CITY OF HOUSTON
15+ Years of Sanitary Sewers Trenchless Rehabilitation

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HOUSTON PUBLIC WORKS

INTRODUCTION

- Houston At A Glance
- City of Houston (COH) Wastewater System Infrastructure

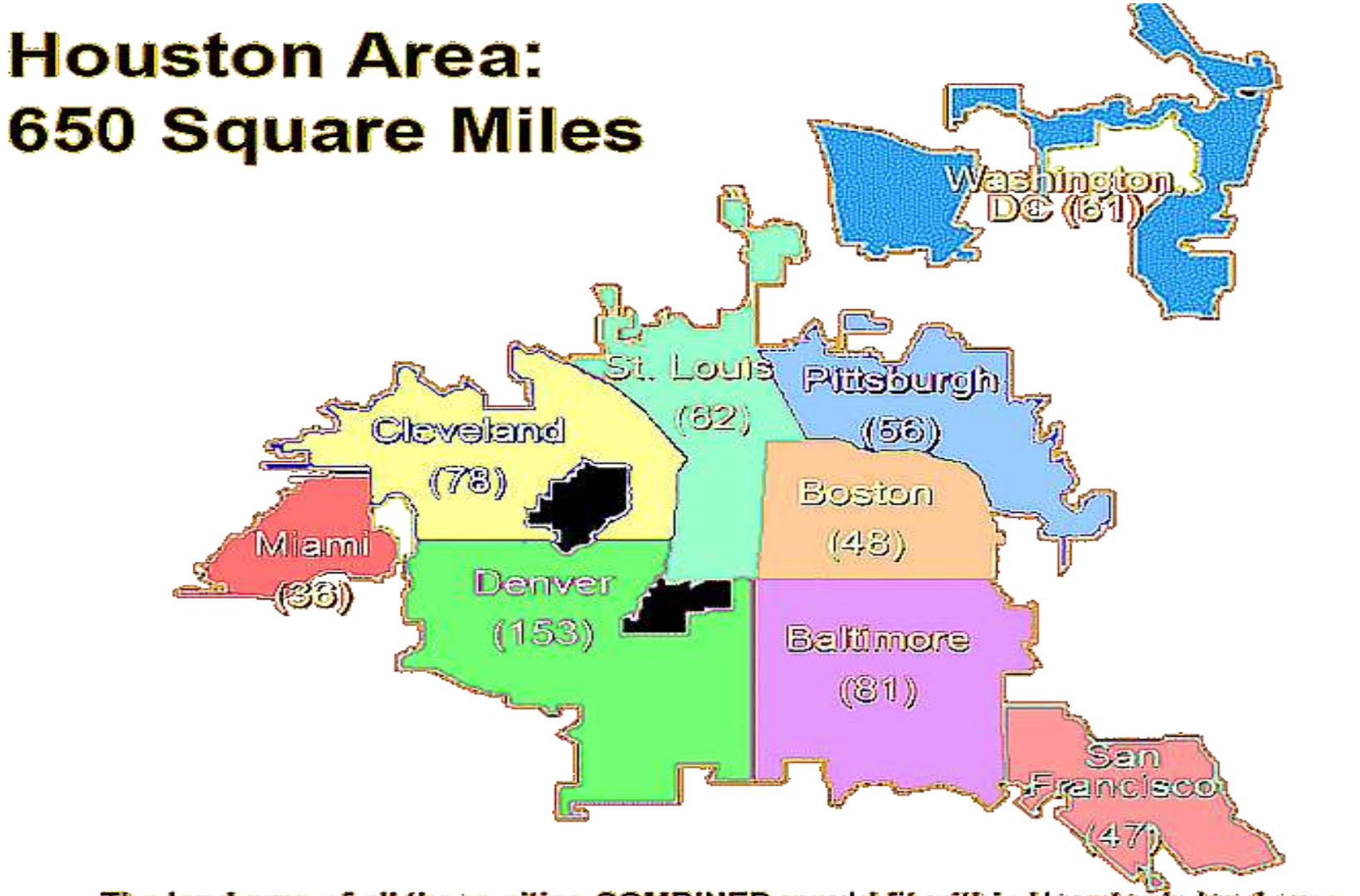
OVERALL COH SANITARY SEWERS REHABILITATION - ACCOMPLISHMENTS & VISION

- Last 15 Years of Accomplishments
- Last 5 Years of Most Used Rehabilitation Methods Footage & Cost Trends
- Current Rehabilitation Plan & Vision

