UCT UNDERGROUND CONSTRUCTION TECHNOLOGY
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Hidden capacity in your wastewater interceptors?

How non-uniform flow modeling can impact pipe sizing

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What's the right way to dispense toothpaste?

Source: AARP

Source: The Guardian

Hydraulic modeling to account for non-uniform flow conditions in gravity interceptors can refine understanding of system hydraulics and uncover capacity that is not realized when evaluations are completed using Manning's equation

1

Uniform Flow

2

Uniform vs. Non-Uniform Flow

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Project Examples

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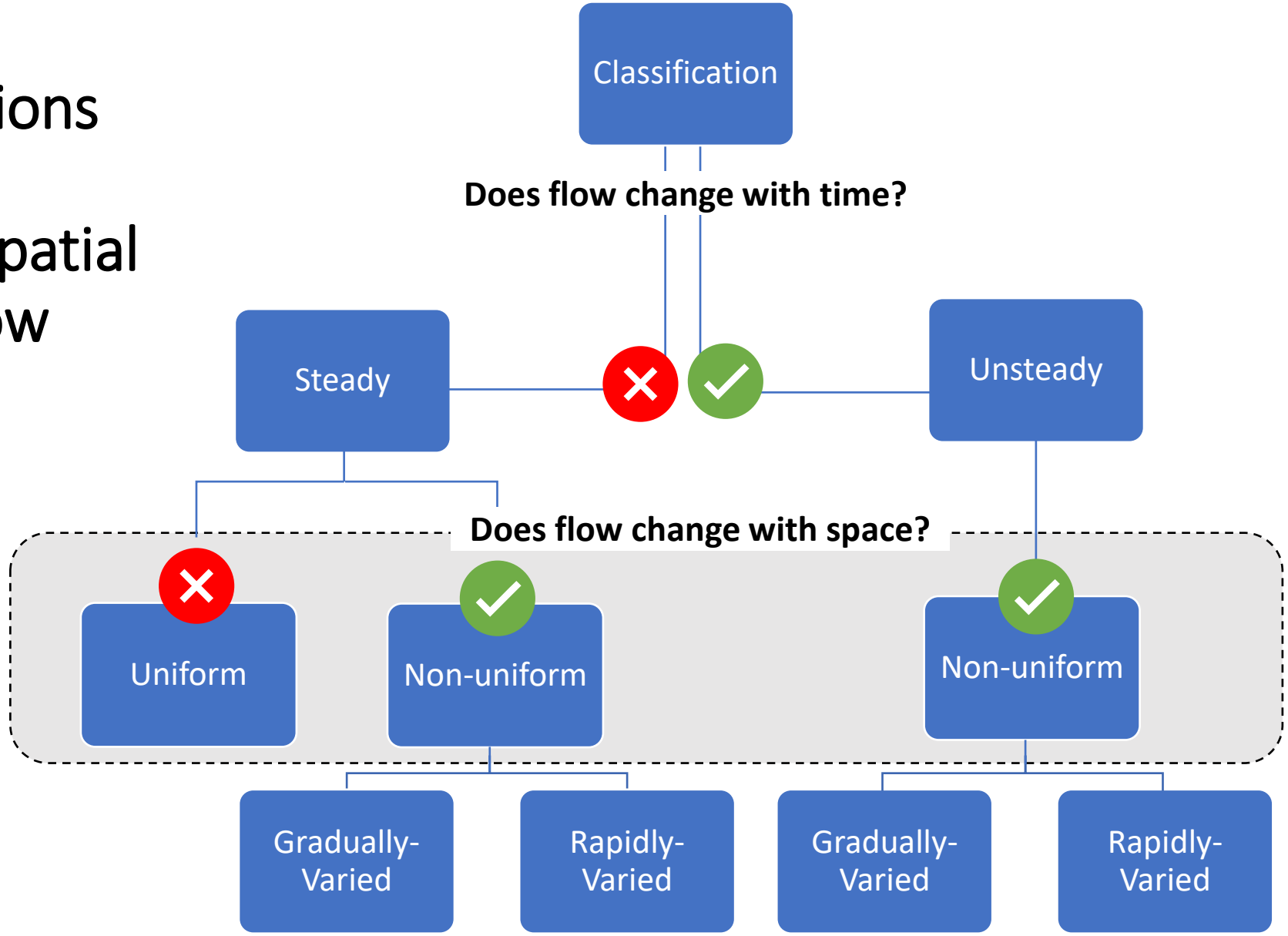
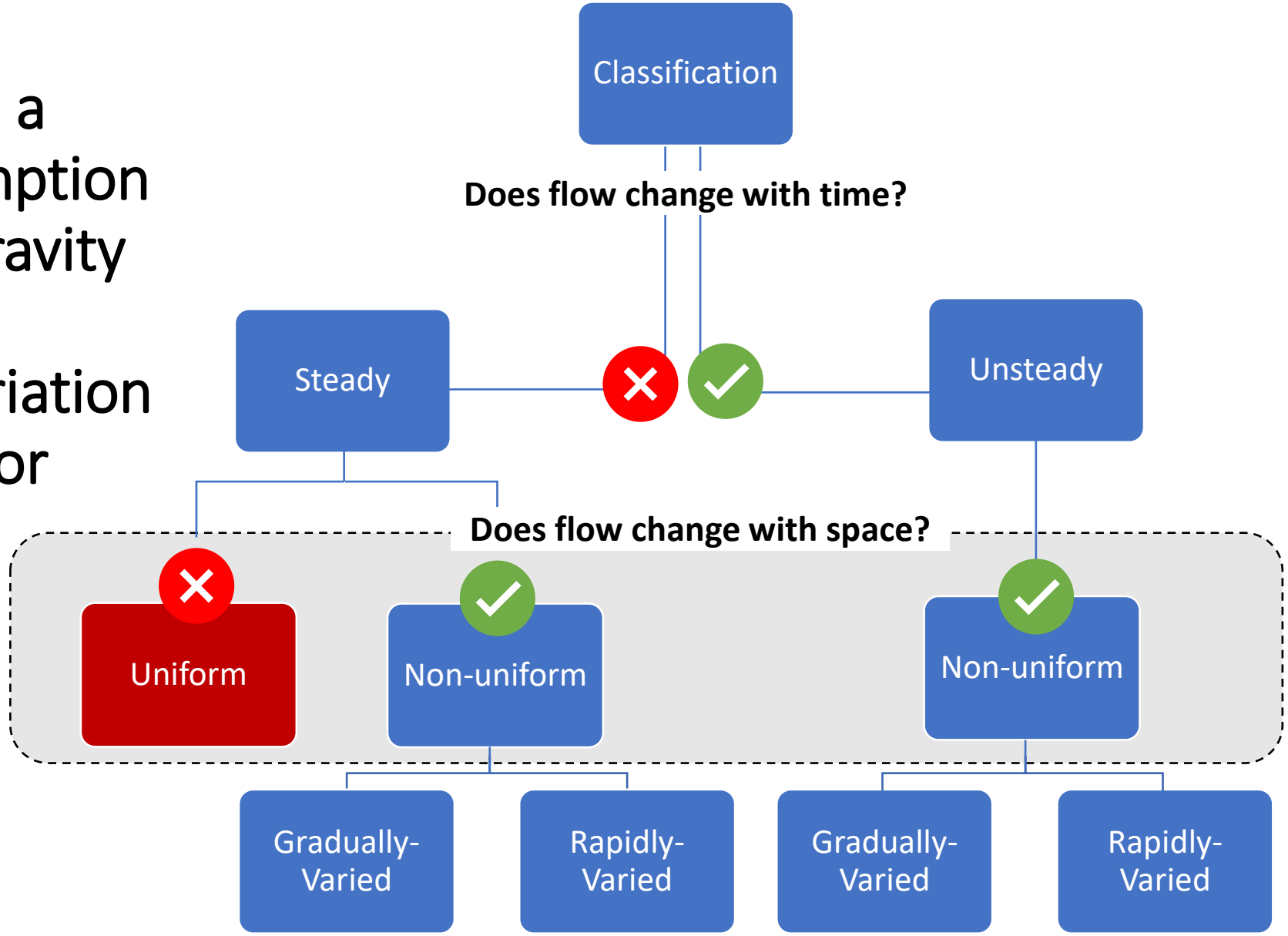
Project Examples

Flow classifications are based on temporal and spatial variations in flow



Uniform flow is a standard assumption in analysis of gravity sewers, and it assumes no variation in flow in time or space



Uniform flow calculations do not account for multiple conditions causing variations in flow

Pipe Changes

- Slope
- Diameter
- Material (n)

