- New municipal housing projects
 - New separated sewers
 - Concrete storm sewers
 - Asbestos concrete pipe sanitary sewers
 - Intermunicipal Connections



1941-1970: Storm Relief and Sprawl



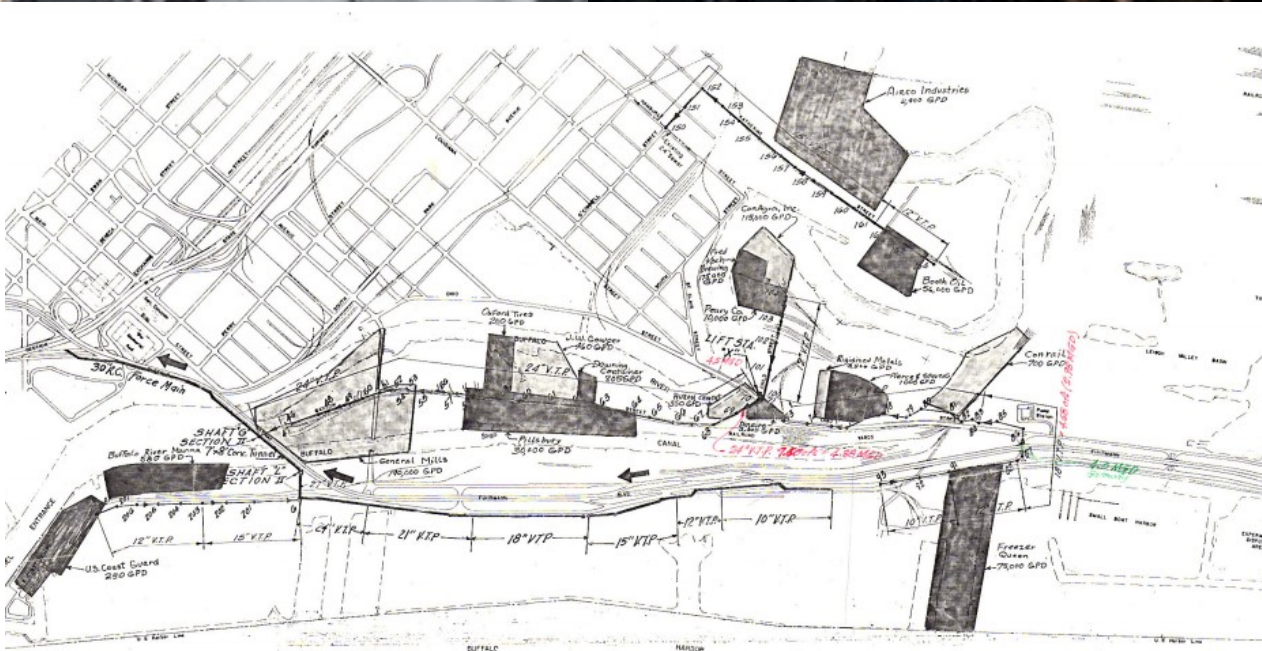
1970-1982: Clean Water Act

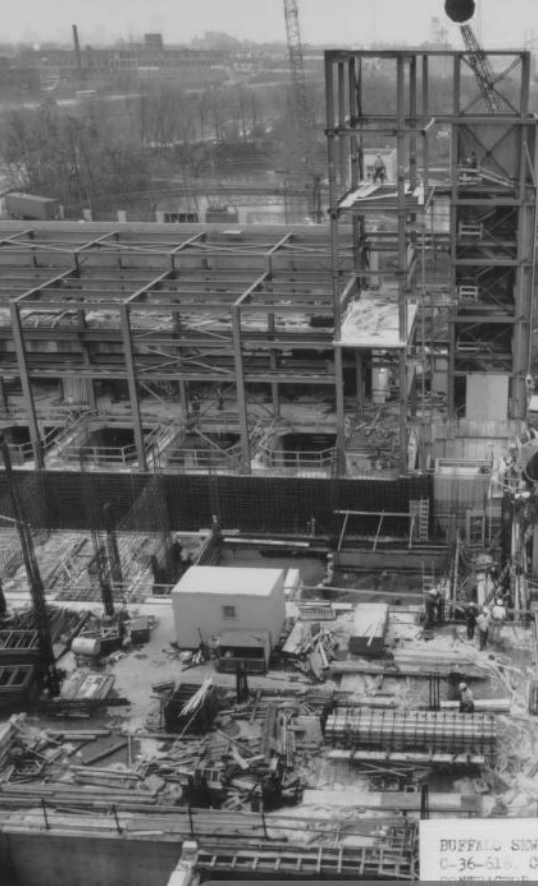




1970- 1982: Clean Water Act

- Kelly Island
 - “Outer Harbor”
 - Heavily industrialized
 - Never sewerred
 - Direct discharge to waterways
 - Failing septic systems
- August 1966 Visit from LBJ
- Buffalo River Fire: 1968
- 1976 Project