COH SANITARY SEWERS REHABILITATION - CONVENTIONAL, RECENT ADVANCES, METHODS ADDED & CHALLENGES

- Conventional Methods, Critical Benefits of Recent Advances & Challenges
- Rehabilitation Methods Added & Critical Advantages
- Rehabilitation/Renewal Difficulties

Houston At A Glance

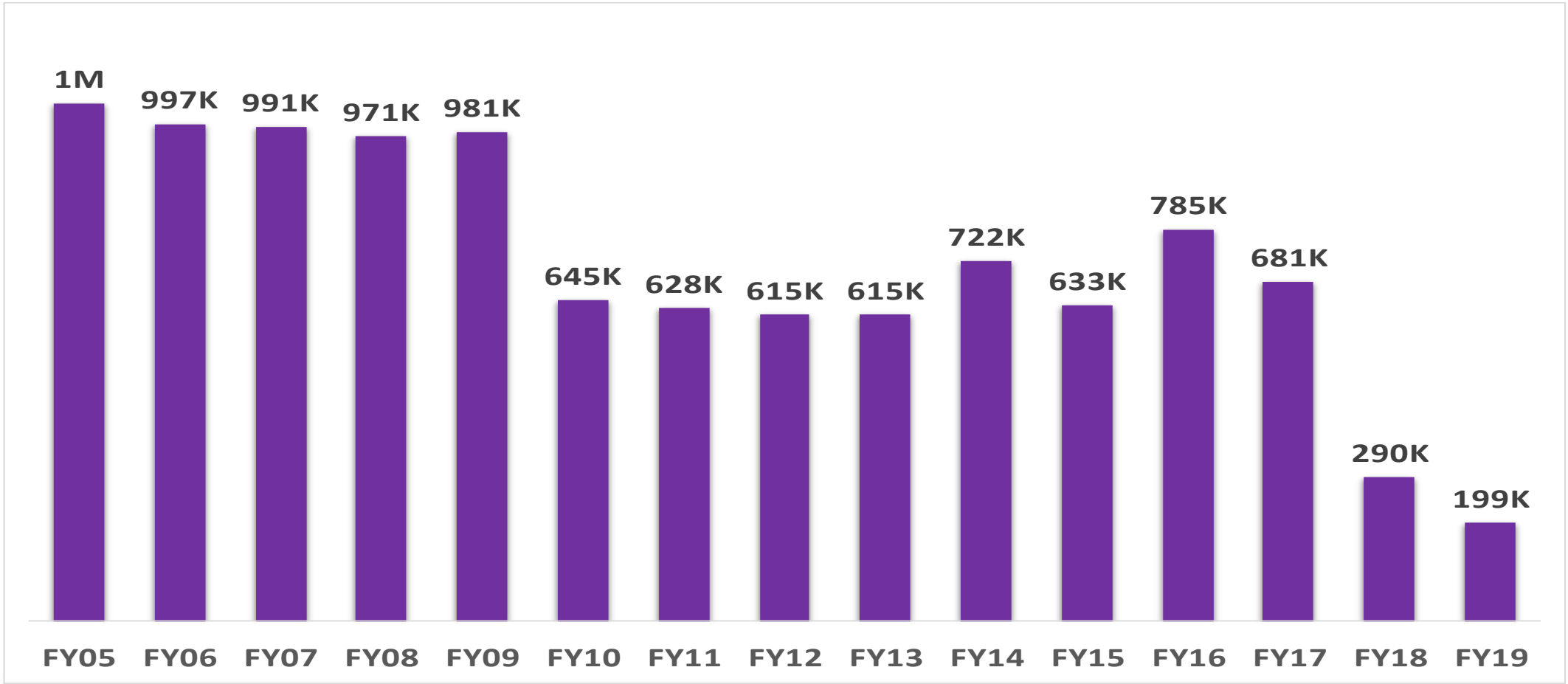


The land area of all these cities COMBINED would fit within Houston's land area.