Boundary Conditions

- Free Outfall
- Backwater

Flow Variation

- Lateral Inputs
- Flow Storage and Attenuation

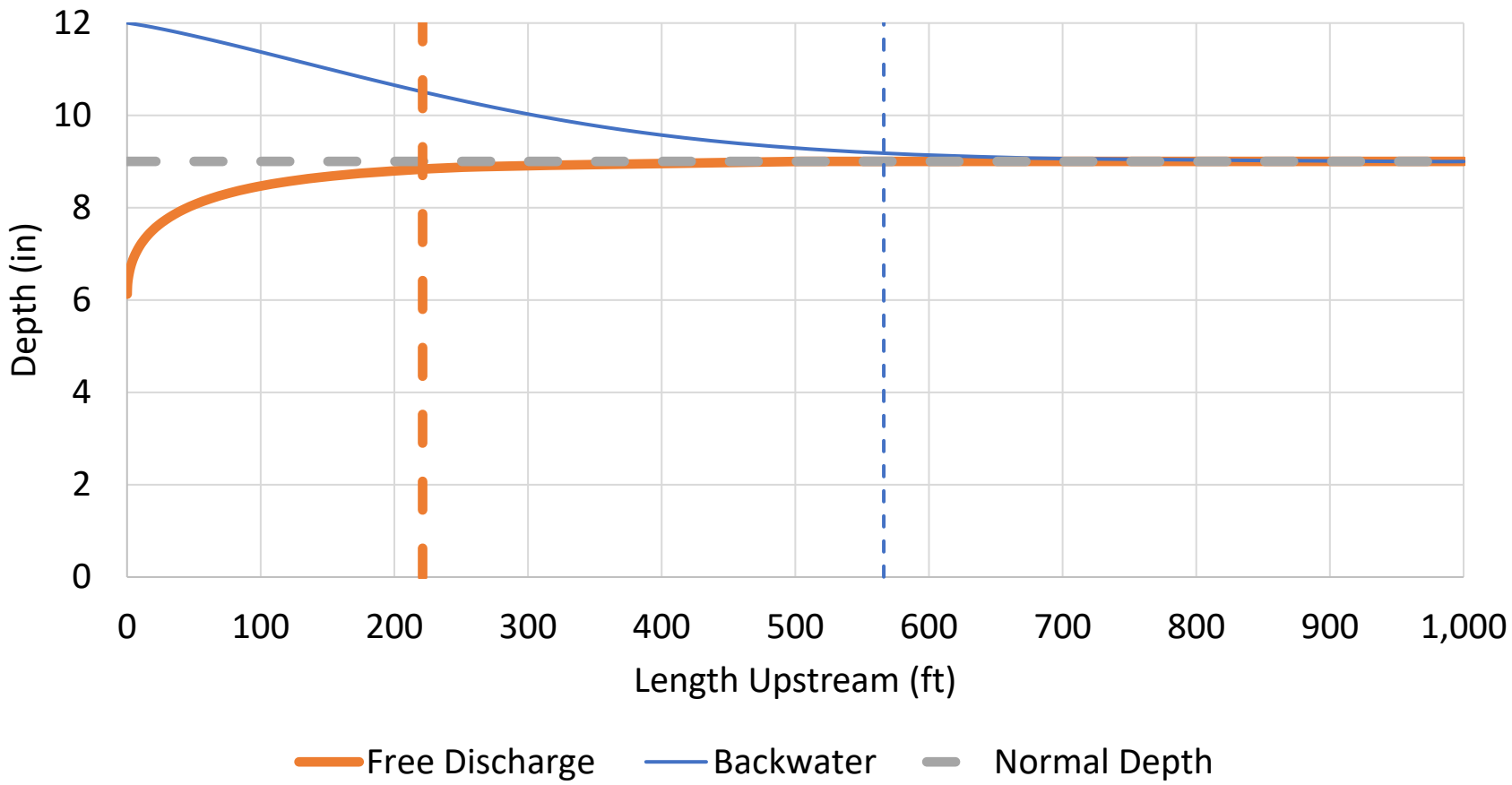
Modeling with uniform vs. non-uniform assumptions can produce significantly different results under certain situations

1 Uniform Flow

2 **Uniform vs. Non-Uniform Flow**

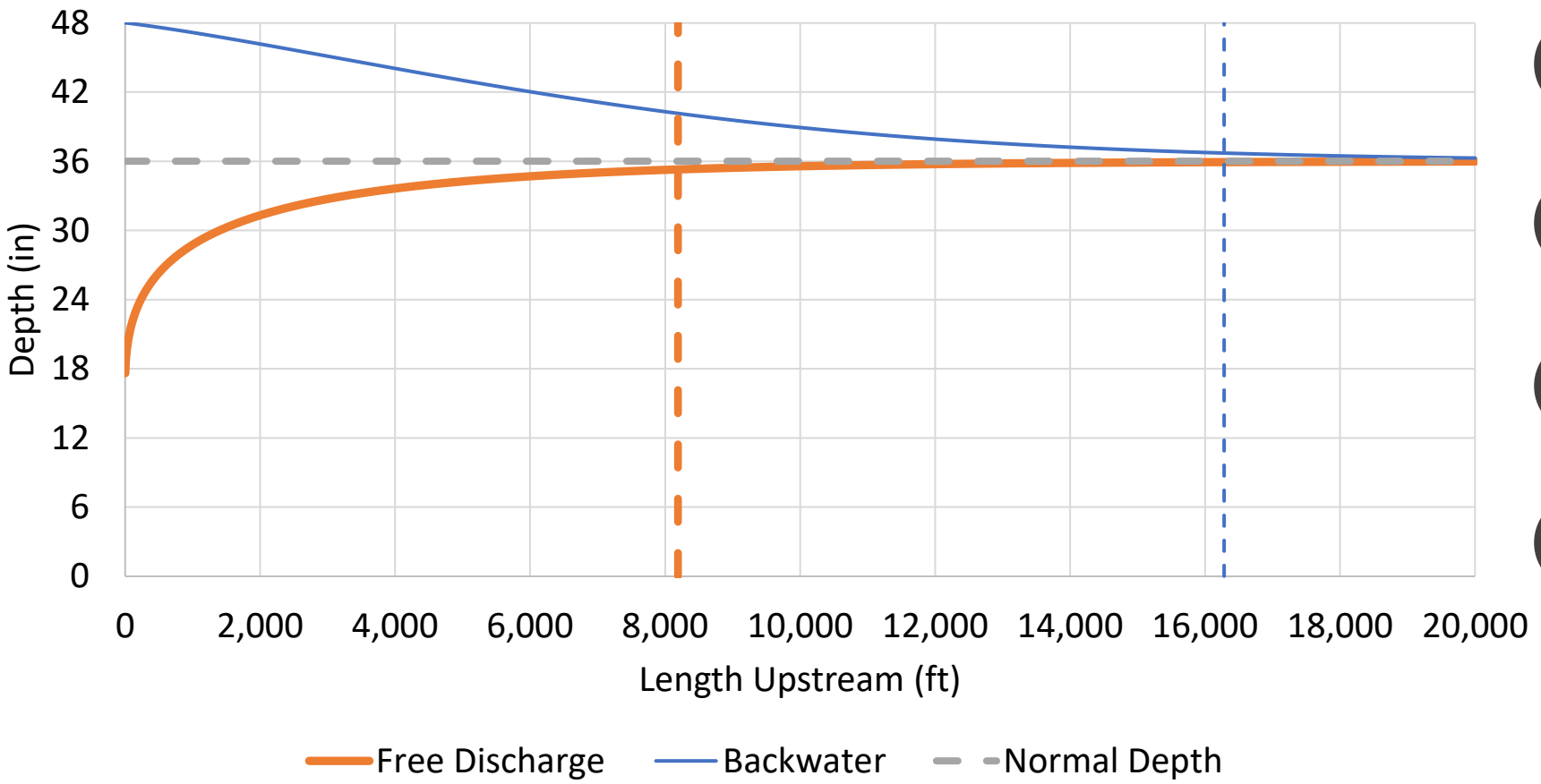
3 Project Examples

Capacity of small-diameter pipes is, generally, reasonably approximated with uniform flow assumptions



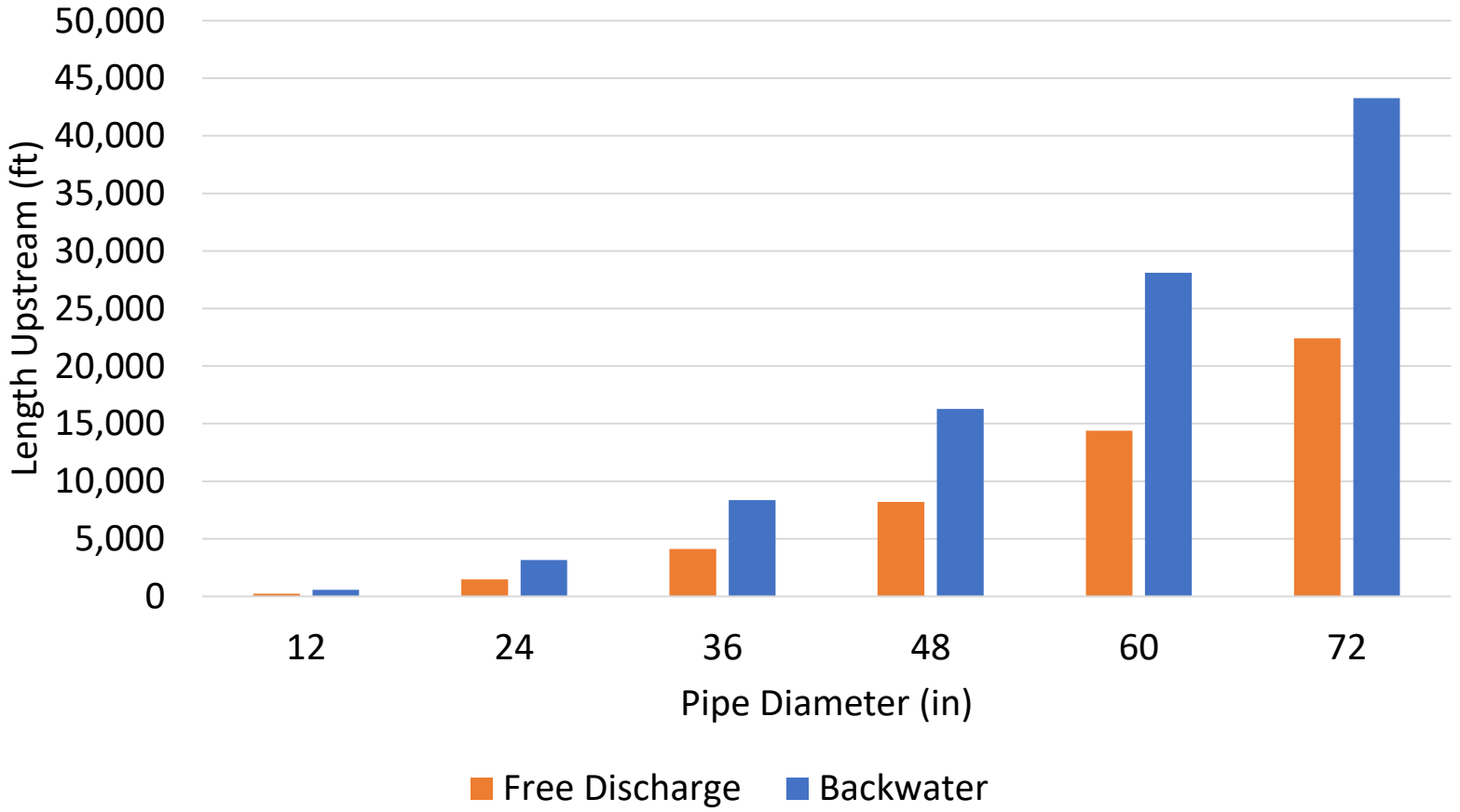
- 12-inch pipe
- n = 0.013
- Slope = 0.200%
- Flow = 0.9 MGD

