Appendix C

Clean Water Nashville Overflow Abatement Program

GUIDANCE FOR DESIGN

WASTEWATER COLLECTION SYSTEM REHABILITATION

Version 7.0

April 2021

cleanwater NASHVILLE
OVERFLOW ABATEMENT PROGRAM

Table of Contents

List of Figures

Section 1

General Information

1.1 Purpose

The Designer shall use these guidelines to design and prepare the plans and specifications for wastewater collection system rehabilitation for the Metro Water Services' (MWS) Clean Water Nashville Overflow Abatement Program (Program). These guidelines are applicable to normal situations as defined herein and can be modified for individual project and site conditions.

These guidelines intend to:

- Present MWS' general approach towards sewer rehabilitation under the Program
- As far as practical, establish a uniform design practice among the rehabilitation projects to be constructed under the Program
- Describe items the Designer should consider when investigating conditions in the field
- Provide guidance on estimating quantities, especially when condition assessment data is unavailable.
- Present the design guidance upon which an evaluation of the plans and specifications will be conducted by the Program Management Team.

Additionally, users should also be cognizant of and follow MWS' adopted water and sewer standards, the Tennessee Department of Environment and Conservation's (TDEC) Design Criteria for Sewage Works, and applicable federal requirements. Recommendations from the Designer regarding any proposed deviations or unforeseen issues should be presented to the Project Manager and noted in the next design submittal. The Designer is strongly encouraged to contact the Project Manager if clarifications on these guidelines are needed.

1.2 Strategy

Sewer rehabilitation projects under the Program may consist of areas targeted for comprehensive rehabilitation and/or areas where only necessary repairs are made, i.e., the "find and fix" approach. The approach to rehabilitation for a project or in a certain area of a project will be described in the Project Summary.

For comprehensive rehabilitation projects, which represent the majority of rehabilitation projects within the Program, the primary goal for rehabilitation is to reduce the amount of rainfall-derived infiltration and inflow entering the collection system for a contiguous area. The secondary goal focuses on comprehensive infrastructure and asset renewal in the aged sewer system. In comprehensive rehabilitation areas, the rehabilitation design should evaluate each main sewer, manhole, and service lateral to the private property line or within MWS' easement except as noted. For 18-inch diameter sewers and smaller, the default Program approach will be to comprehensively rehabilitate all sewer segments, corresponding manholes and service laterals unless the sewer is previously lined, PVC, or cast/ductile iron pipe in good condition (no structural defects, no infiltration/inflow sources, no significant operations and maintenance defects). For larger diameter sewers (sewers greater than 18-inches in diameter), the available data, such as closed-circuit

television (CCTV) inspection data, should be reviewed to make design decisions by sewer segment and confirm the need to rehabilitate the sewer segment and corresponding manholes and service laterals. For large diameter sewers, all observed sources of infiltration/inflow should be addressed, taking into consideration the possibility of flow migration along the trench, and applying engineering judgement for construction and maintenance access conditions, continuity of rehabilitation work, diversion pumping setups, etc. In those cases, expansion of the large diameter pipe segments to be rehabilitated should be presented to MWS for detailed review along with conceptual-level construction costs developed in conjunction with the Program Management Team.

Not all small diameter sewer segments in a "fix and find" project area require rehabilitation. Some segments may have been previously lined, PVC, or cast/ductile iron in good condition. The Designer shall evaluate both small and large diameter sewers to determine where repairs are necessary and the most appropriate approach for those repairs. All observed sources of infiltration/inflow should be addressed, taking into consideration the possibility of flow migration along the trench, and applying engineering judgement for construction and maintenance access conditions, continuity of rehabilitation work, diversion pumping setups, etc. In those cases, expansion of the pipe segments to be rehabilitated should be presented to MWS for detailed review along with conceptual-level construction costs developed in conjunction with the Program Management Team. Repairs may range from point repairs (internal or external) to full segment lining with manhole and service lateral renewals. Only applicable portions of these guidelines should be applied to project areas identified as "find and fix".

1.3 Limited Data Availability

The availability of condition assessment data, such as CCTV inspection data, will vary by project. In some locations, CCTV inspection data may be available for nearly every sewer segment. Other projects and locations may have limited, scattered, aged, or no CCTV inspection data. The Designer is expected to analyze the available condition assessment data provided, conduct limited supplemental field investigations, make design recommendations, and produce the required deliverables. For locations where CCTV inspection or other condition assessment data is not available during design, the Designer is expected to prepare deliverables and estimate quantities utilizing limited field investigations and available data, such as geographic information system (GIS) data, record drawings, or condition assessment data from adjacent sewers within the project area. See **Section 7, Quantity Estimates** for additional guidance on estimating quantities where condition assessment data is unavailable.