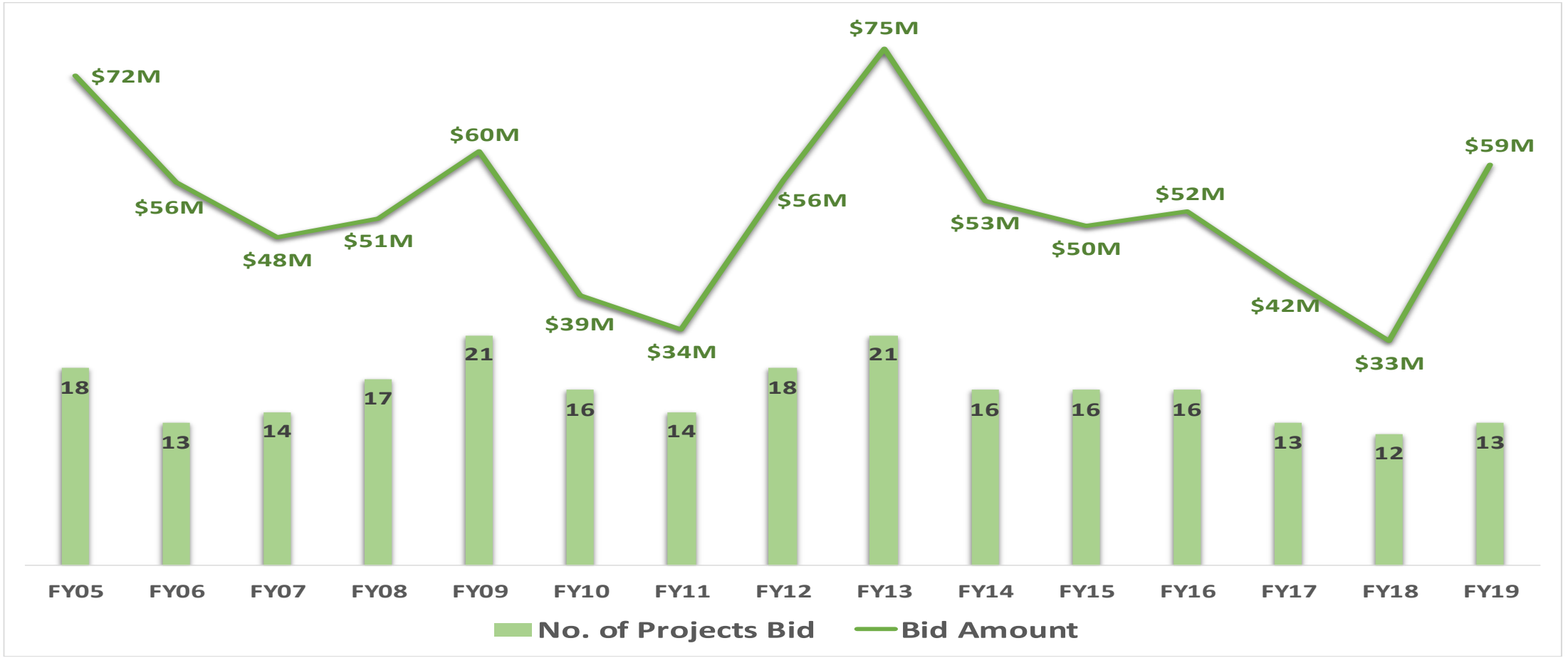
Wastewater Infrastructure

- 39 Permitted WRRFs
  - 239 MGD actual (5yr avg)
  - 565 MGD permitted
- 3 Wet Weather Facilities
- 383 Lift Stations
- 34.3 Mil LF Collection Lines
  - 6,200 miles
- 1.54 Mil LF Force Mains
  - 325 miles of sewer force mains
- 127,400 Manholes