In contrast, large-diameter pipes are more likely to require analysis using non-uniform flow calculations to accurately identify capacity



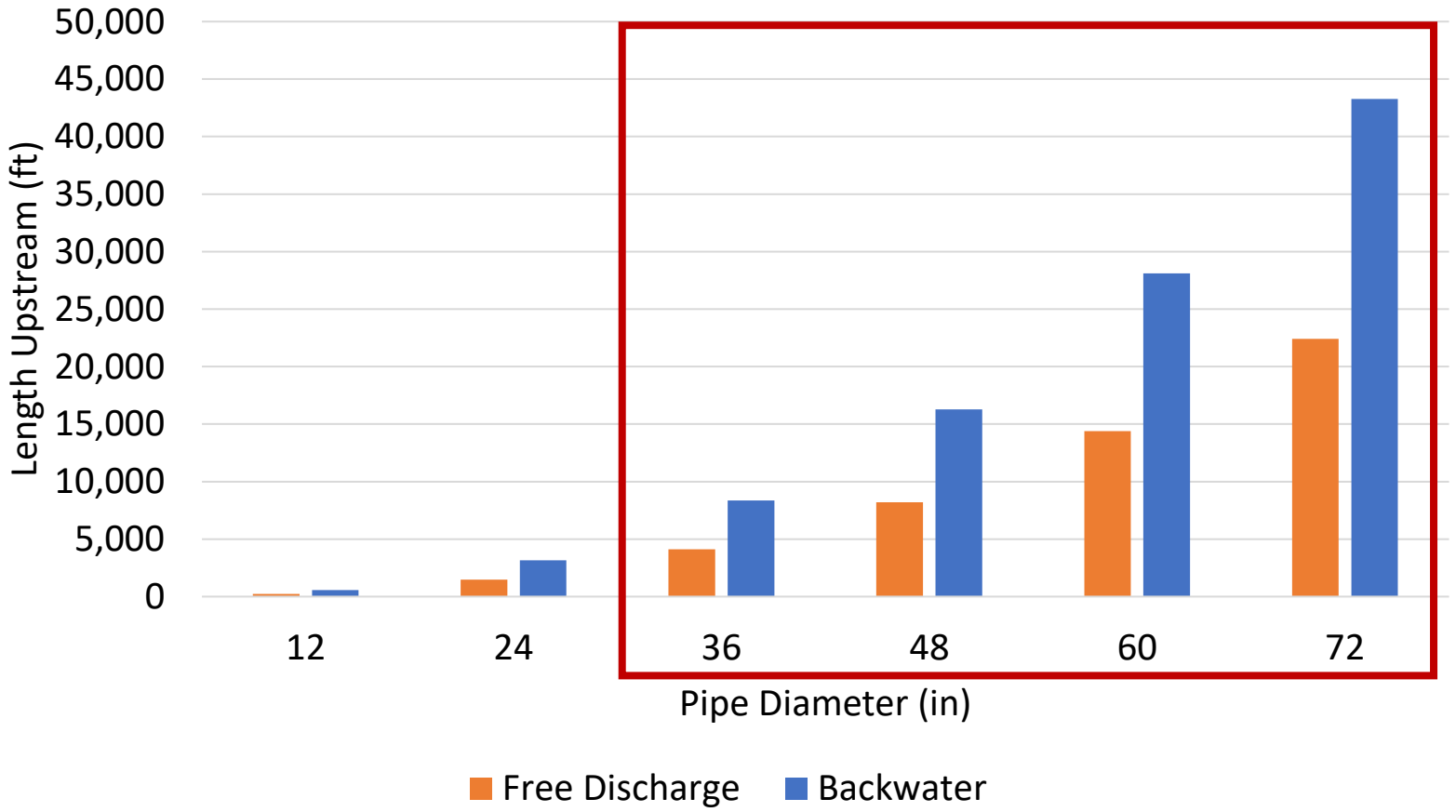
- 48-inch pipe
- n = 0.013
- Slope = 0.031%
- Flow = 14.9 MGD

The pipe length to approach normal depth (uniform flow conditions) increases significantly with pipe size



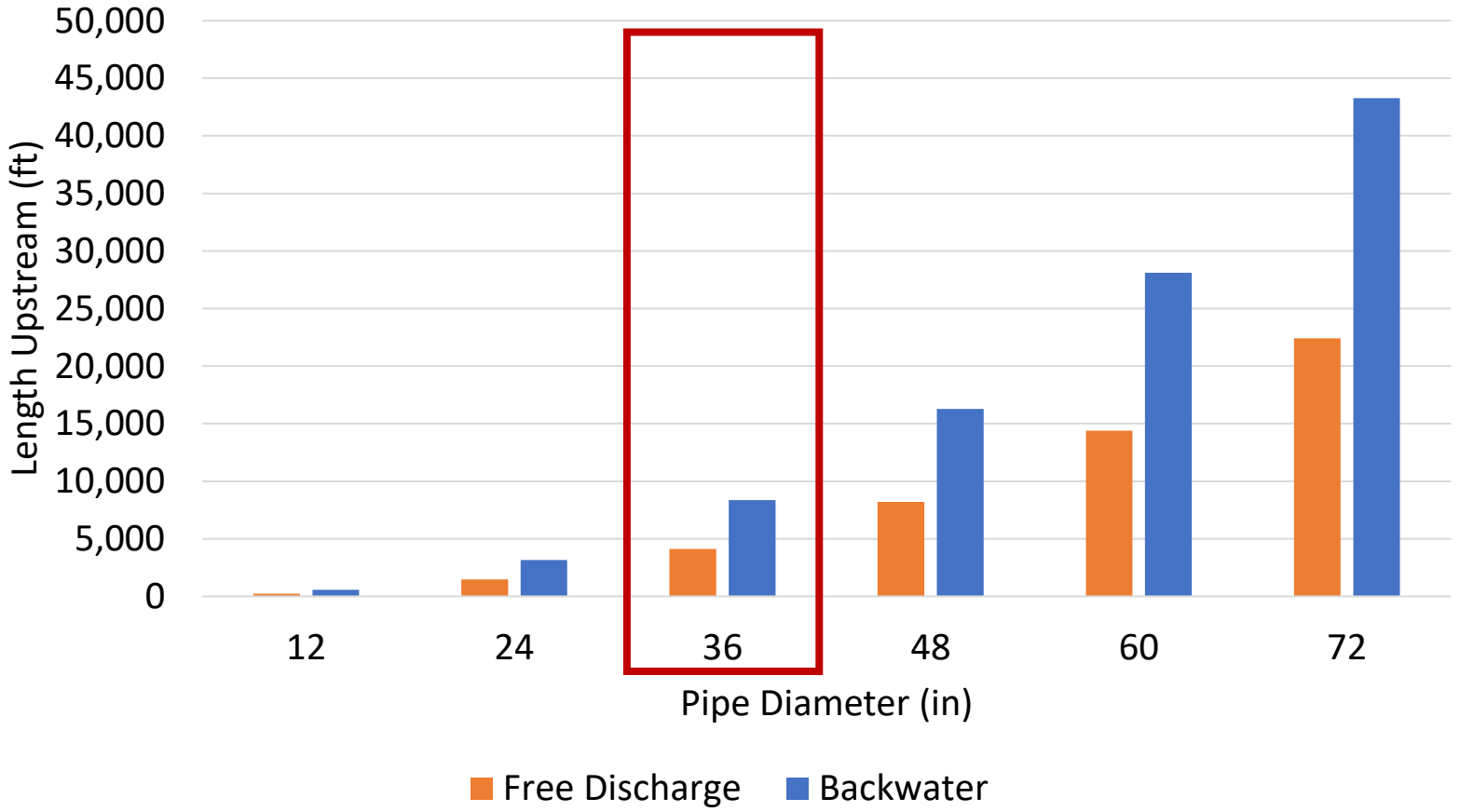
- Length to achieve ±2% of normal depth
- Slopes are minimum based on TCEQ requirements

These long GVF profiles in large-diameter pipes can allow flows to exceed the capacity predicted using uniform flow assumptions