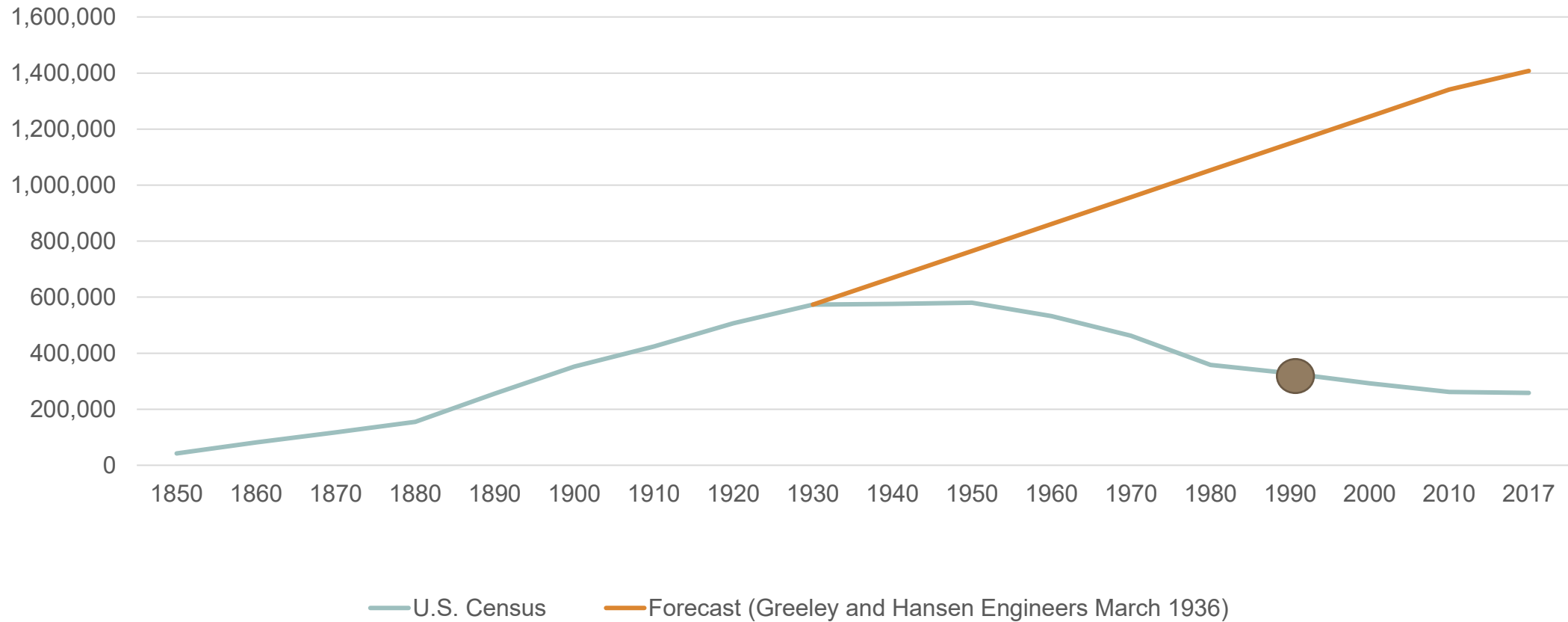


1970-1982: Clean Water Act

- Scajaquada Tunnel 1977
- Weir Modifications 1980-1982
 - Diversion from Scajaquada Drain to Tunnel
 - Raising of weirs
- Backwater Gates
- Secondary Treatment Process
 - Completed 1980
 - Constructed on municipal landfill in Niagara River on piles