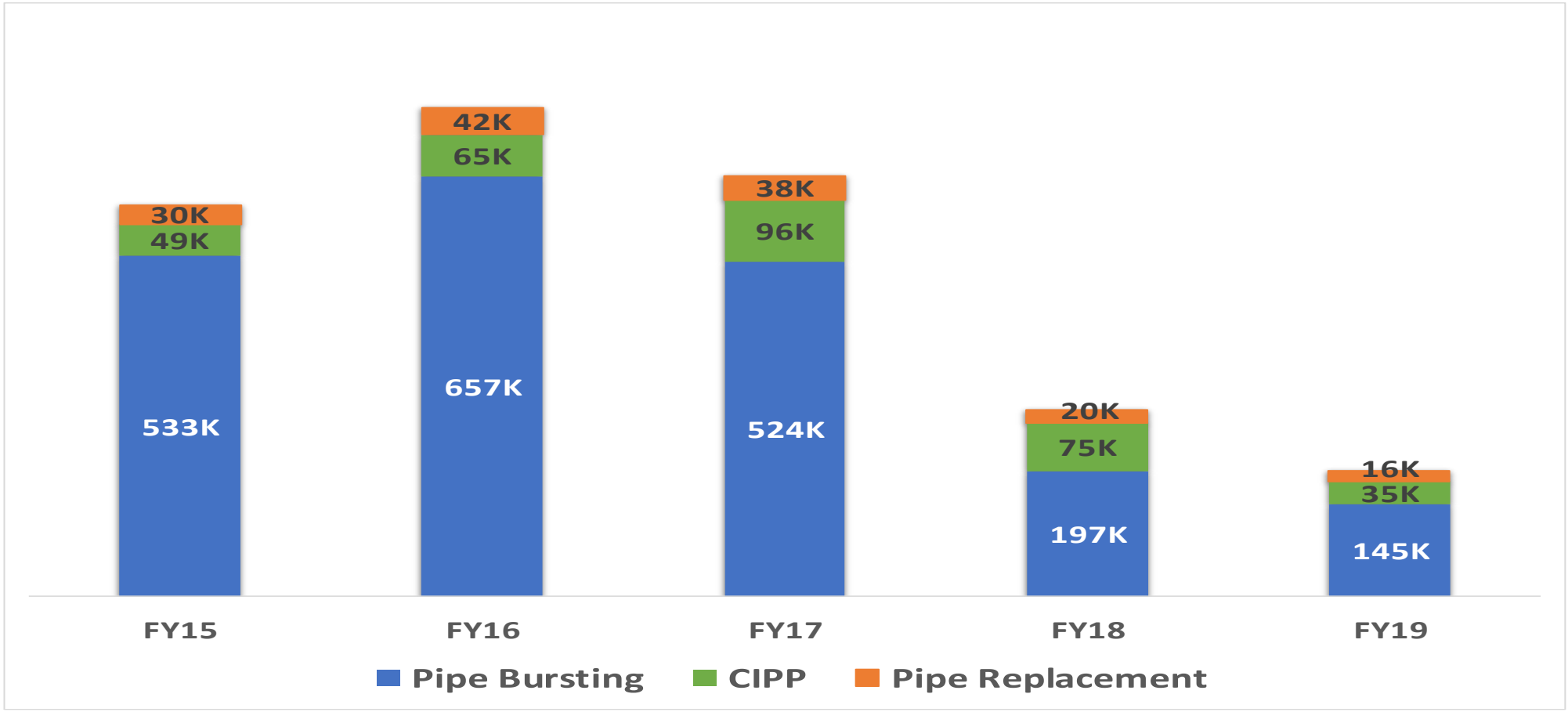
Last 15 Years Rehabilitation/Renewal Footage