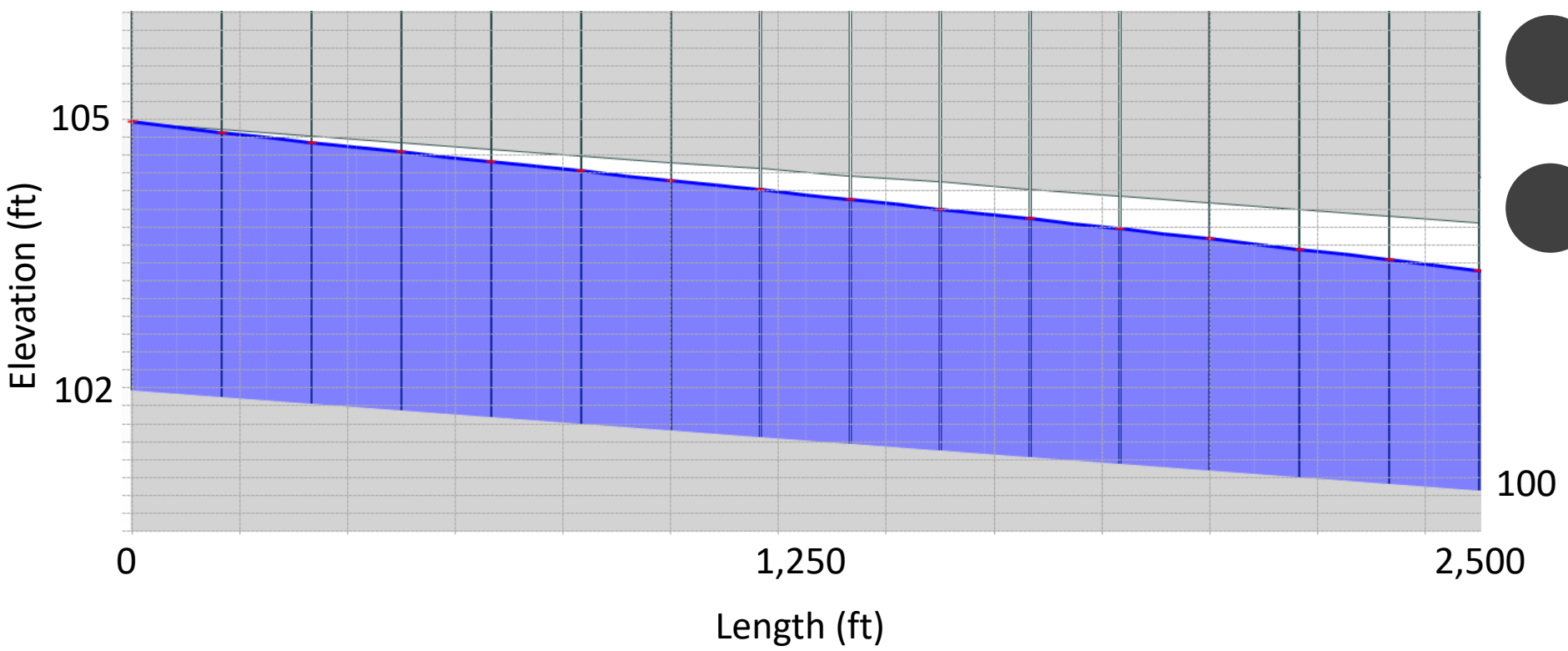


- Length to achieve ±2% of normal depth
- Slopes are minimum based on TCEQ requirements

For a 36-inch pipe, a GVF profile can increase capacity for a few thousand linear feet



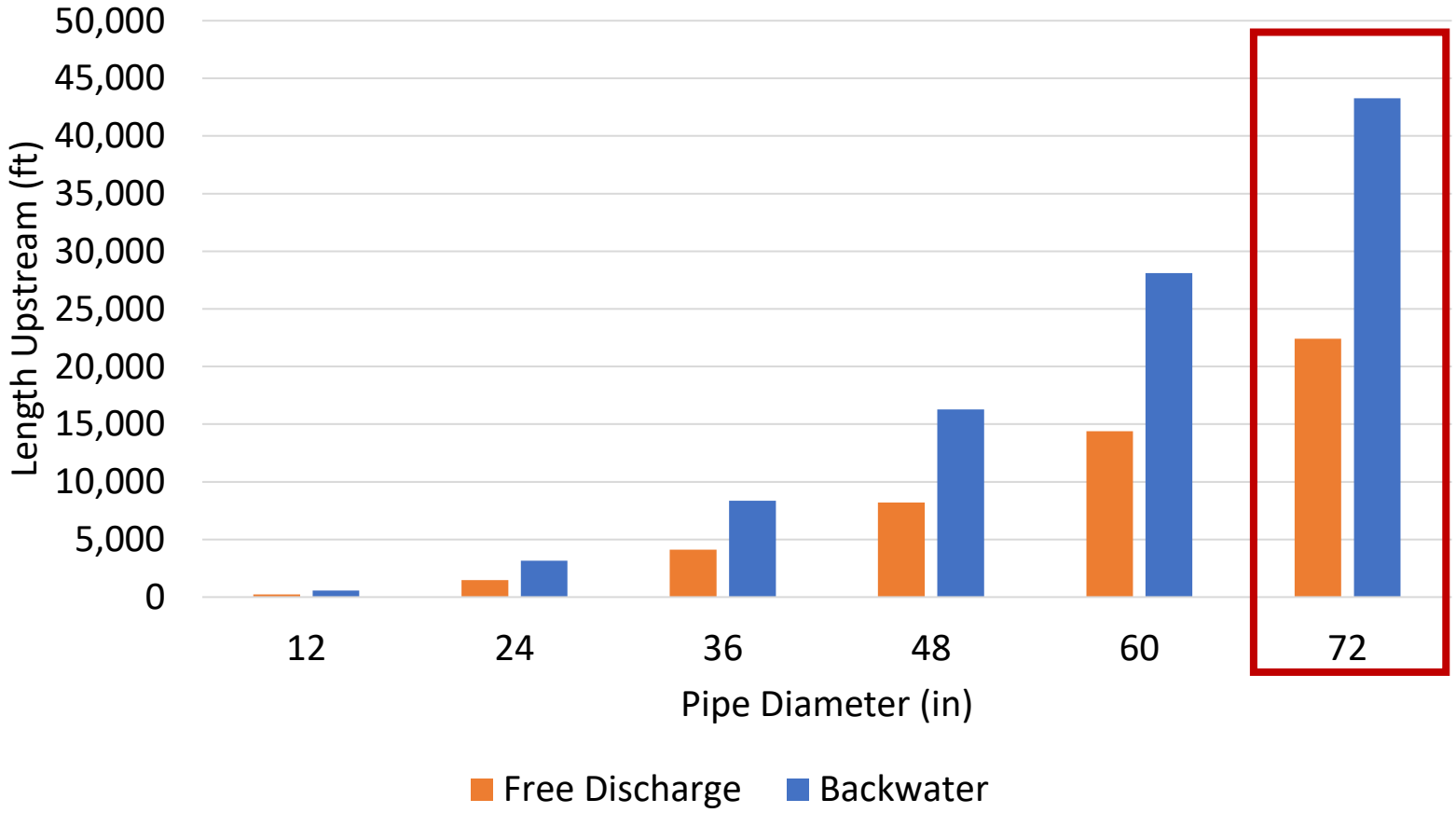
The GVF profile in this 2,500 linear feet, 36-inch pipe allows for 27% more flow capacity than pipe full conditions with uniform flow



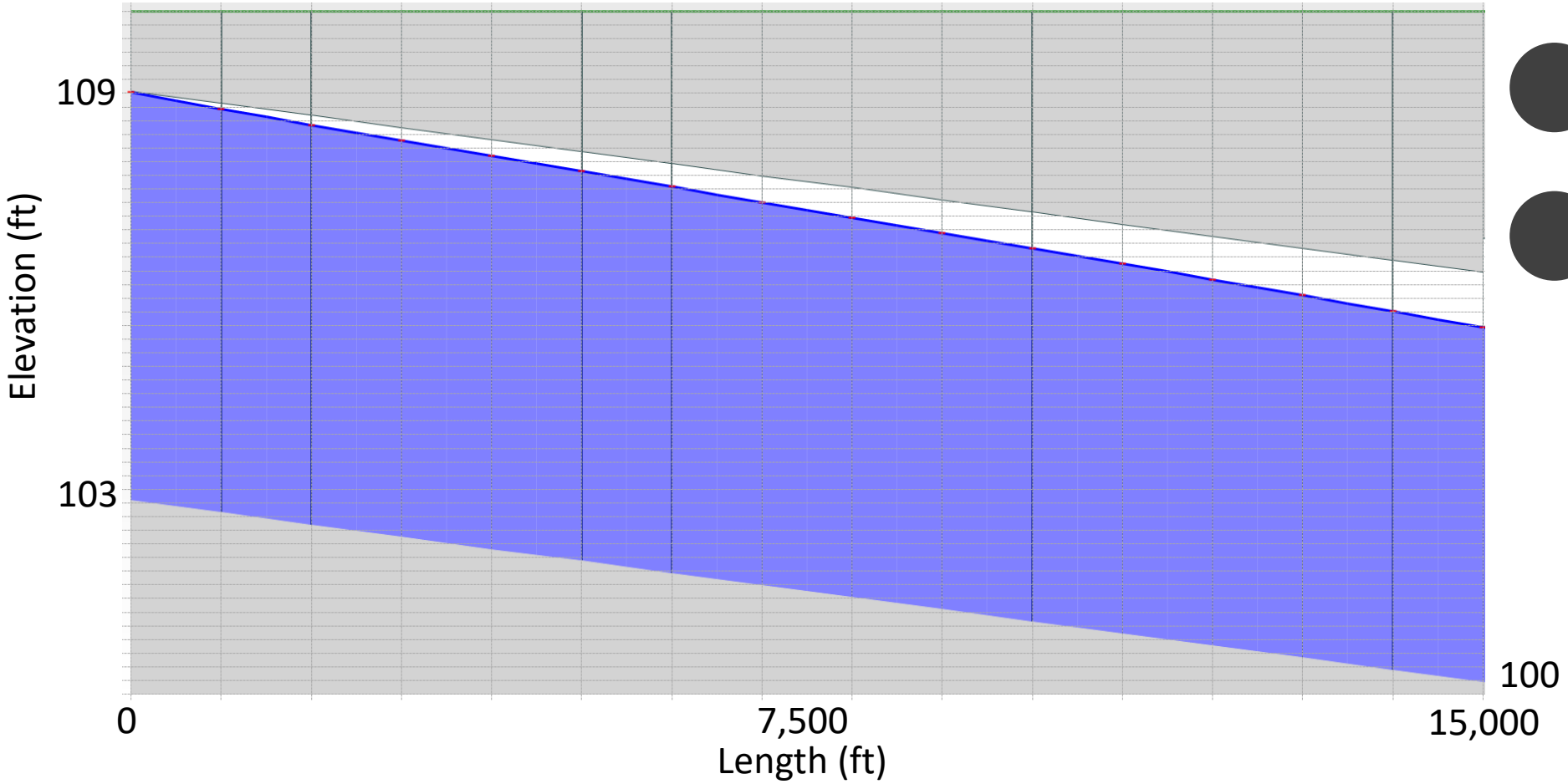
Uniform Flow = 9.12 MGD

Non-Uniform Flow = 11.60 MGD

For a 72-inch pipe, a GVF profile can increase capacity for 10,000+ linear feet



The GVF profile in this 15,000 linear feet, 72-inch pipe allows for 21% more flow capacity than pipe full conditions with uniform flow