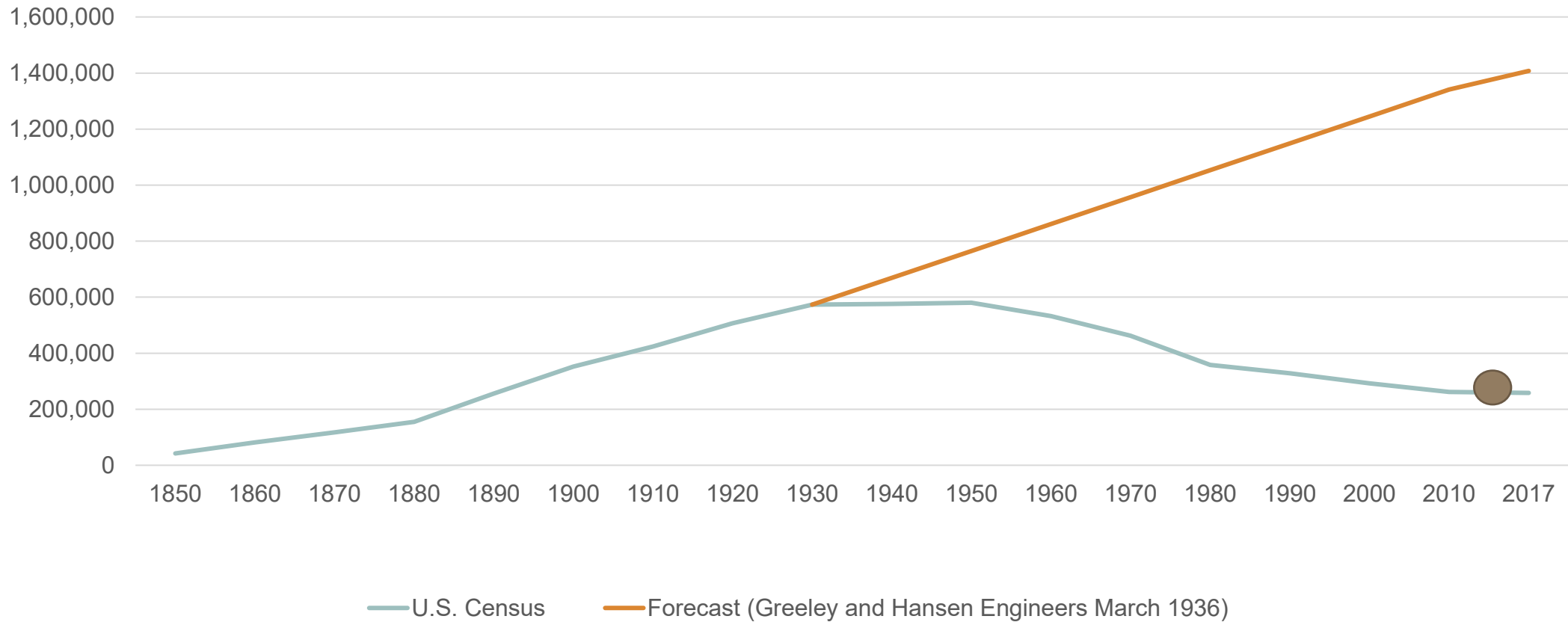
1983-2010: CSO Abatement Phase I



1983-2010: Combined Sewer Overflow (CSO) Abatement Phase I

- Sewer Separation
- Weir modifications
- Emphasis on eliminating number of CSO locations

