



# Urban sediment transport from hydrodynamic separators cleaning data

## in Worcester, MA

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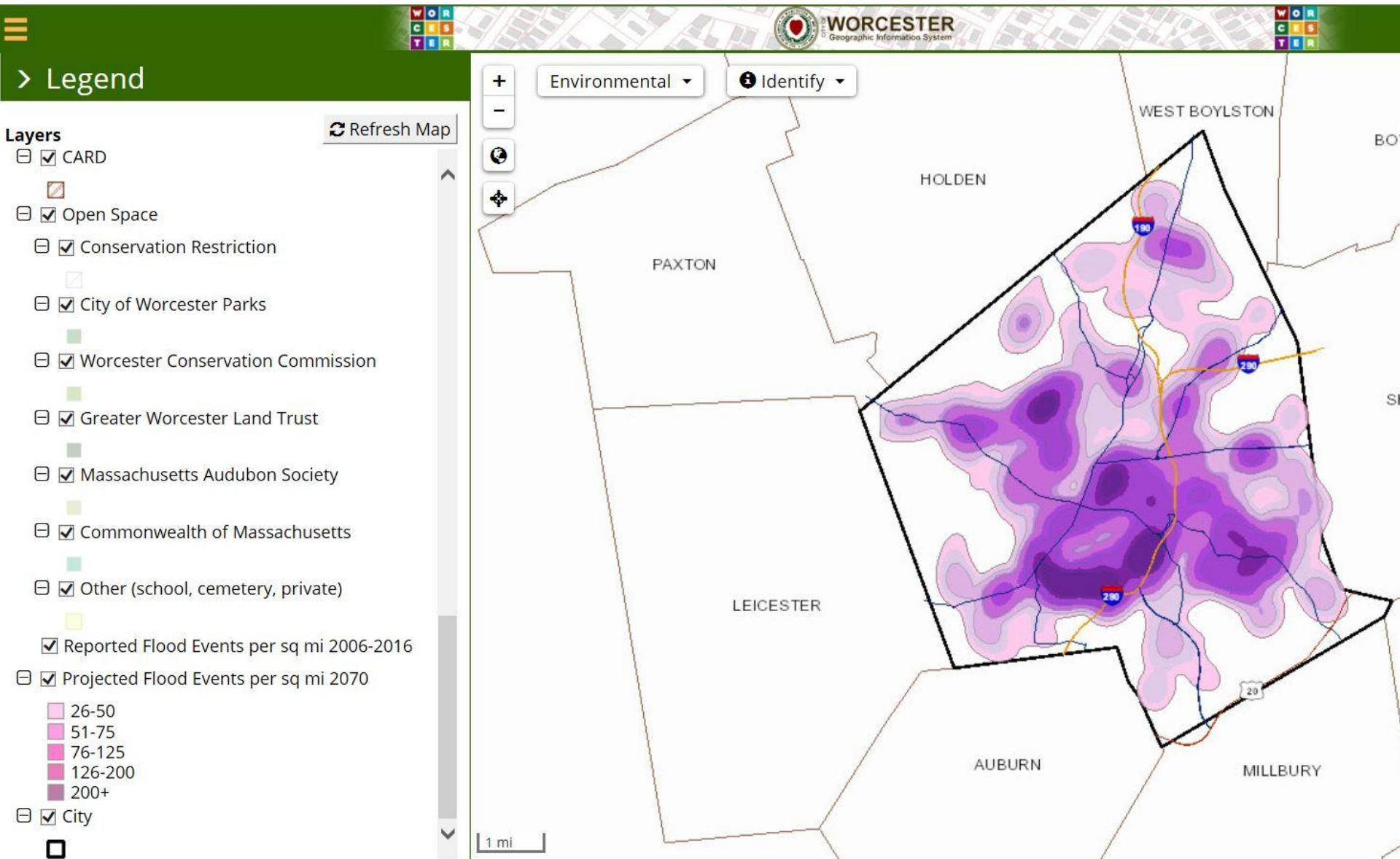
# Motivations

