Underground Waterfalls

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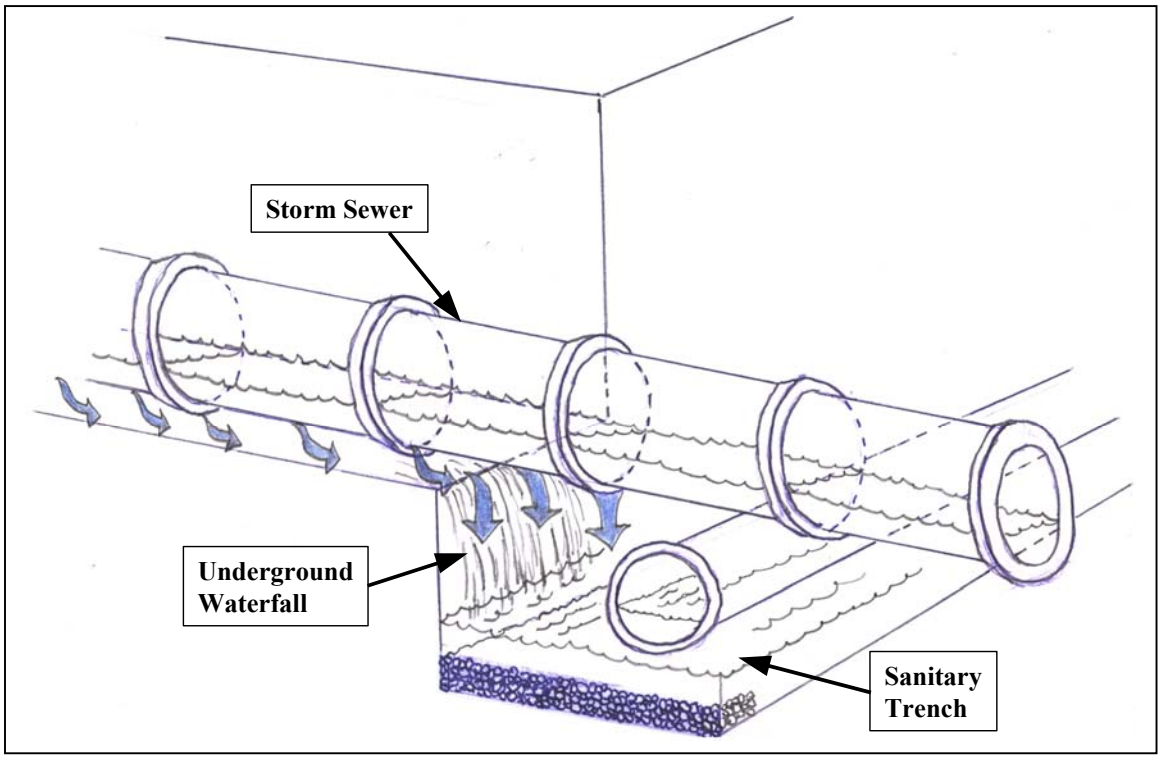
The Problem:

Identified more than 20 years ago[1], trench water migration continues to ruin the effectiveness of sewer rehabilitation projects throughout the separately sewered world. Rarely seen and perhaps never quantified, trench water migration is the movement of rainwater or ground water into and along utility trenches and sewer trenches. Storm water flows quickly out of intentionally open storm sewer joints into the shallow storm sewer trenches, flowing through the sand and gravel bedding until it falls into deeper sanitary sewer trenches.



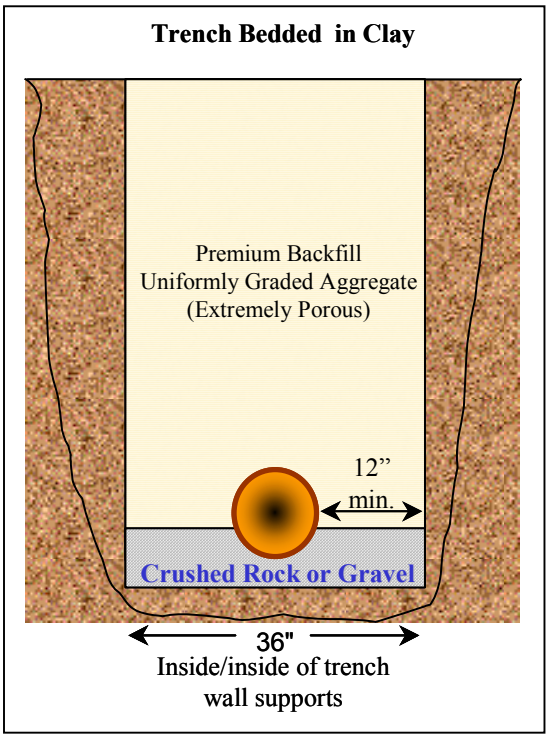
In the sanitary trenches water flows quickly down grade entering the sanitary sewers through every gap, crack and chink in the pipes or wye connections. It creates a spike on hydrographs that looks exactly like inflow, but it isn't. It's infiltration – very rapid infiltration.