CSO Abatement Phase II LTCP 2010-Today



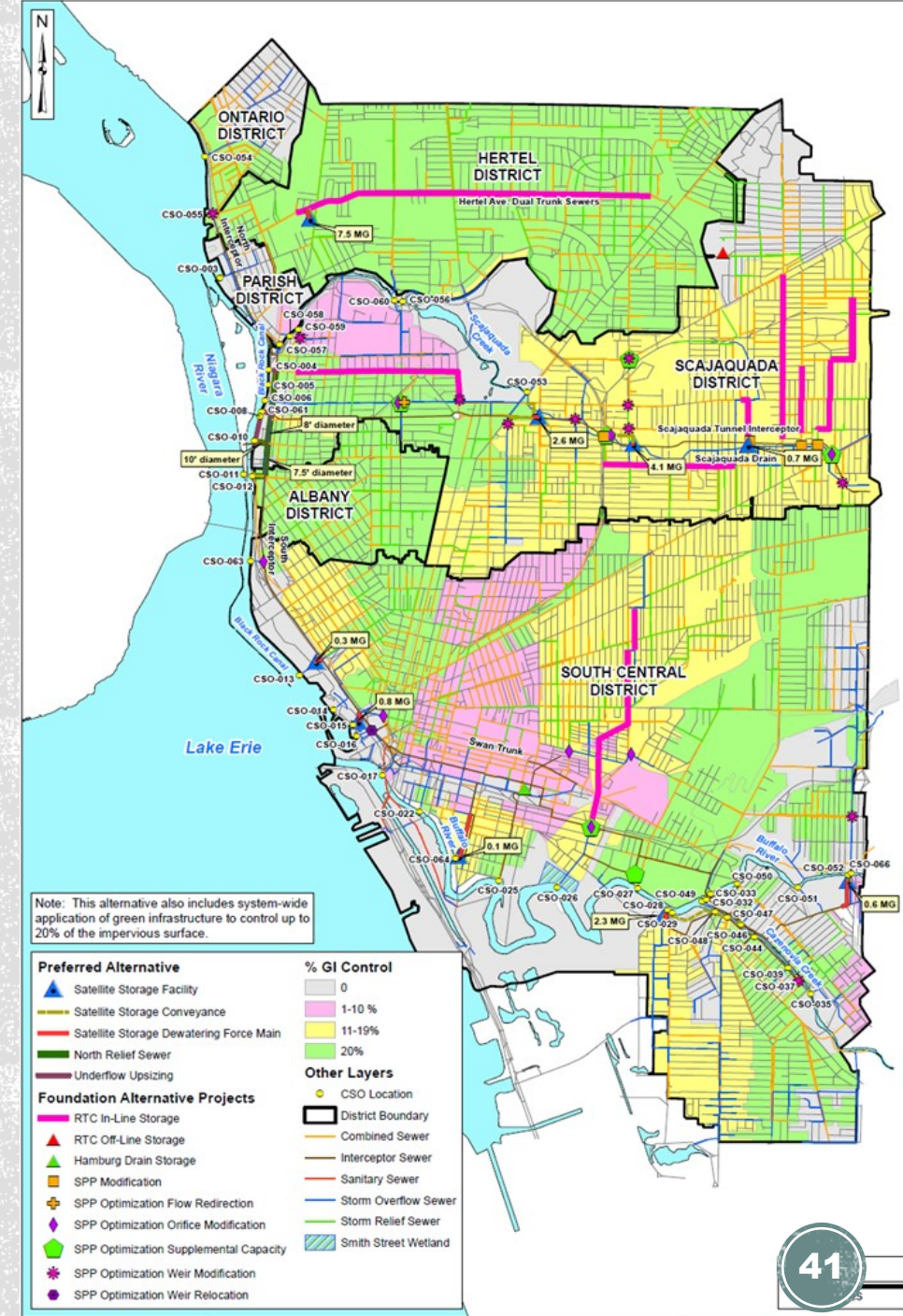


2010-Today: CSO Abatement Phase II

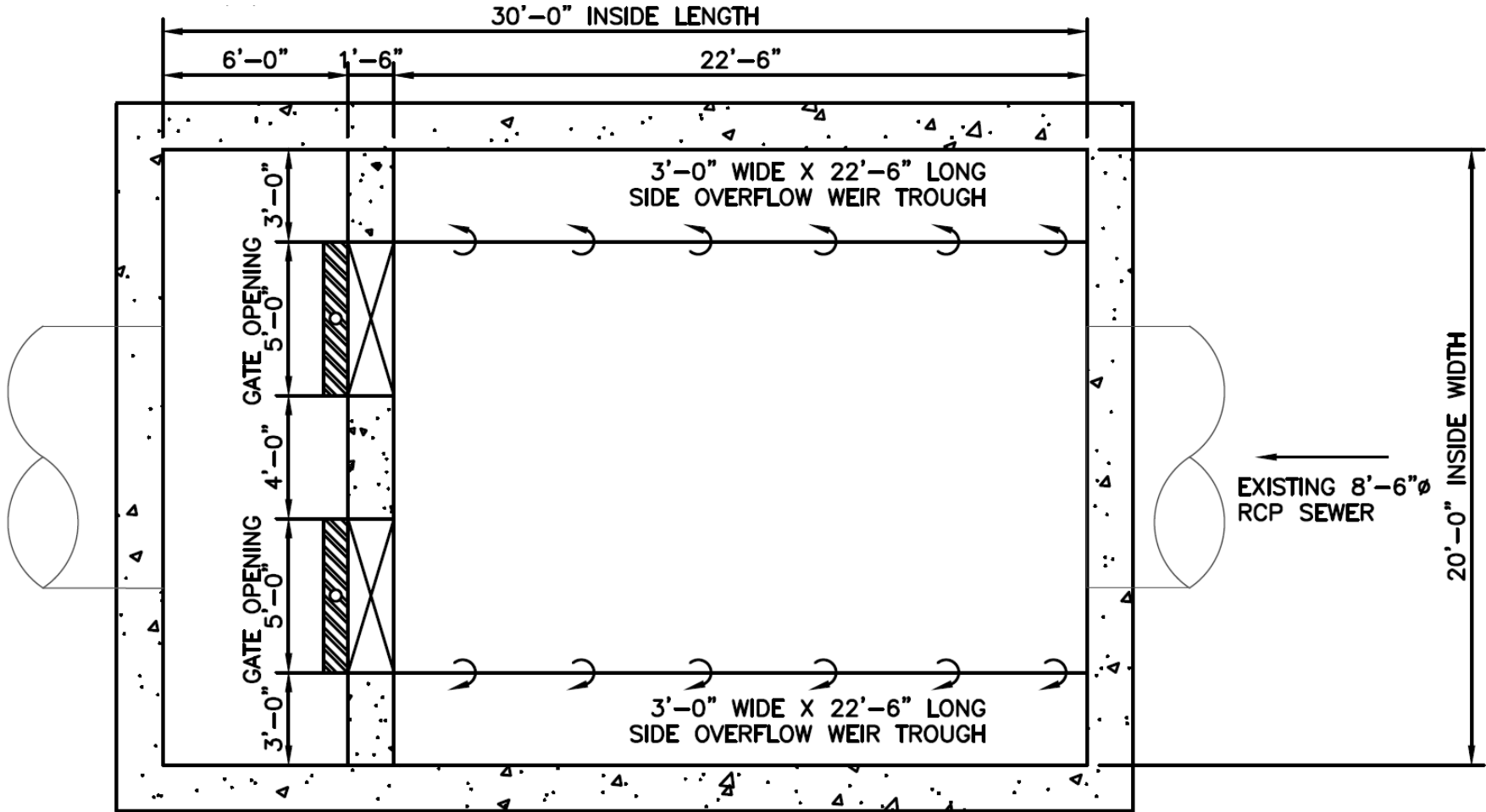
- Final Long-Term Control Plan (LTCP) approved March 18, 2014
- Decrease CSO activations
- \$380 Million (2012 Dollars)
- Mix of gray
 - Wastewater Treatment Facility upgrades
 - Real Time Control “Smart Sewers”
 - Localized Sewer Separation
 - Underground detention tanks
- And green
 - Bioretention
 - Permeable pavement
 - Demolitions