- Flash flooding and erosion in Worcester



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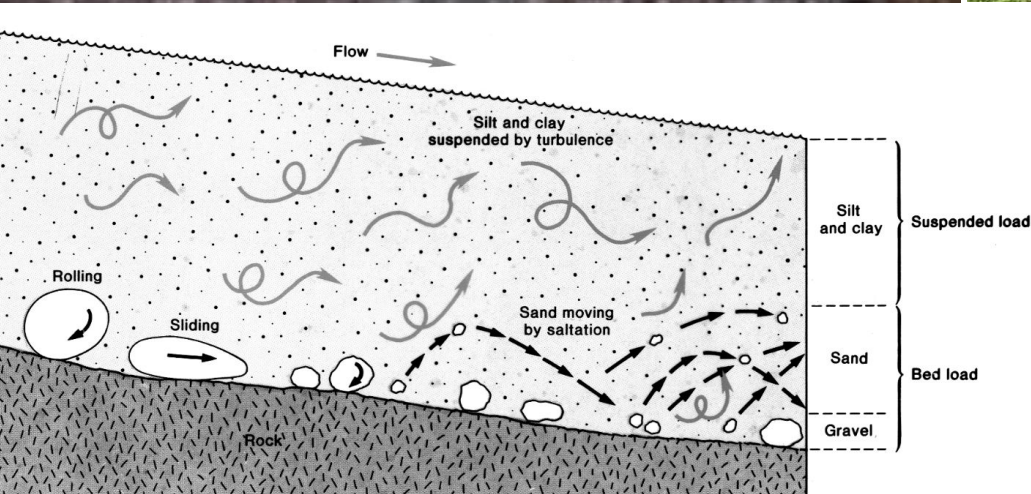
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At a given place:

$$Q_{\text{sediment}} \sim (Q_{\text{water}} - Q_{\text{water,c}})^n$$



# Motivations

- Flash flooding and erosion in Worcester



July 2018



After Ida Hurricane  
Sept 2021

- High(er) sediment transport rate indicates:
  - More water discharge at a given time   climate change  
or
  - More sediment available   poorly managed development projects

# Motivations

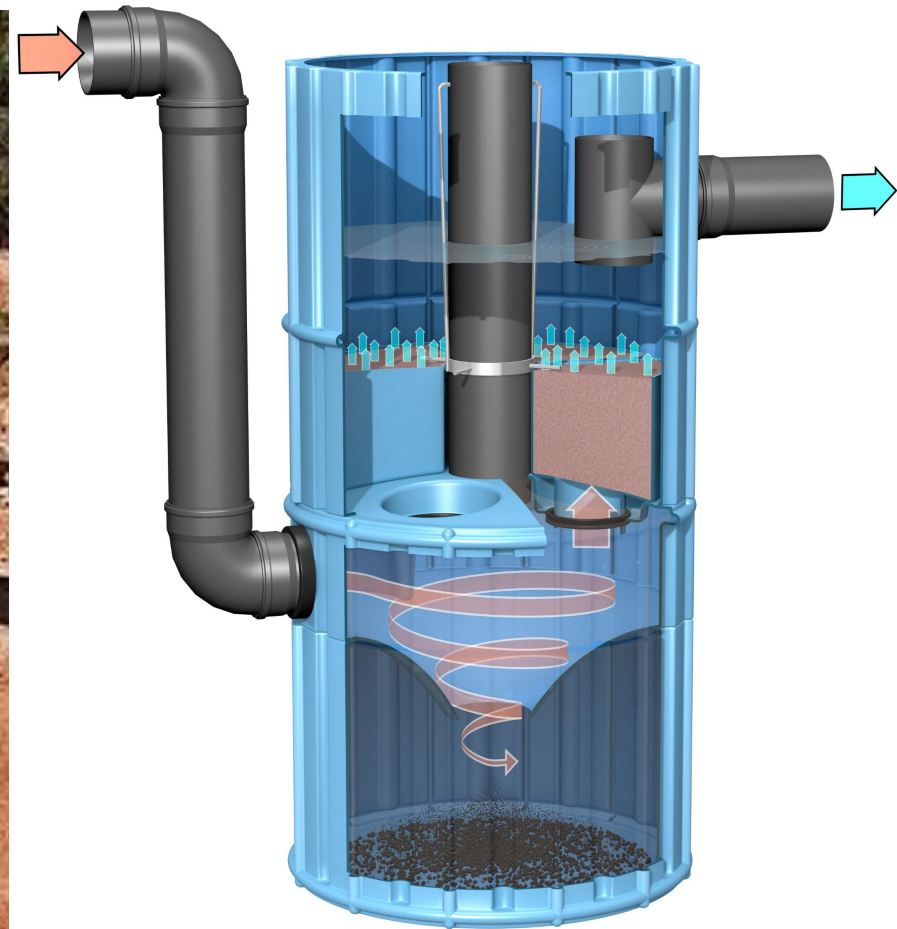
- Flash flooding and erosion in Worcester