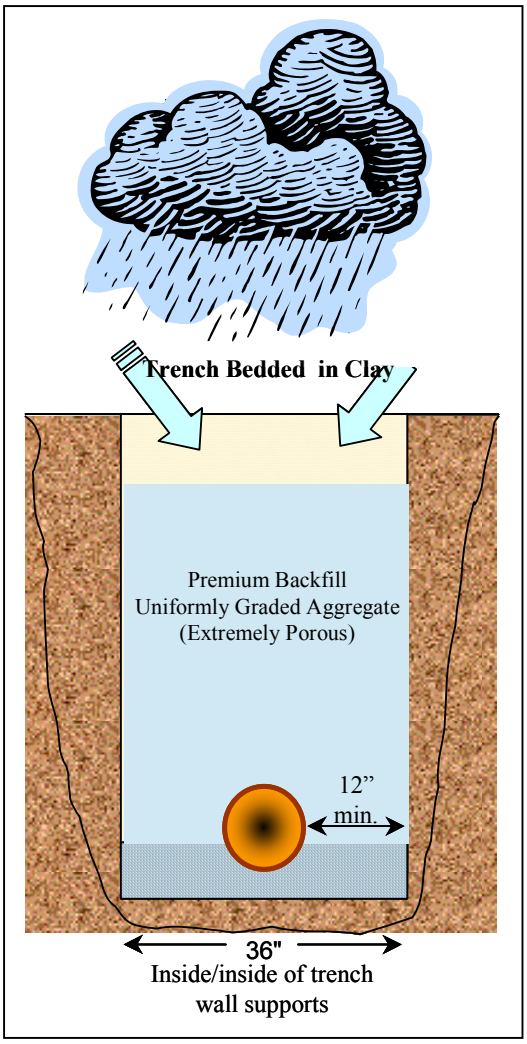
Rapid infiltration looks identical to inflow on hydrographs in most sewer systems. The problem is that rapid infiltration is one or two orders of magnitude more difficult and

[1] Steketee, C.H., "*Why EPA's I/I Control Program Fails,"* Public Works Magazine, July 1981.

more expensive to identify and remove from a sewer system. Many communities miss it completely during the SSES process. Further down the road, they wonder why all the expensive rehab had no discernible affect on I/I in their sewer systems.

In separate sewer systems, especially those constructed of vitrified clay or reinforced concrete pipe and situated in tight soils or bedrock, rapid infiltration is ubiquitous. It can flow through the trenches for miles always ready to enter the sanitary sewer through any crack, open joint or defective building lateral. It is so widespread and so similar to pure inflow in response to rainfall that the industry has coined a term to cover both of them: "Rainfall Derived Infiltration and Inflow" or RDII.





Experienced rehab engineers plan for it successfully and often achieve RDII reductions between than 50% and 90%[2]. Cookbook engineers (those who read the EPA Handbook for guidance) routinely misdiagnose rapid infiltration as inflow and fail

[2] Kurz, G.E., Stonecipher, P.A., Dillard, C.W., Ballard, G.A., Scott, L.B, Toosi, C.Q., *"Successful Sewer System Rehabilitation"* 1996, No-Dig Engineering, March/April

to remove much, if any, I/I from their sewer systems. Misdiagnosis can easily waste thousands or even millions of dollars of municipal money on ineffective rehab projects.

The Solution:
Give migration a face and emphasize it. Migration remains largely unknown 20 years after its discovery. It's treated as a detail in the EPA Handbook[3] rather than an important, widespread phenomenon that can ruin a poorly planned rehab project. Rewrite the Handbook. Emphasize migration, and illustrate it with a better picture than the poor one on the front of this abstract. The new Handbook needs to help "cookbook engineers" avoid the pitfalls of misdiagnosis. The same recommendation goes for WEF MOP FD6 which is currently being rewritten.

Recommend comprehensive rehab throughout entire subdivisions or neighborhoods. Although comprehensive rehab is currently mentioned in the EPA Handbook, as an alternative to traditional "Source-by-Source" rehab, the Handbook remains silent on the subject of which one is most effective. Conklin, Aldrich, Kurz and others have demonstrated that comprehensive rehab tends to be much more effective than Source-by-Source rehab. This knowledge needs to be published as widely as possible.

Clay or concrete dams installed in sanitary sewer trenches[4] can stop migration. They can be an integral part of an effective sewer rehabilitation program and can actually be too effective! Jurgens and Kelso showed that if the trench water isn't given a place to relieve itself, it can spring all the way to the surface. Using clay dams to redirect sanitary trench water back into storm sewer trenches can solve the upwelling spring problem while simultaneously recharging urban waterways with filtered water.

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[3] Smith, J., Bowker, P., Shah, H., *"EPA Handbook – Sewer System Infrastructure Analysis and Rehabilitation"* October 1991, EPA/625/6-91/030.
[4] Jurgens, D., Kelso, H., *"Sewer Rehabilitation Results, Ten Years Later,"* WEFTEC Annual Conference, 2003.