2010-Today: Real Time Control (RTC) Smart Sewer Concept Viability

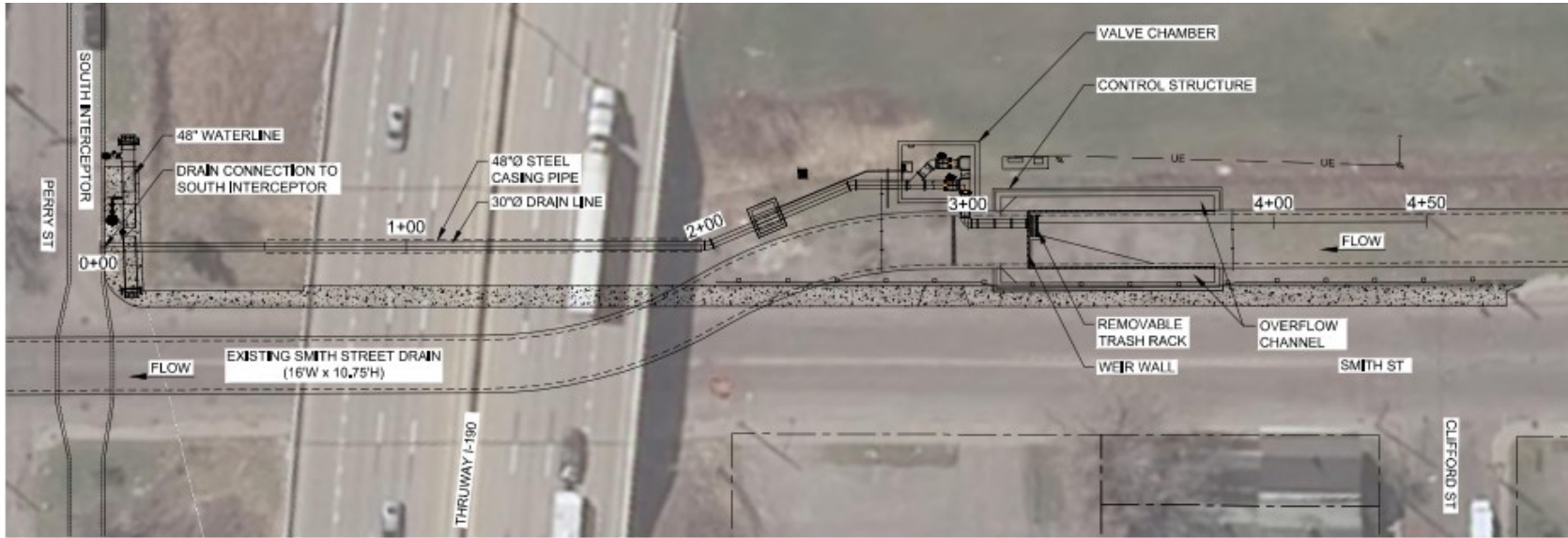
- Vacancy on East Side
 - Vacant lots absorbing water that would have gone into combined system
 - Sanitary and industrial discharges reduced
- Kensington Expressway cutting off half of the flows
- Hertel sewers are deep to capture Cornelius Creek
- Overflows to Historic Canals/Creeks



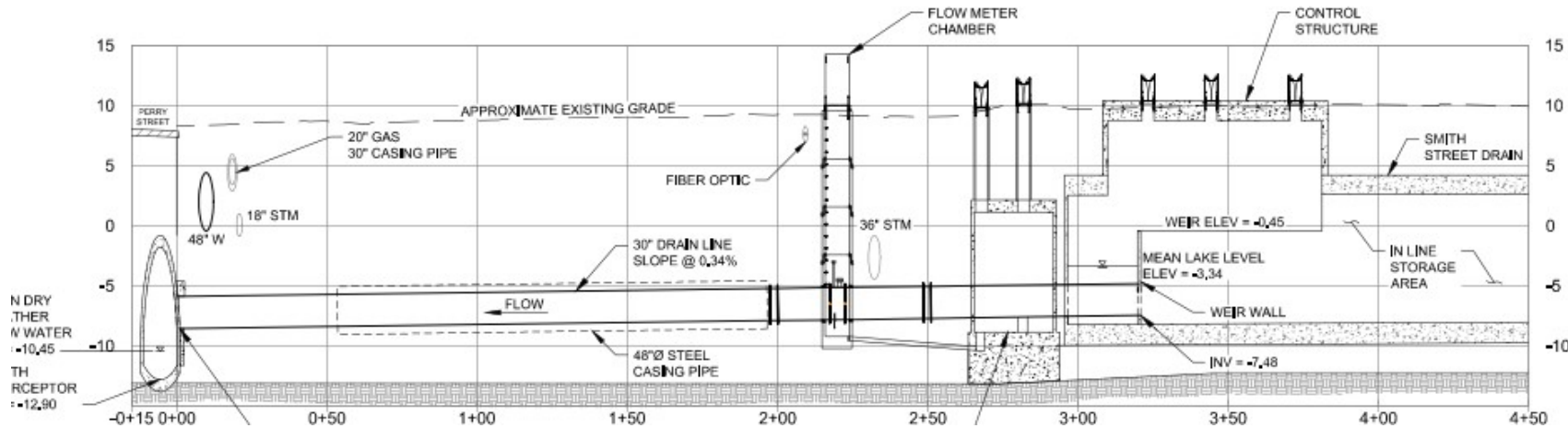
2010-Today: Real Time Control (RTC) Smart Sewer Inline Storage Concept