- Uniform Flow = 36.41 MGD
- Non-Uniform Flow = 44.00 MGD

The following examples illustrate concepts of how a utility can discover hidden capacity in their wastewater interceptors

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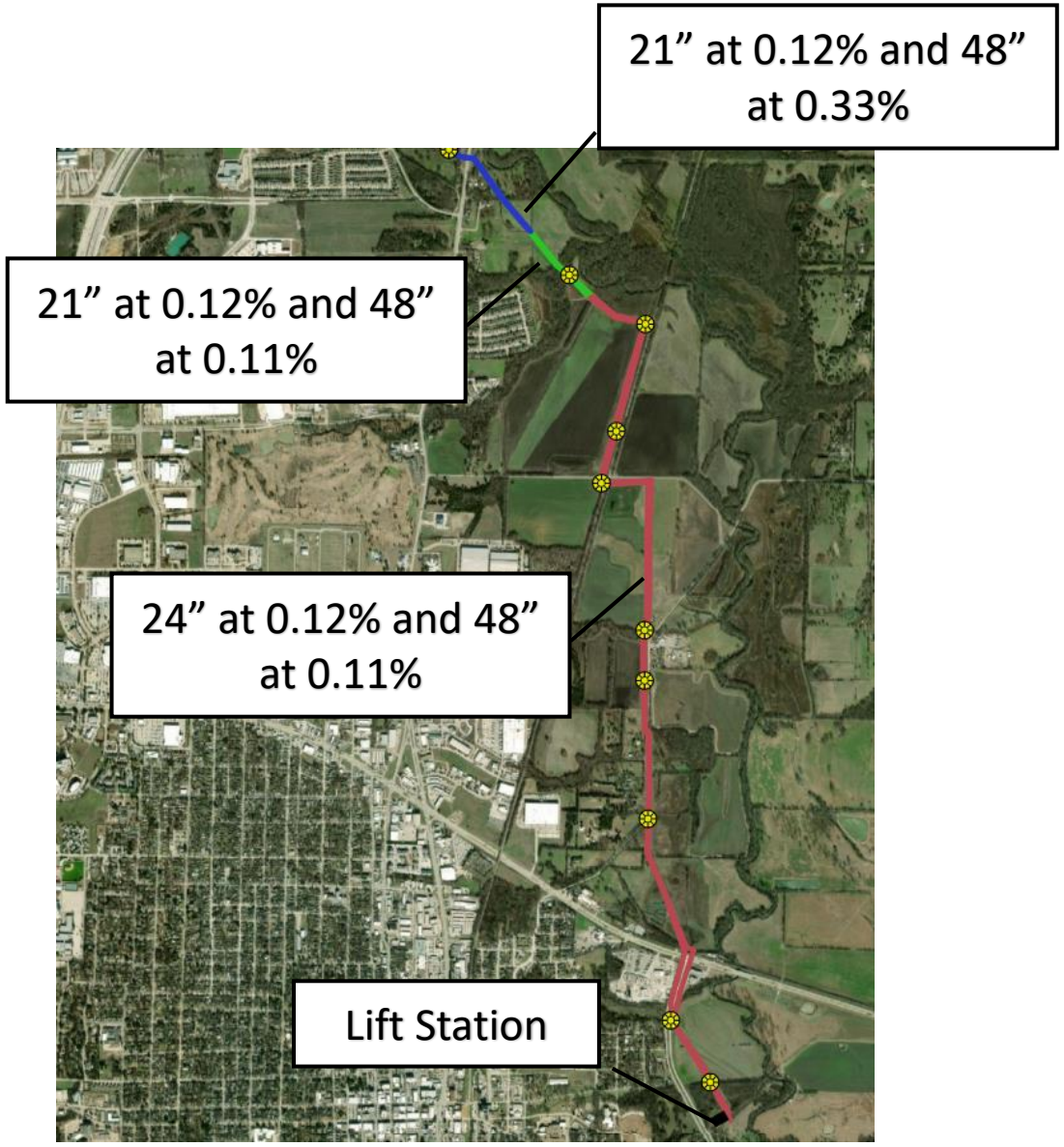
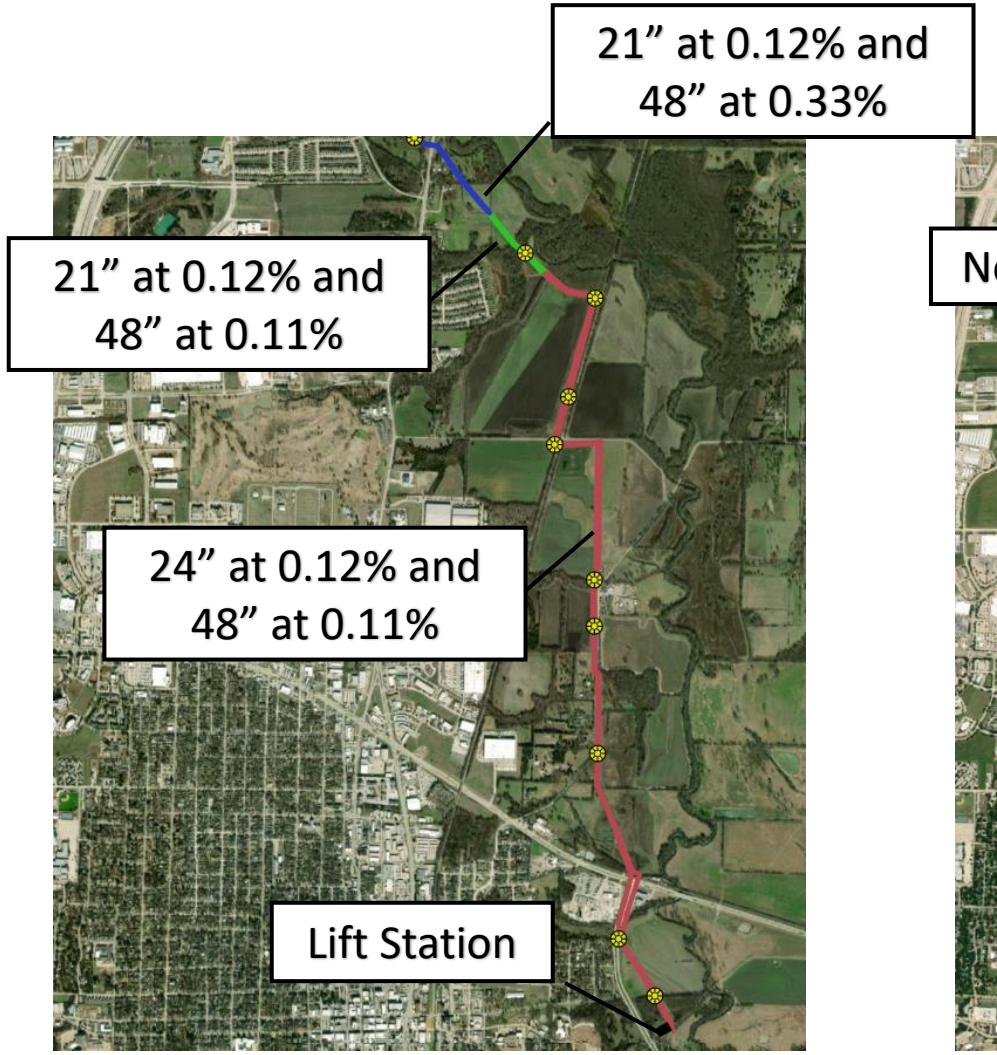
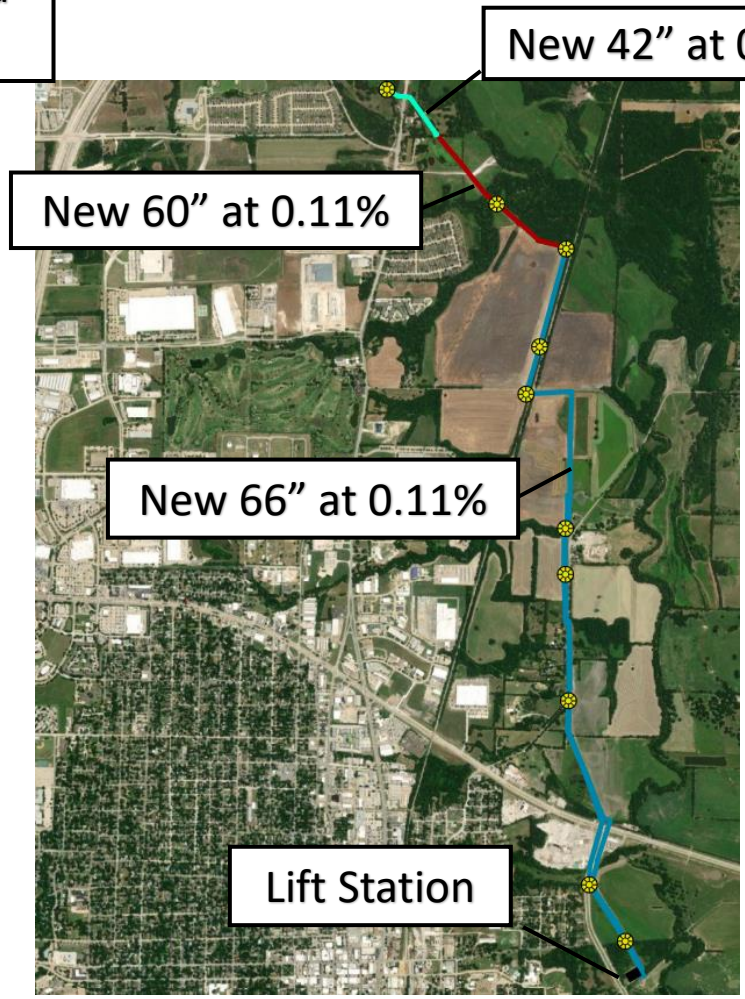
This North Texas utility needed additional capacity to provide capacity over the 19,000 linear feet project extent