- High(er) sediment transport rate indicates:
  - More water discharge at a given time □ □ climate change  
or
  - More sediment available □ □ poorly managed development projects
- Sediment transport is a great integrated information  
**BUT is notoriously hard to measure in the environment!**



# What are hydrodynamic separators?



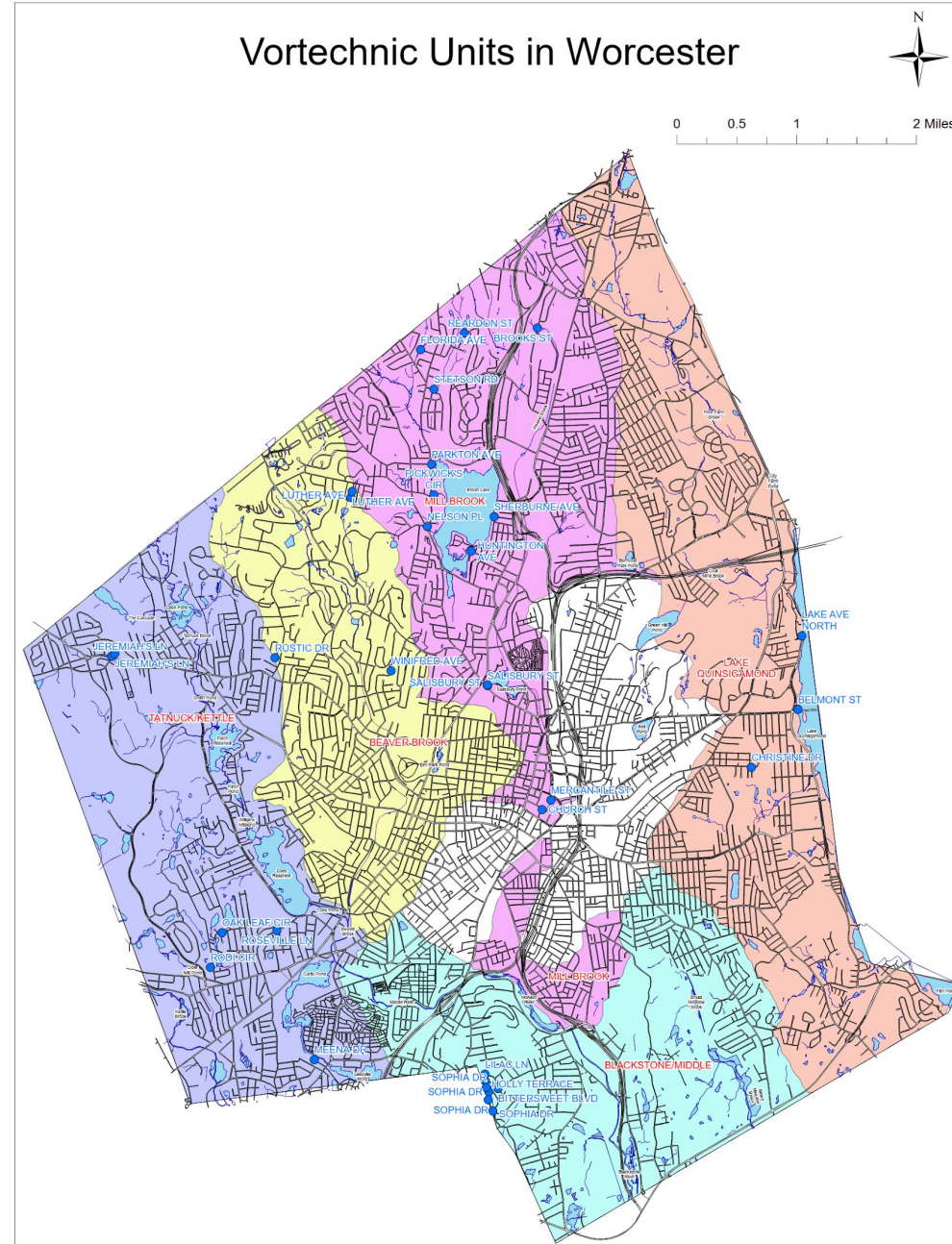
They are considered structural Best Management Practices (BMPs), and are used to treat and pre-treat stormwater runoff.