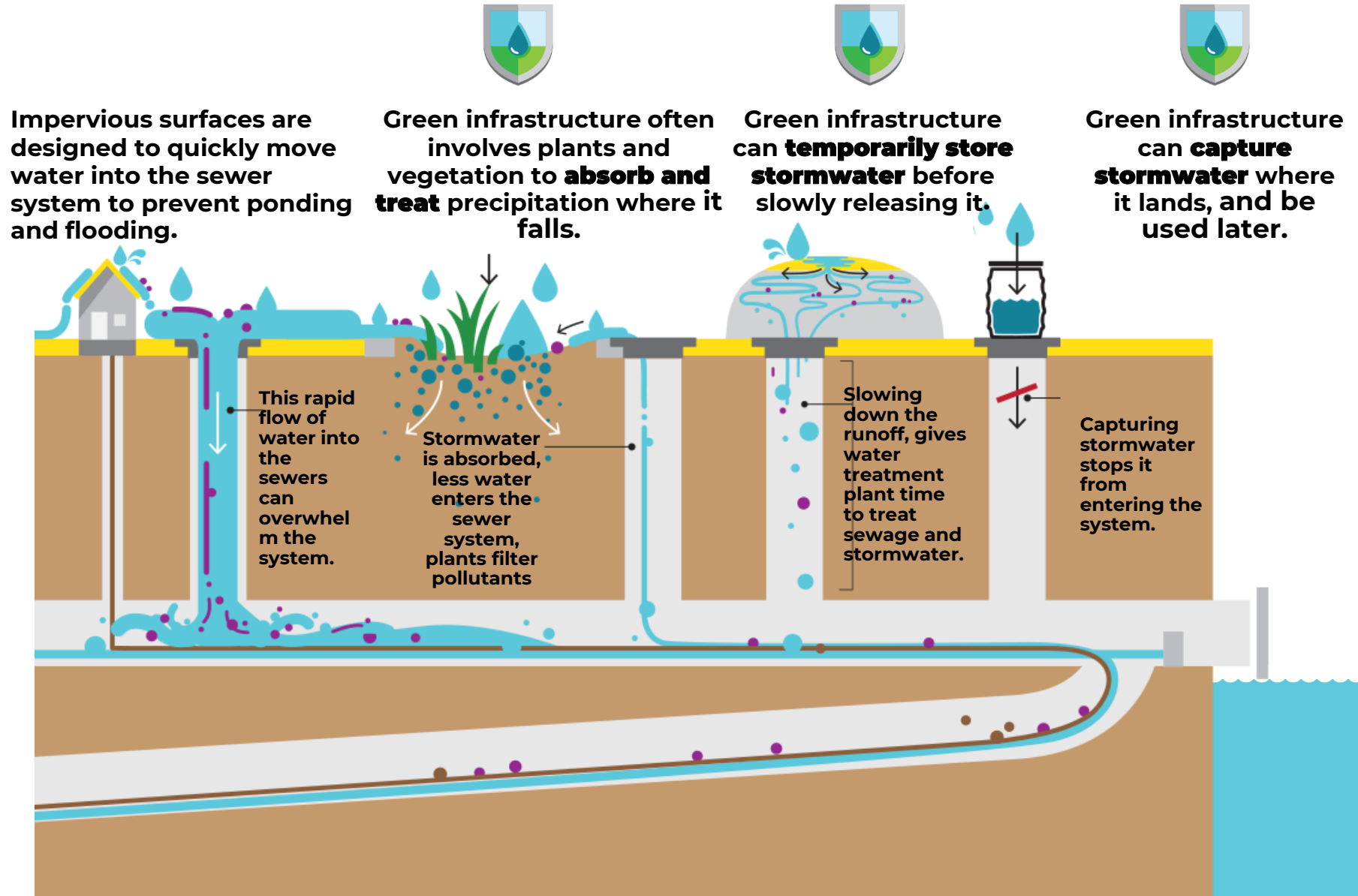
Long Term Control Plan: CSO 026 Smith Street RTC



PLAN
SCALE: 1" = 40'