Last 15 Years Rehabilitation/Renewal Contracts Bid

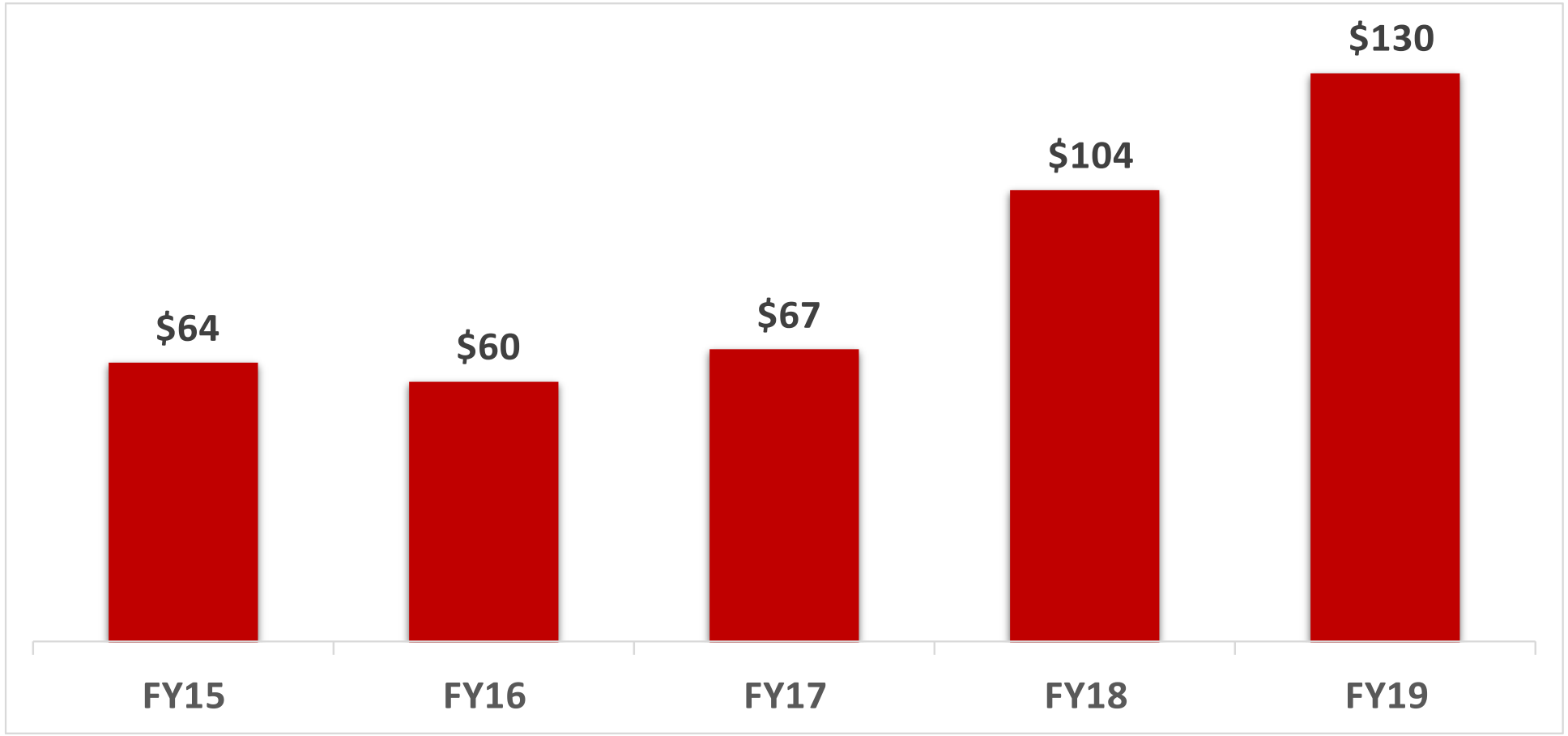


Last 5 Years Renewal Footage - Three (3) Most Used Methods



Last 5 Years Rehabilitation/Renewal Expenditures

Last 5 Years Rehabilitation/Renewal Cost Per Linear Foot



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Last 5 Years Rehabilitation/Renewal Cost Per Linear Foot By Project Type

Fiscal Year	Pipe Bursting	CIPP	CIPP (Large Diameter)	Combo
2015	$42	$67	$677	NA
2016	$44	$82	$905	NA
2017	$42	$83	$2,013	NA
2018	$66	$101	$655	$58
2019	$107	$201	$1,060	$69

CURRENT REHABILITATION PLAN & VISION

- **CURRENT REHABILITATION PLAN & VISION**
  - The City of Houston, Fourth Largest City in the USA, is continuing with trenchless rehabilitation of the sanitary sewers to ensure performing work which benefits most Houstonians in a timely manner. Below are the valuable benefits.
    - Least expensive renewal of sanitary sewers;
    - Least disruptive to the vicinity;
    - Trenchless/limited trench methods;
    - Dependable; and
    - Most efficient.
  - Currently City of Houston plans to rehabilitate more than 800,000 linear feet of sanitary sewers in a year.

CONVENTIONAL REHABILITATION METHODS & RECENT ADVANCES/CHANGES

- **SLIPLINING**
  - Size reduction worsens hydraulics – Used as last resort.

- **PIPE BURSTING**
  - Pneumatic method is a time-tested, cost-effective and most used method for COH.
  - Require sanded collar pipe to manhole connection to ensure soil & water-tight connections to eliminate infiltration sources and minimize potential sinkholes/cave-ins.
  - Remove existing liner in the sliplined sewers and pipe burst to increase the sewer size, where appropriate, to eliminate/minimize the bottlenecks.
  - Upsize sanitary sewers to improve hydraulics of the sanitary sewers with substandard slopes based on data (customer concerns, estimated sewage flow and etc. analysis.
  - Static method (costlier 3+ times pneumatic) has been added for use in specific cases with structures in the proximity over the sanitary sewers where pneumatic method is not feasible.
  - Hand excavation and deep hand excavation bid items have been added to accomplish renewal and sanitary services reconnection beside structures.