# hydrodynamic separators in Worcester

- About 30+ Installed since 2010
- Inspected 1 to ~5 times a year
- Cleaned/emptied 1 to ~3 times a year

Source: City of Worcester D. of Public Works & Parks

- “some of them have been needing more and more cleaning these last years” Ian Weyburne, Sanitary Engineer (DPW&P), Fall 2022





# hydrodynamic separators in Worcester

What inspection&cleaning data looked like from 2010 to 2020:

			Brooks Street 10' to RIM (empty)		Central Sector		
<i>Date</i>	<i>Rim Height</i>	<i>sediment height</i>	<i>oil</i>	<i>floatables</i>	<i>Date Cleaned</i>	<i>Sediment removed</i>	<i>Notes</i>
8/28/2010	8.7	1.3	no	no			
8/28/2010	10	0	no	no	8/28/2010	1/4 yard	small access port to clean device
10/5/2012	9.8	0.2	no	no			
4/26/2013	8.9	1.1	no	no			
7/25/2013	8.9	1.1	no	no	7/25/2013	0.5 yards	done by Alpine
4/8/2014	9.6	0	no	no			
8/29/2014	9.3	0.7	no	no			
9/22/2014	9.3	0.7	no	no	9/22/2014	0.5 yards	done by Alpine
4/17/2015	9.8	0.2	yes	no			
8/31/2015	9.4	0.6	yes	no	9/1/2015	1/2 yd	
5/12/2016	9.7	0.3	yes	yes			
10/3/2016	8.8	1.2	no	yes	10/5/2016	.5 yards	Earth Tech
5/19/2017	9.2	0.8	yes	no			
12/12/2017	9.1	0.9	no	no	12/12/2017		
5/10/2018	9.9	0.2	yes	yes			DAL
7/25/2018	9.8	0.3	no	yes			DAL
9/27/2018	9	1	no	no	9/27/2018	3/4 + yds	sas
9.12.2019	8.6	1.4	no	no	9.12.2019	3/4 ish yard	

# Data analysis basics

From inspection infos of:

- separator radius ( $R$ )

- sediment heights ( $h_{\text{sed}, 1}, h_{\text{sed}, 2}, \dots, h_{\text{sed}, j}, h_{\text{sed}, j+1}, \dots, h_{\text{sed}, n}$ )

and

- dates ( $d_1, d_2, \dots, d_j, d_{j+1}, \dots, d_n$ )