How green infrastructure helps us meet the stormwater challenge



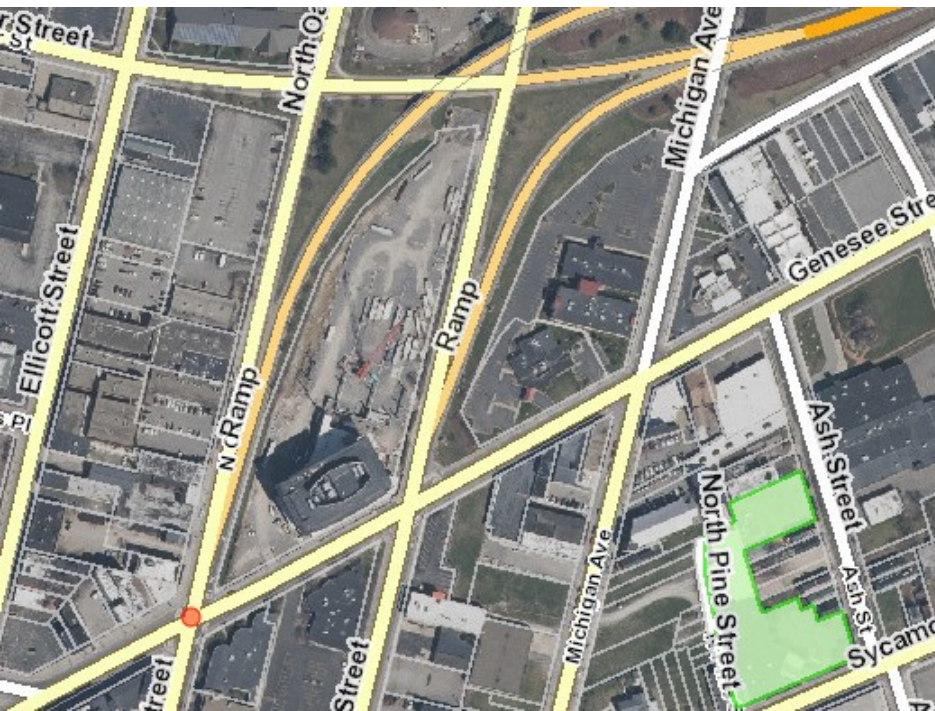


Long Term Control Plan Projects: Bioretention and VTP



Pre-Civil War Sewers

- Pratt Street
- Oak Street
- Poor Records
 - Cross-Referencing No Dates and Historic Waterways
 - Downtown
 - Hydraulics/Larkinville
 - Black Rock





Lost Waterways



Lost Waterways

Modern Location

River is ~450 feet away



1870 Map

Buffalo Creek runs under location



Climate Change Downscale Forecast

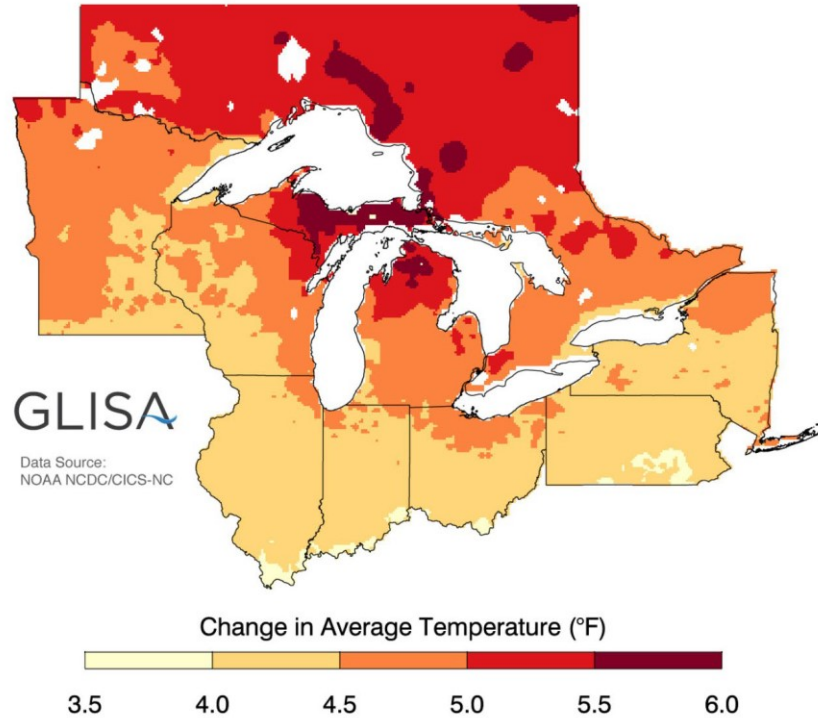
Variable of Interest	Sub-Variables of Interest	Historical/Current	Mid-Century Projected Changes	% Change Between Historic and Future; Mid Century % / End Century %
Precipitation	Total Annual Precip	40.5 in.	40 to 45 in.	-1 to 11% / 4 to 19%
Precipitation	Winter Avg Precip	9.6 in.	10 to 12 in.	4 to 25% / 4 to 25%
Precipitation	Spring Avg Precip	9.3 in.	7 to 11 in.	-25 to 18% / -14 to 29%
Precipitation	Summer Avg Precip	10.1 in.	8 to 10 in.	-21 to -1% / -21 to -1%
Precipitation	Fall Avg Precip	11.4 in.	11 to 12 in.	-4 to 5% / 5 to 14%
Precipitation	Heavy Precipitation Days(>1.25")	2.9 days (> 1.25")	2.6 to 5.3 days	-10 to 83% / 62 to 124%

