

Hudson Line Resilience Case Study

Confronting sea level rise along Metro-North's Hudson Line

Metro-North Hudson Line along the Hudson River

We will invest in long-term climate resilience measures to continue safe and reliable regional service for millions of riders annually.

Climate change poses an existential threat to the Hudson Line

Metro-North's Hudson Line is renowned for its scenic views of the Hudson River. However, this proximity to the water also means that it is increasingly threatened by flooding. Over 50% of the approximately 74-mile-long line is vulnerable to coastal flooding from storms today. This number will grow as sea levels rise and coastal storms become more frequent and intense due to climate change.

For 10 million annual Hudson Line riders, that means more potential service delays as storms and chronic flooding get worse in the coming decades. It will also impact riders on Amtrak and freight deliveries carried by CSX, as both services rely on portions of the Hudson Line.

Recent resilience investments have reduced coastal flood risk

During Superstorm Sandy in 2012, over half of the Hudson Line flooded, resulting in significant damage to power, communications, signal systems, and other assets. After Sandy, we made significant investments in resilience measures along the 30-mile electrified portion of the line from the Bronx to Croton-Harmon. These investments enable critical power, communications, and signals assets to withstand the impacts of coastal storm surges and reduce the duration of potential service interruptions during and immediately after such events. But our work is not done. As the climate changes, we must also grapple with the growing climate hazards that threaten the Hudson Line tracks and right-of-way.

Sea level rise is leading to growing and changing flood risks

While the MTA's post-Sandy investments help mitigate coastal flood risk, flood events related to non-coastal surges are increasing. Sea level rise will lead to higher tides and chronic sunny day flooding along the Hudson Line right-of-way.

Sea level rise also accelerates shoreline erosion and enables smaller, routine storms to result in more extensive flooding. In addition, these higher tides can reduce the functionality of existing gravity-dependent drainage systems, further exacerbating flooding.

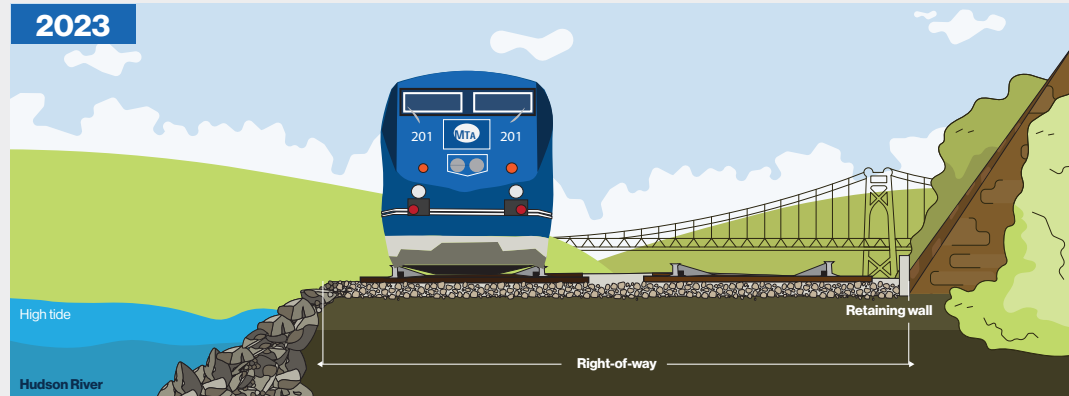
The threats posed by sea level rise, particularly combined with the increased torrential rainfall we are already experiencing, mean that we must proactively act to ensure continuous service over the long term.

Post-Sandy Hudson Line resilience mitigations include elevated equipment platforms



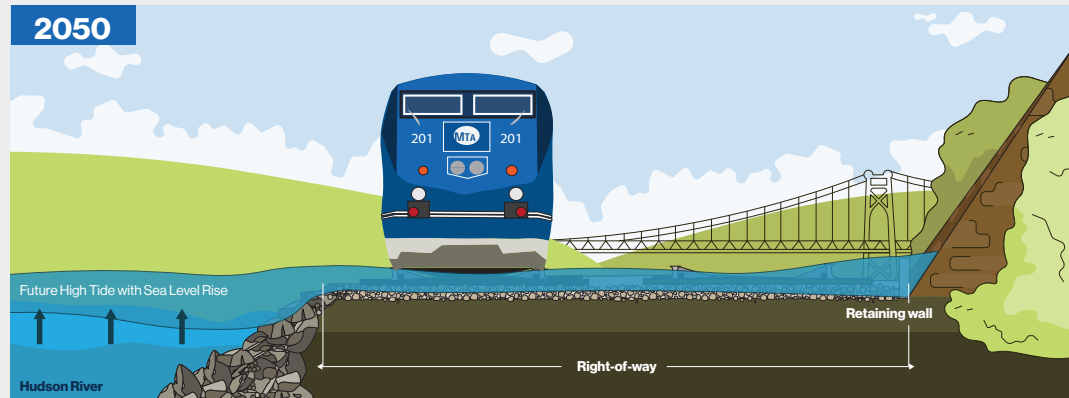
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Sea level rise on Metro-North's Hudson Line



Current sunny day during high tide

The Hudson Line runs directly adjacent to the Hudson River. Much of the right-of-way is between the Hudson River and the foot of a steep embankment on the other. During high tide, portions of the right-of-way are just a few feet above the river.



Future sunny day during high tide

The Hudson River is a tidal estuary that experiences daily tidal shifts. Rising sea levels will lead to higher tides that cause flooding along the right-of-way. The New York City Panel on Climate Change estimates that sea levels could rise 2.5 feet by the 2050s and by 4.8 feet by the 2080s. Without action, entire low-lying segments of the Hudson Line will be subject to regular tidal flooding. Tidal floods will be salt water on this portion of the river, causing corrosive damage.



Future torrential rainfall during high tide

During torrential rainfall events, runoff flows down the embankments and into the Hudson Line right-of-way, gathering speed and carrying debris flows toward the river. With sea level rise, the rising tide of the Hudson River will meet runoff from the steep slopes within the Hudson Line right-of-way. The resulting floods can cause track washouts, erosion of shoreline and ballast, debris accumulation and other types of equipment damage that result in service impacts and repair expenses.

Responding to a changing climate requires significant planning and investment

A challenge of this magnitude requires a combination of near, medium, and long-term solutions. The portions of the Hudson Line right-of-way that will be exposed to imminent tidal flooding will be prioritized for capital improvements over the next 20 years.

As part of that plan, key near-term actions include the rehabilitation of shoreline structures, addressing erosion hot spots, stabilizing upland slopes, and upgrading undersized and underperforming drainage, where feasible.

We will also pursue a long-term resilience strategy that will include floodproofing and raising assets to safer levels to ensure that this line can continue to provide service throughout this century and beyond.



Washout of Hudson Line north of the Croton-Harmon due to severe weather, July 9, 2023