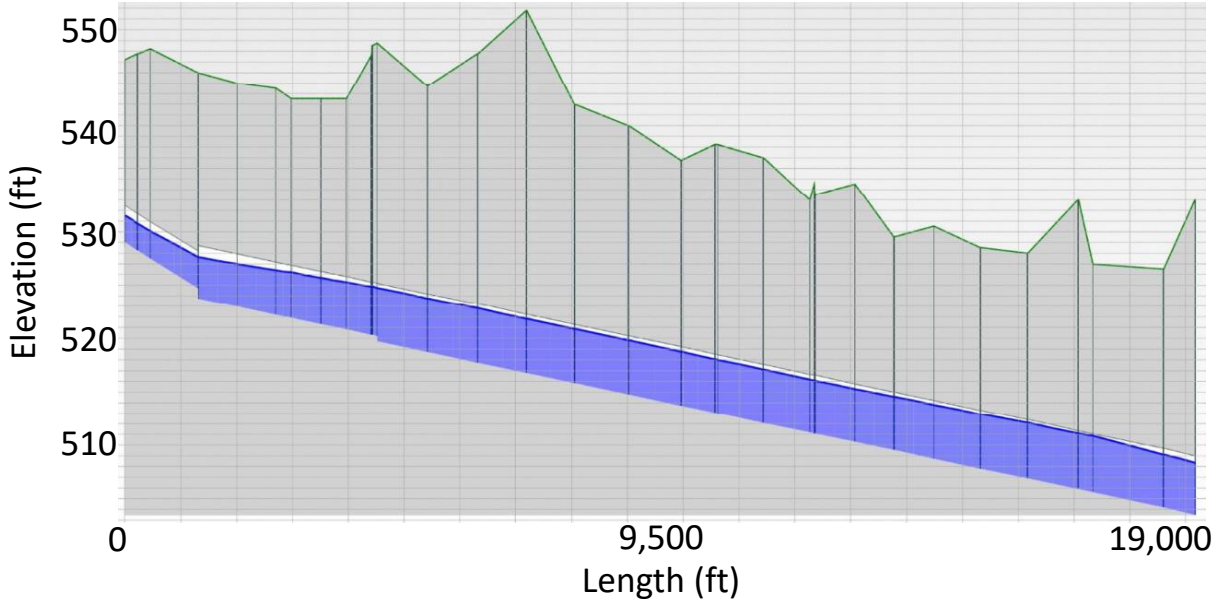
A new parallel line was designed to provide capacity for projected 2070 flows



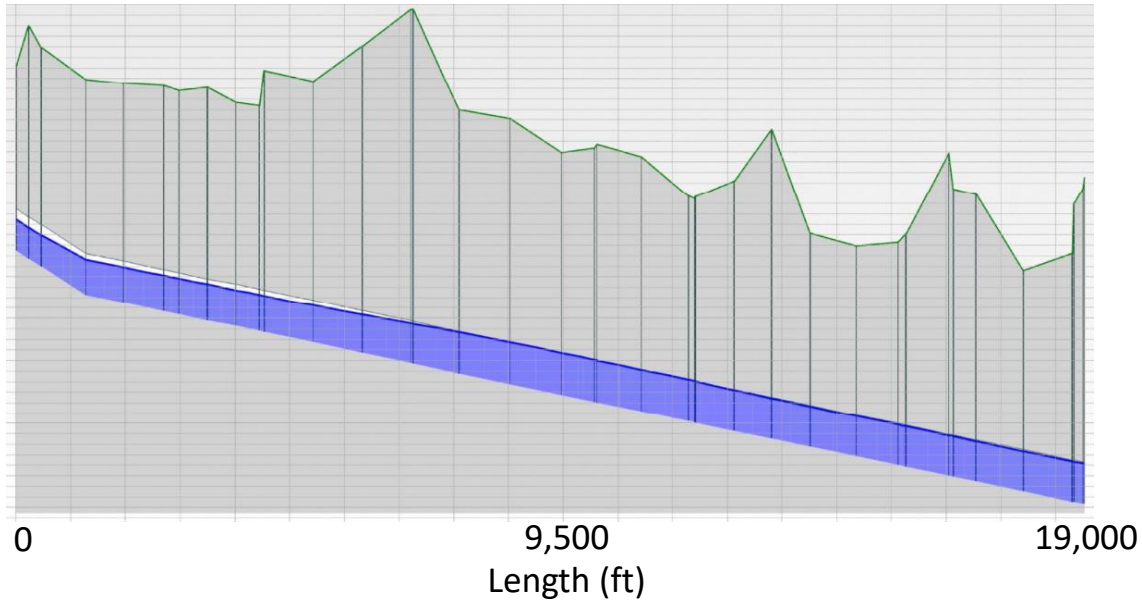


Modeling demonstrated the proposed parallel interceptor (up to 66-inch) could convey flow without surcharge