□ the volume of sediment that was deposited over the period of time between two cleanings ( $\Delta t_{j+1/2} = d_{j+1} - d_j$ ):

$$V_{\text{sed}, j+1/2} = (h_{s, j+1} - h_{s, j}) \pi R^2$$

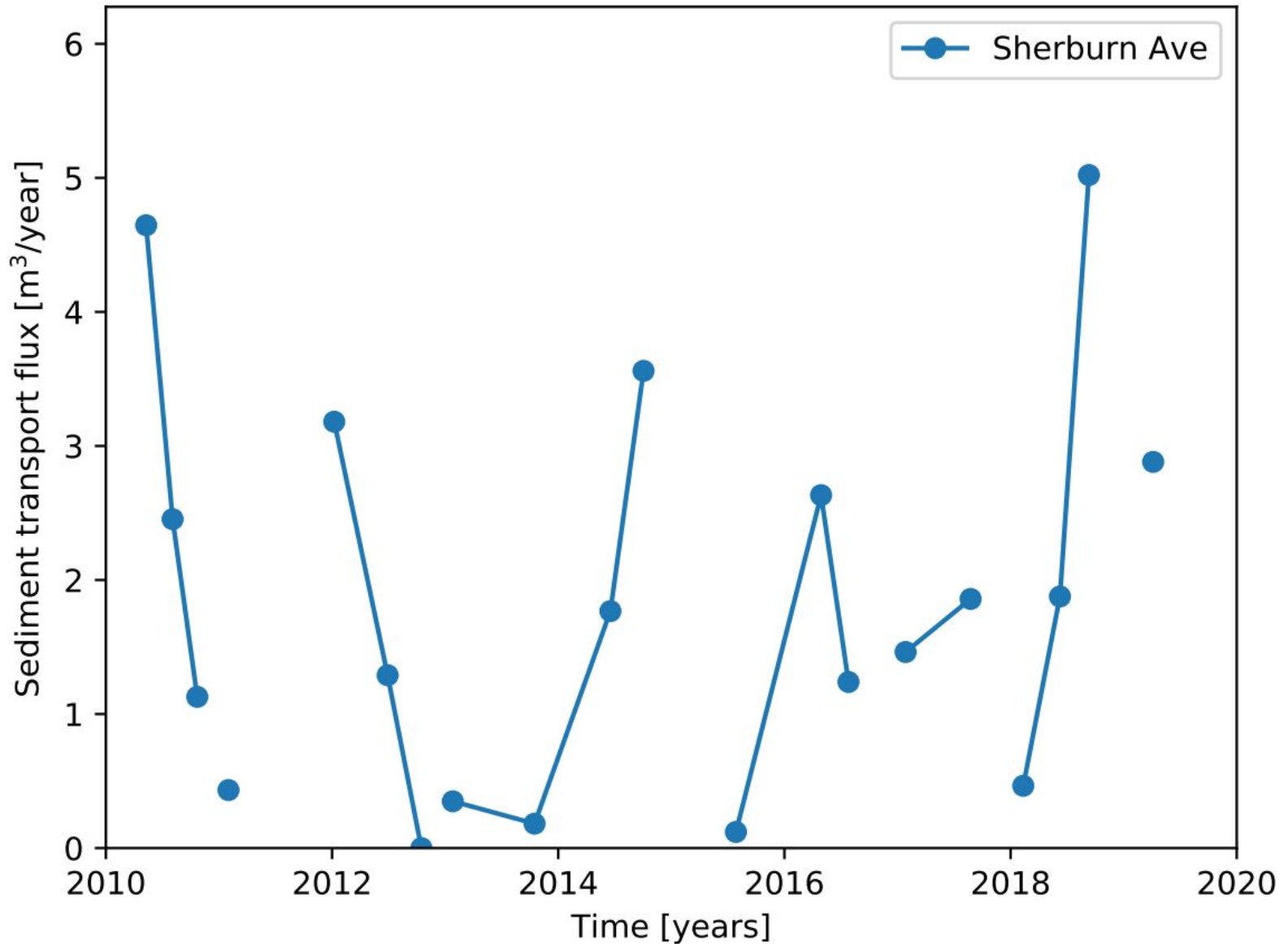