Climate Change Downscale Forecast

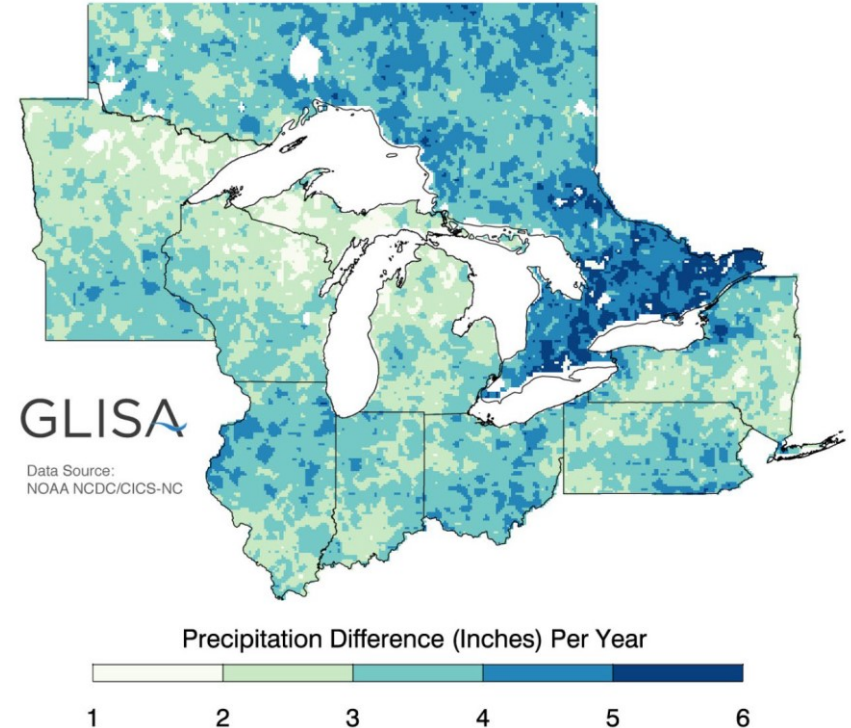
Variable of Interest	Sub-Variables of Interest	Historical/Current	Mid-Century Projected Changes	% Change Between Historic and Future; Mid Century % / End Century %
Temperature	Avg Annual Temp	48.6°F	52 to 54°F	7 to 11% / 13 to 21%
Temperature	Winter Avg Temp	27.4°F	29 to 31°F	6 to 13% / 17 to 31%
Temperature	Spring Avg Temp	45.9°F	48 to 51°F	5 to 11% / 11 to 24%
Temperature	Summer Avg Temp	69.2°F	73 to 75°F	5 to 8% / 11 to 17%
Temperature	Fall Avg Temp	51.5°F	54 to 58°F	5 to 13% / 11 to 22%
Temperature	Avg Low Temp	40.5°F	45 to 46°F	11 to 14% / 19 to 28%
Temperature	Avg High Temp	56.7°F	60 to 62°F	6 to 9% / 8 to 18%
Temperature	Days/Year Greater Than 90F	2 days	9 to 26 days	350 to 1200% / 1050 to 2600%
Temperature	Days/Year Greater Than 95F	0.3 days	1 to 9 days	233% to 2900% / Not Available
Temperature	Days/Year Less Than 32F	117 days	91 to 95 days	-22% to -19% / Not Available

Downscale Model Great Lakes as a Whole

Projected Change in Average Temperature
Period: 2041-2070 | Higher Emissions: A2



Projected Change in Average Precipitation
Period: 2041-2070 | Higher Emissions: A2



SEICHE EVENTS

Historic Crests

(Station Established 4/1/1860)

1. 12.08 ft 12/2/1985
2. 11.12 ft 11/15/2020
3. 11.06 ft 1/30/2008
4. 10.67 ft 12/23/2022
5. 10.65 ft 11/1/2019
6. 10.65 ft 4/6/1979
7. 10.57 ft 12/11/2021
8. 10.36 ft 12/20/2020



Niagara River Flow

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1926 - 2022, BY WATER YEAR (WY)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean	202,200	202,900	203,800	199,000	195,600	202,000	210,400	218,600	217,700	214,600	210,500	205,400
Max	254,000	254,400	260,900	265,900	241,600	270,500	279,600	277,300	285,000	276,500	270,200	257,299
(WY)	(1987)	(2020)	(1986)	(2020)	(1987)	(2020)	(2020)	(2019)	(2019)	(2019)	(2019)	(2019)
Min	152,700	148,100	149,800	138,500	116,200	142,700	152,000	159,100	158,000	154,100	155,000	153,900
(WY)	(1935)	(1935)	(1965)	(1964)	(1936)	(1934)	(1935)	(1934)	(1934)	(1934)	(1934)	(1934)

Water-Data Report 2022

04216000 NIAGARA RIVER AT BUFFALO, NY -- Continued

Climate Change

- Climate Refuge???
- Average Rainfall
 - Increasing Slightly to Moderately
 - Possibly Falling in the Near Term?
- Average Temperature
 - Increasing Slightly to Moderately
 - May Have 100 + degree days by Century's End
- Winds: Poorly Modeled, But Likely Increasing Significantly

Up-Lake Communities

Average Rainfall Increasing

2016- Current Historically High Lake Levels

- **Buffalo and Niagara Rivers**
- **Basement Back-ups**
- **Syphon Risks**
- **Smart Sewer Viability**

What Are We Doing?

Back Water Valves and Gates

Working with Army Corps of Engineers to Rebuild Walls

Revised Long-Term Control Plan

New Development Green Code Ordinance

Working with Multiple Partners to Develop Downscale Model with Wind

Using CREAT to Identify Climate Change Mitigation Opportunities

Advancing Projects with Synergistic Opportunities

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Questions?