Proposed Improvements



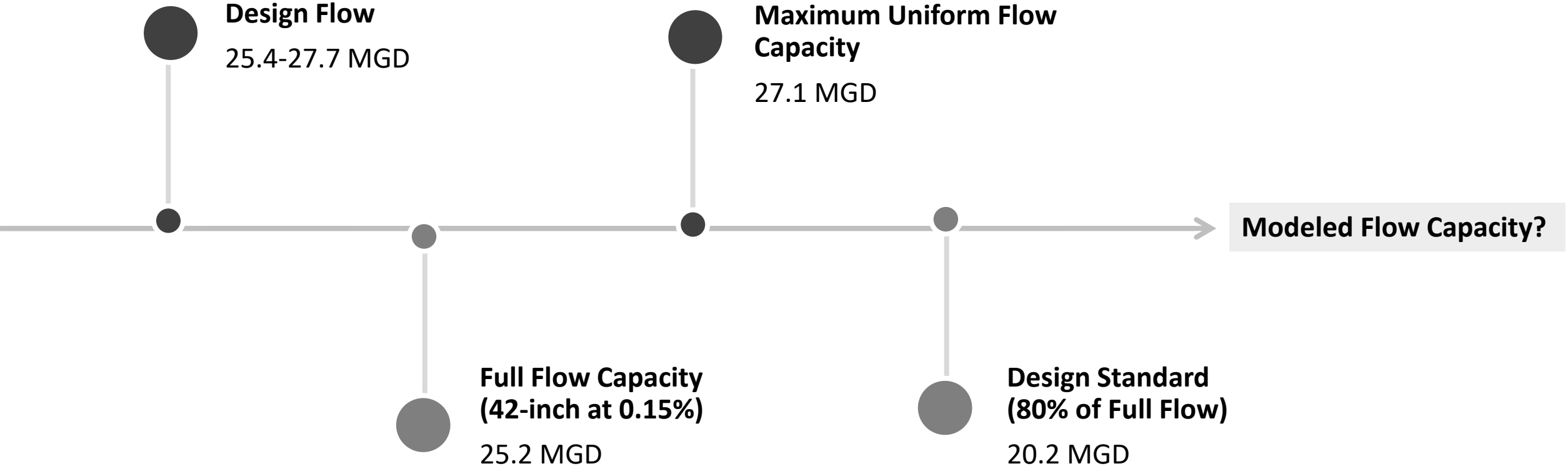
Existing 48-inch Line



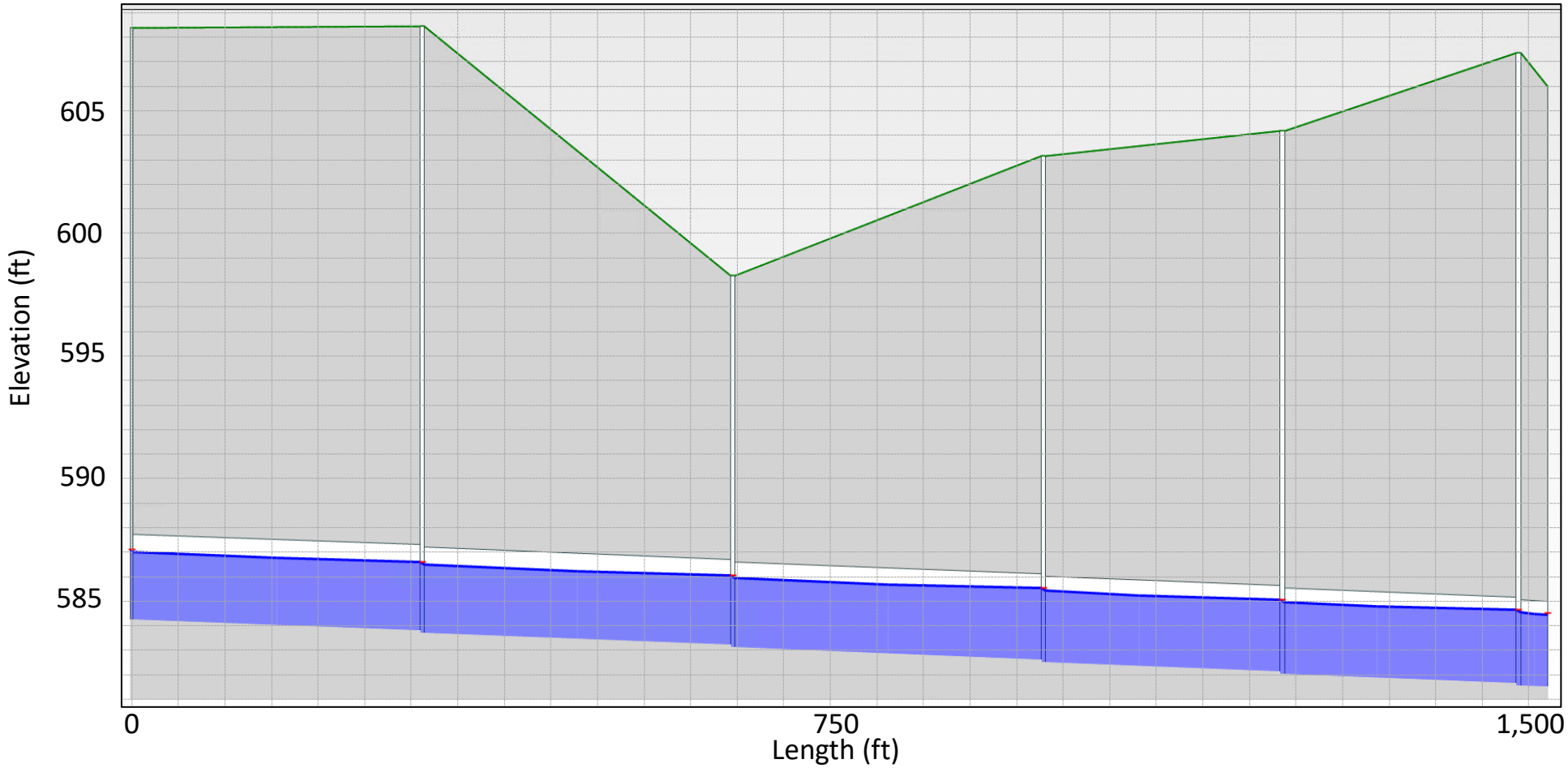
Design Flow: 109.3 MGD

Uniform Flow Capacity: 102.8 MGD

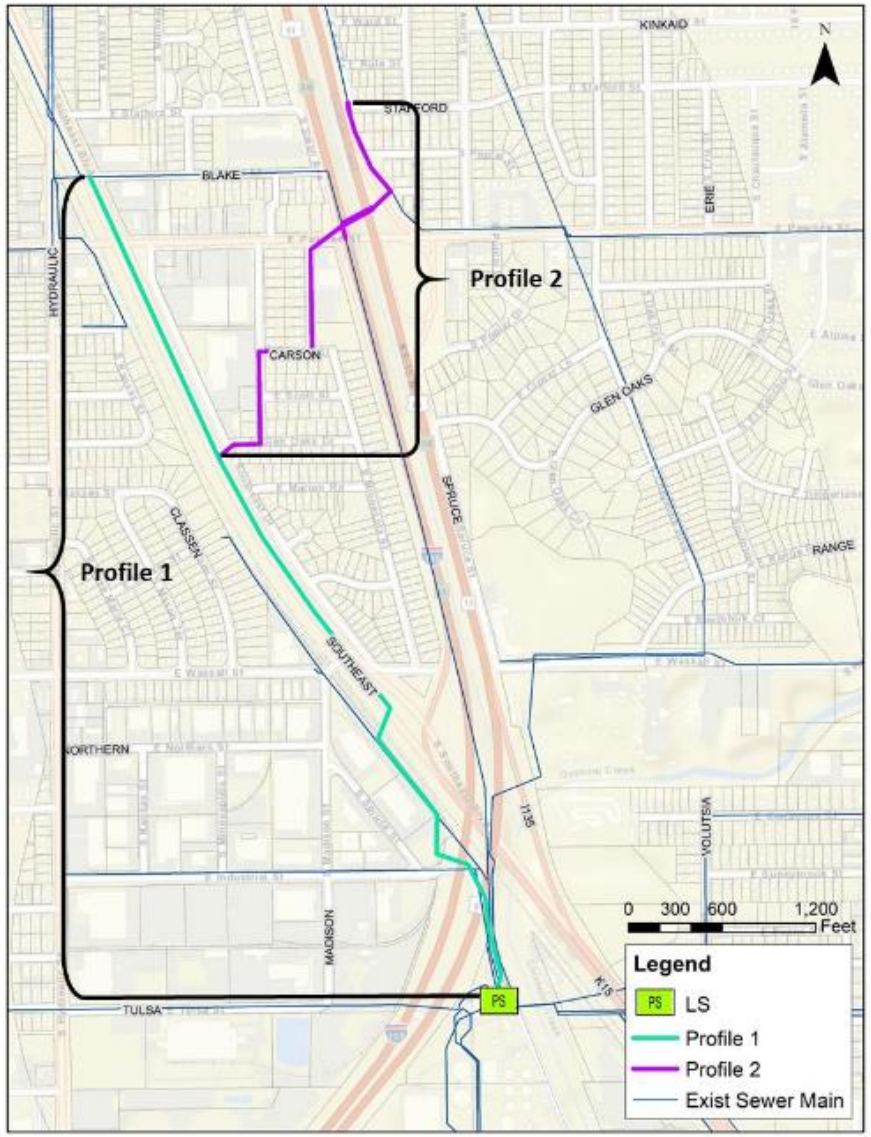
A utility in Central Texas was interested if an existing 42-inch interceptor had adequate capacity for proposed development



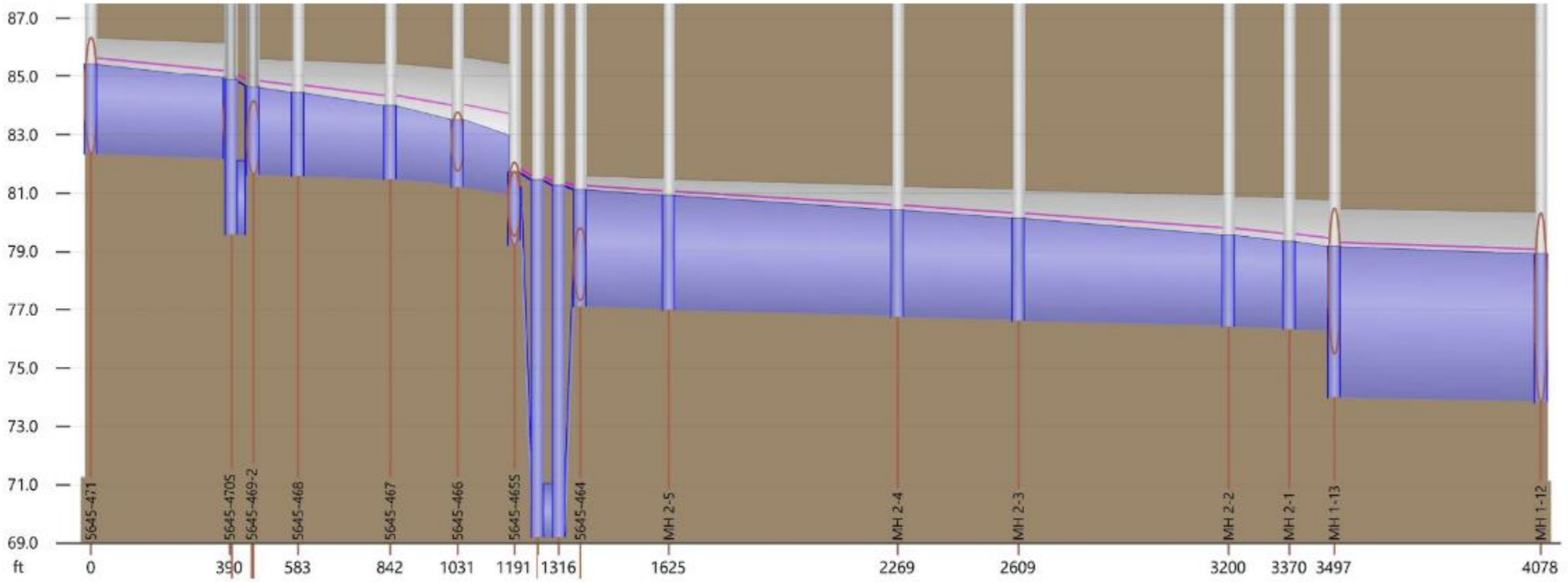
Modeling showed the existing 42-inch interceptor had sufficient capacity to convey flows without surcharging



A reroute of a major interceptor in Kansas had to be designed with slopes as mild as 0.02% due to vertical constraints

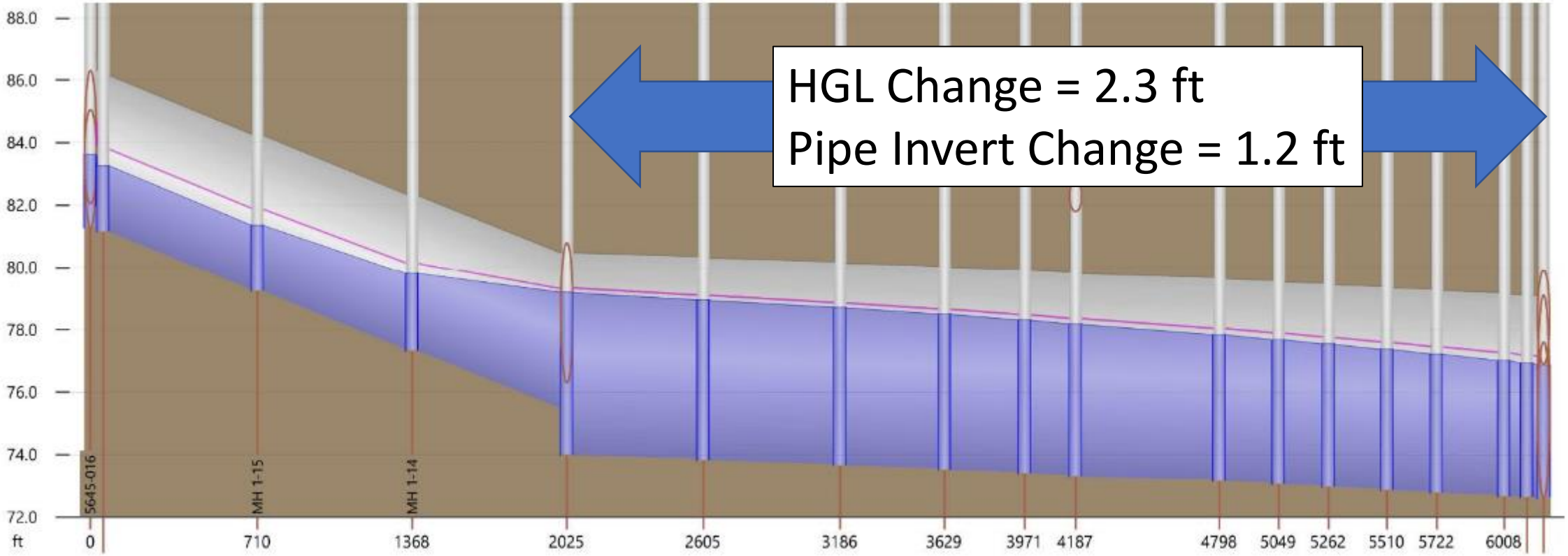


Modeling allowed identification of pipe sizes required to convey flows from the 10-year event without surcharge