and then the sediment transport rate

$$Q_{\text{sed}, j+1/2} = V_{\text{sed}, j+1/2} / \Delta t_{j+1/2}$$

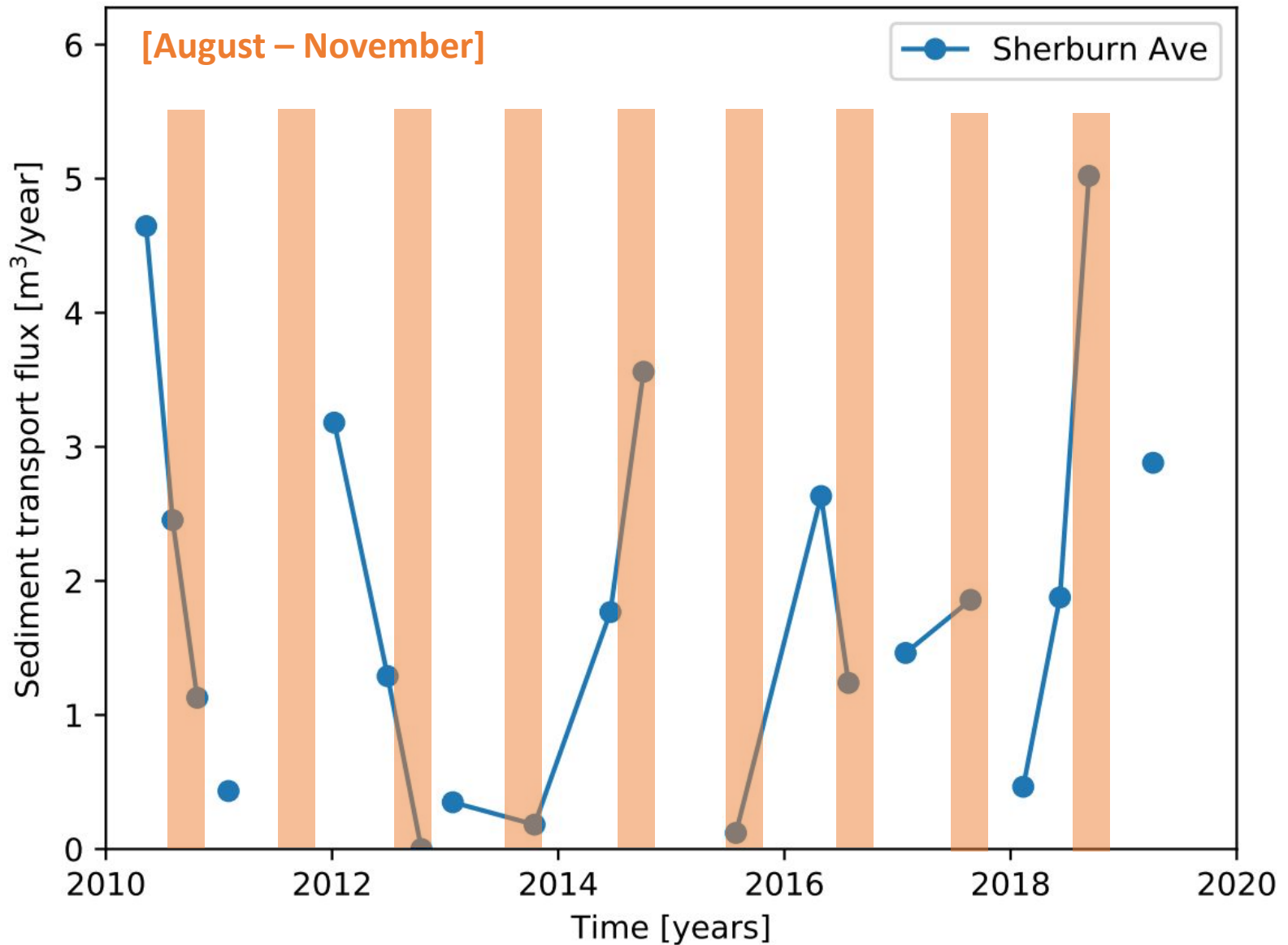
which happened, on average, at the time  $t_{j+1/2} = (d_{j+1} + d_j) / 2$