CONVENTIONAL REHABILITATION METHODS & RECENT ADVANCES/CHANGES

- **CURED-IN-PLACE PIPE**
  - COH utilizes felt as standard practice.
  - Perform crown repair of 36” and above diameter in lieu of point repair by removing the existing replacing portion of the pipe. Expedites backfilling of unsafe sinkholes with long-term fix by CIPP scheduled in due course.
  - Added fiberglass material as an alternate and is required in specific situations. The prominent benefit has been reduced thickness maximizing pipe diameter.
  - We started utilizing pressure rated CIPP liner for sanitary sewers rehabilitation crossing water lines. This minimizes potential impact due to waterline break pressures on the sanitary sewers.

COH SANITARY SEWERS REHABILITATION – METHODS ADDED

- **SLURRY BORING (8” – 12”)**
  - When rehabilitation of the existing sewer is not feasible, depending on the feasibility, slurry boring is utilized to install a new trenchless sanitary. Existing deteriorated pipe is abandoned.
  - Where feasible and as needed, slope of the proposed sanitary sewer is improved.

- **CHEMICAL GROUTING**
  - This method has been helpful in sinkholes/cave-ins/voids beside manholes which are damaged but have not sunk or collapsed.

- **SPIN CASTING (54” – 72”)**
  - This method provides a monolithic conveyance from manhole to manhole, including the manholes and avoid potential infiltration/exfiltration in vulnerable pipes.

SANITARY SEWERS REHABILITATION/RENEWAL DIFFICULTIES

- **PIPE BURSTING**
  - Difficulty connecting 6” sanitary service to 8” HDPE sanitary sewer. This has required reducing the 6” sanitary service to 4” prior to connecting to 8” sanitary sewer.
  - To avoid remove and replace of every long side service the existing 6” sanitary services are sliplined to 4” size.
  - Identifying sags of concern (1/2 pipe and above) and correcting.
  - Remove and replace of external drop connections, in view of practical difficulties, is avoided. These are deficiencies which could be I/I sources. We are currently evaluating options.
- **CURED-IN-PLACE PIPE**
  - Correcting overcut/mis-cut services in previous remote cutting of services is a challenge we are trying to solve.
  - Failure of connection between services and CIPP liner has occurred in multiple locations and we are evaluating alternates to improve.

SANITARY SEWERS REHABILITATION/RENEWAL DIFFICULTIES

- **SPIN CASTING (<54”)**
  - We hope to include this in the future Contracts to address sewers damaged with access from manholes difficult and other methods not feasible because of constructability issues.

- **INTERNAL MECHANICAL POINT REPAIR**
  - We utilized this method at some locations but have run into problems at other locations because of heavy infiltration. Hope to study more before including as a standard bid item.

- **DEWATERING CHALLENGES**
  - We experience substantial difficulties in dewatering at some locations which resulted loss of soil around the pipe. This resulted in sagging of rehabilitated pipes and horizontal mis-alignment of pipe installed at one location.

- **CHEMICAL GROUTING CHALLENGES**
  - Chemical grouting is difficult at locations with unstable soils and heavy groundwater flow.

CONCLUSIONS

- **Rehabilitation of the sanitary sewers is a cost-effective, least disruptive method of renewal.**
- **Starting efforts accomplish work that is low-hanging fruit and the later efforts accomplish work that is high-hanging fruit, which is difficult, time consuming and costlier.**
- **Over time we identify deficiencies in the previous work that has to be fixed and upgrade the specifications/details to avoid these in the following projects. Sanitary sewers rehabilitation is only as effective as the weakest link.**
- **It is important to avoid future problems by avoiding cross-bores of private utilities and properly designing utility crossings/conflicts.**

CONCLUSIONS (Cont'd)

- **Impact of underground ambient conditions changes, such as subsidence, groundwater changes, water wells operation, waterline breaks, storm sewer damages and etc., are not understood. It is suspected that in some cases these could be contributing substantially to sanitary sewers damages.**

- **Sanitary sewers rehabilitation for the City of Houston has proven to be of immense value to maintain Resiliency. This is evident in our ability to respond and repair promptly to catastrophic failures (sinkholes/voids/etc.) and avoid/minimize safety issues.**

- **Sanitary sewers rehabilitation provides a more sustainable solution because it utilizes lesser resources than alternates and offers long-term renewal.**

QUESTIONS?