Profile 2

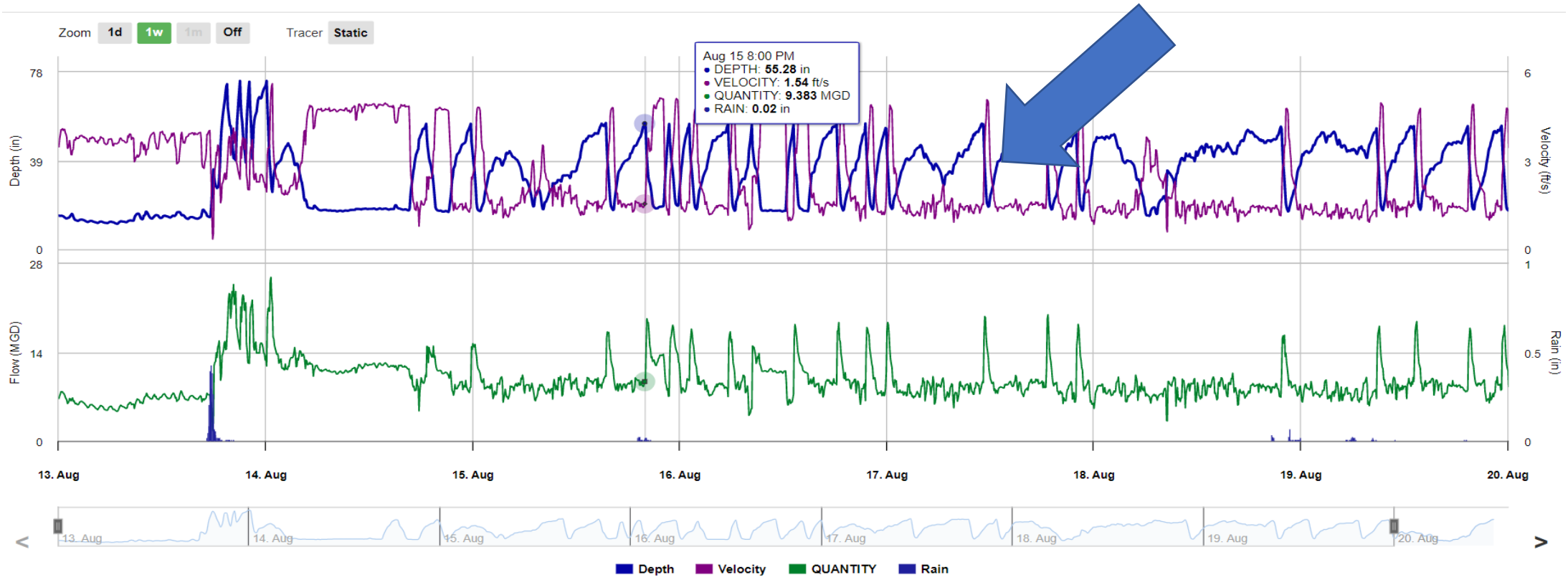
For large diameter lines at very mild slopes, the change in HGL can significantly exceed the bottom slope



Profile 1

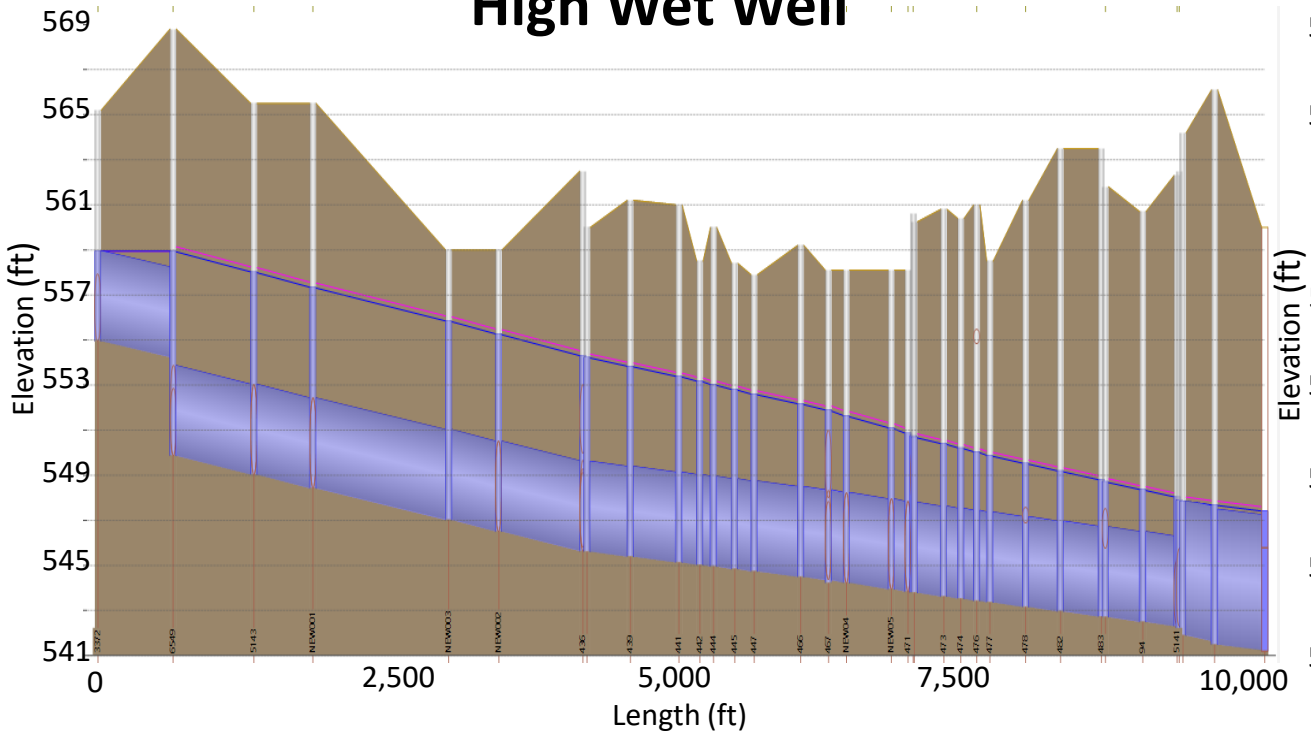
A utility in northern Alabama was experiencing capacity issues on their 36-/42-inch interceptor upstream of the WWTP

The downstream lift station wet well levels significantly impact interceptor hydraulics

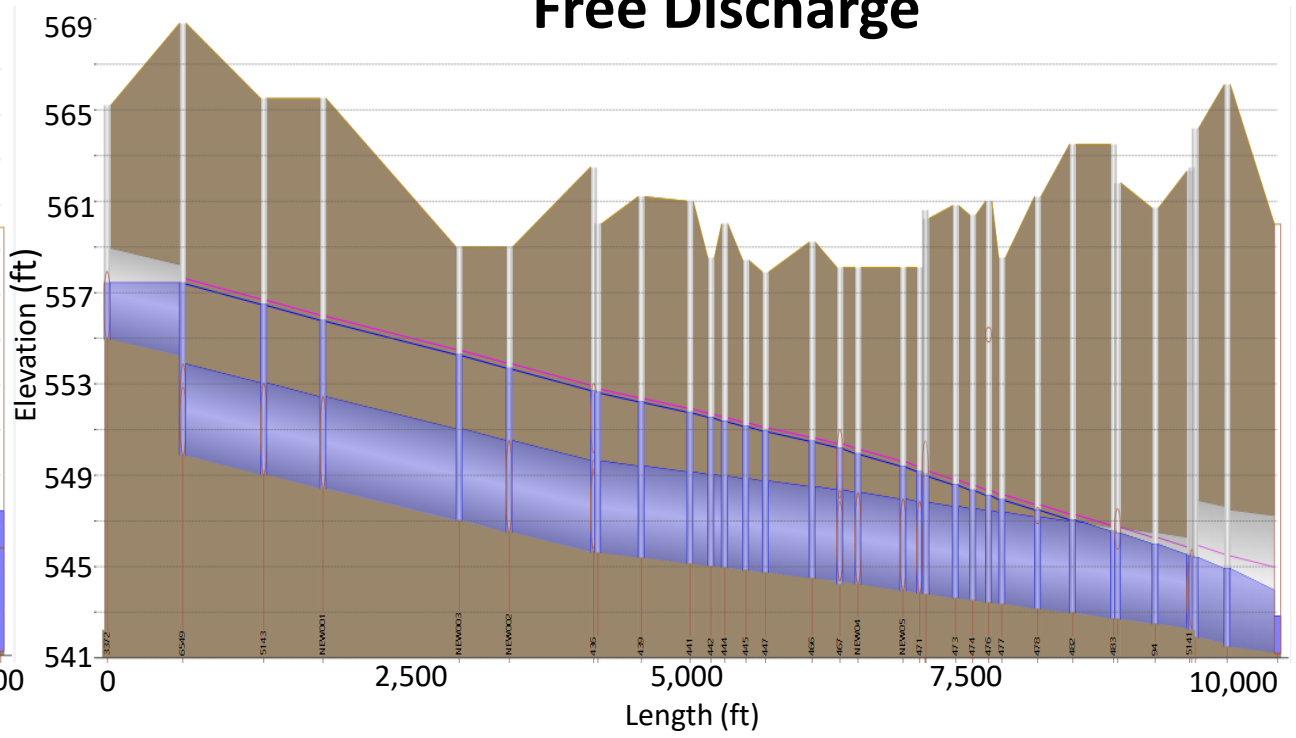


Modeling showed a parallel 48-inch interceptor would provide adequate capacity at a peak flow of 65 MGD

High Wet Well



Free Discharge



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Questions?

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