# Some preliminary results

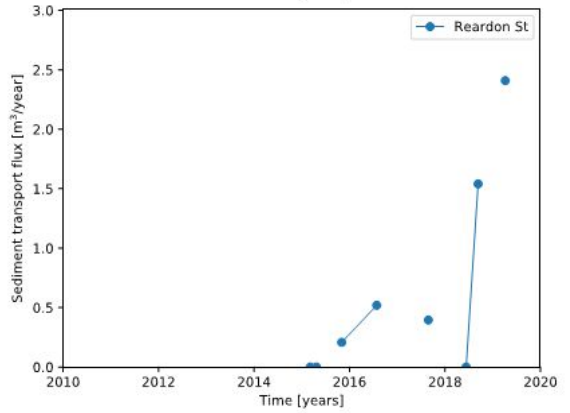
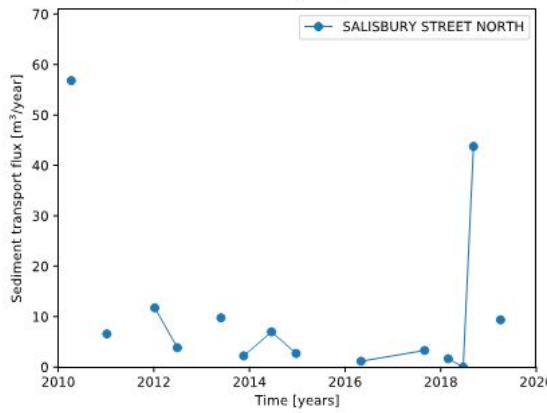
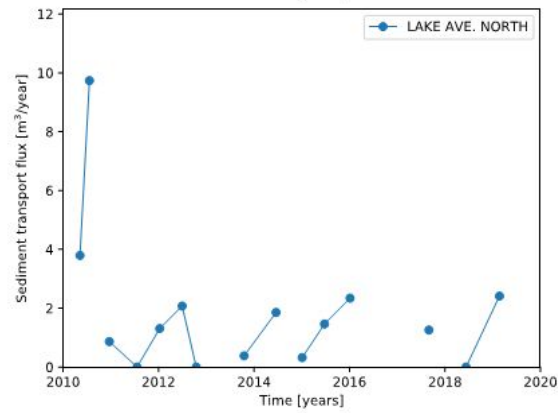
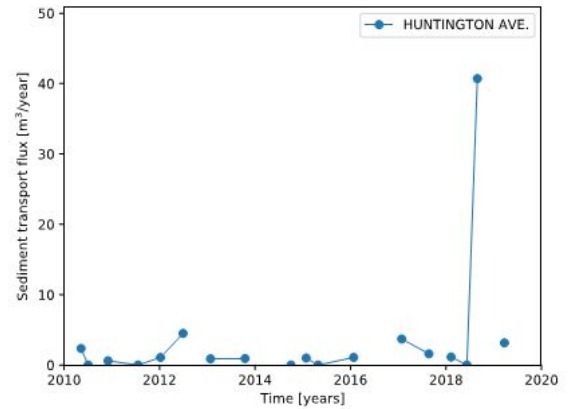
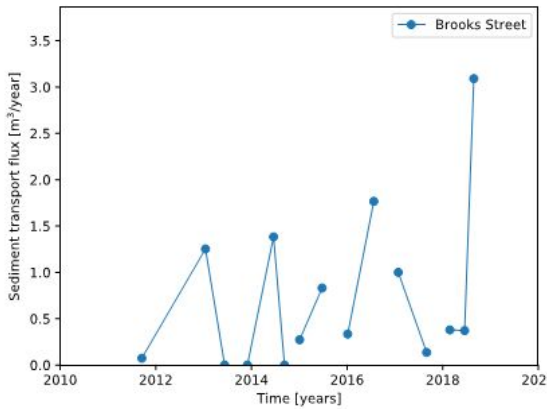
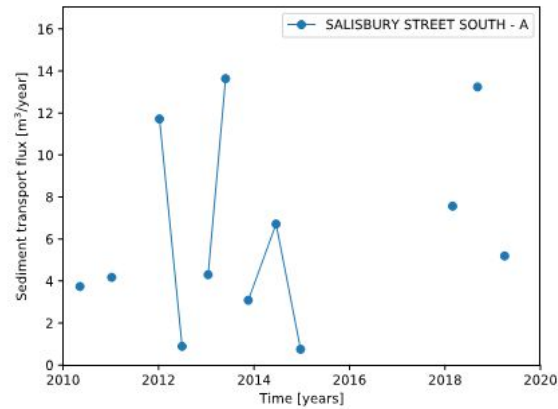
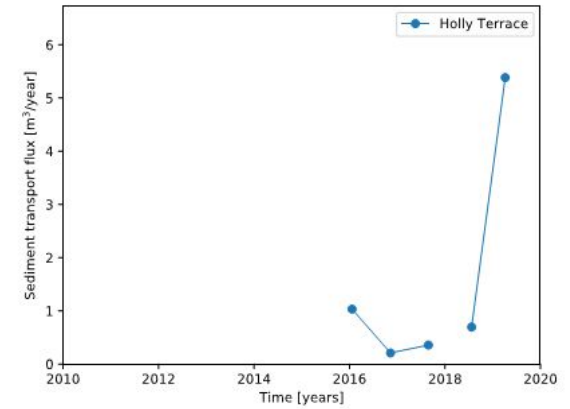
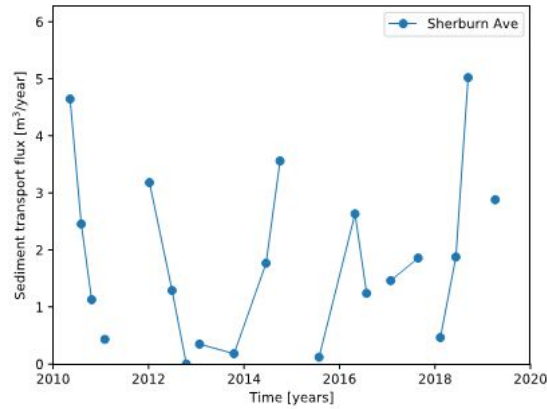
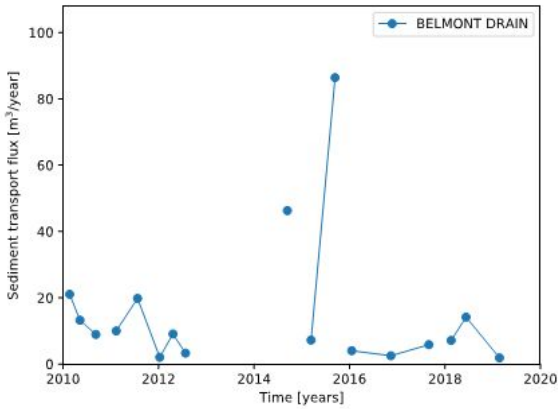


# Some preliminary results





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# Conclusion & perspectives

- Hydrodynamics separators data can participate to provide a more detailed picture of how flooding affects a city over the years
- Statistical data analysis over time could show and inform on specific trends due to climate change and/or development project management, and/or city infrastructure change
- Developing and enhancing such data tracking could be used to assess new flooding mitigation plans over the next decades