Where condition assessment data is unavailable, the awarded rehabilitation contractor will be required to complete CCTV inspection for review and verification by the Construction Management Consultant prior to rehabilitation authorization. In those cases, it is recognized by MWS and CWNOAP that this design approach shifts parts of the rehabilitation analysis to field decisions during the construction phase and that the rehabilitation activities and final quantities will vary from the design drawings and quantities.

Section 2

General Considerations

2.1 Stormwater/Drainage Impacts

These rehabilitation projects may cause issues on private and public property by eliminating drainage routes for stormwater or allowing the emergence of groundwater. Unless included in the Project Summary, the rehabilitation design does not include a complete evaluation of the area's stormwater/drainage systems. The Designer should review the project area to ascertain and address likely additional flooding issues created by removing identified stormwater inflow sources such as those created by changing manhole frame/cover assemblies. Any areas identified with a high likelihood of potential issues should be discussed with the Project Manager. MWS will handle these situations on a case-by-case basis to prevent additional liability.

2.2 Stormwater Piping Reviews

When open-cut excavation is required in public pavement areas, the area's stormwater/drainage systems should be evaluated. Geographic information system (GIS) data and limited field investigations should be used to identify storm drains/piping that cross or closely parallel the open cut area, and the Designer should present this information to the Project Manager. MWS Stormwater will handle these situations on a case-by-case basis; however, it is anticipated that deteriorated storm drains/piping replacement will be included as part of the sewer rehabilitation project where full-width paving restoration in the public roadway is anticipated. MWS Stormwater will determine the need for stormwater pipe replacement and flow/sizing of the replacement pipe. The Designer shall design replacement pipes and associated appurtenances and include them on the drawings. This pipe design effort may be authorized by MWS as additional work under contractual allowances.

2.3 Water Quality and Erosion Control

The Designer shall follow MWS' stormwater guidelines (latest version) when developing the project design and shall utilize best management practices (BMPs) for all water quality and water control aspects. On the site design drawings, the Designer shall indicate appropriate typical water quality and erosion control details.

The Designer shall consider the minimization of stream buffer disturbances and delineate construction limits to control such; consider limits of construction to reasonably define cost-effective, necessary primary and support construction operations; designate logistically convenient and ample material "laydown" areas, access roadways, concrete washdown areas; and provide erosion control BMPs.

2.4 Diversion Pumping

The Designer shall consider diversion pumping needs for the rehabilitation project, paying special attention to large diameter sewers through greenways, roadways, wetlands, jurisdictional waterways, parks, golf courses, and other special use open lands. The Contract Documents shall include concept plans, as necessary, to establish conditions and constraints for environmental protection and continued public use / access. See Appendix E for a sample.

Section 3
Field Investigations

Unless defined in the Scope of Work, the Designer is not expected to perform full basin sanitary sewer evaluation surveys (SSES) such as smoke testing, flow monitoring, comprehensive manhole inspections, and comprehensive condition assessments as part of the rehabilitation project. These services may be performed by others under contract to MWS and/or by MWS. Available condition assessment data will be provided to the Designer.

The Designer is expected to perform limited data collection and limited field services to support the development of project designs. The specific field services required will vary based on the project needs and is intended solely to support the development of project designs. GPS-based surveying of manholes, the evaluation and documentation of manhole castings, and investigations to locate critical manholes may be included if noted in the scope of services. The performance of condition assessment data collection by specialty services firms is not required unless explicitly described in the Scope of Work. In general, the Designer should consider, but is not limited to, the following when developing their field investigation activities, although all aspects listed below may not be necessary for all projects:

- Identification of surface features and utilities at locations of external point repairs or pipe replacement
- General determination or confirmation of pipe materials in locations where no or conflicting information is available via condition assessment data, Metro's geographic information system (GIS) data, or record drawings
- Review of a sample of manholes with potential corrosion issues requiring epoxy or polyurethane liners (see Section 6.2)
- Review of manholes on sewers in close proximity to force main discharges for manhole bench modifications to full pipe height to improve flow conditions and reduce turbulence, hydraulic losses, and surcharging during high flow conditions
- Review of a sample of manholes located in the floodplain, in and adjacent to wetlands, or adjacent to water bodies for confirmation of watertight lids and/or the need to raise manholes
- Review of sewer segments located in and adjacent to wetlands, streams, wet-weather conveyances, or other water bodies to assess conditions and constraints for conceptual routing of diversion pumping
- Review of the proximity of the main sewer and service laterals to "blue line" streams, creeks, or water bodies as defined on USGS topographic maps and other wet-weather stormwater conveyances to determine permitting needs, especially when excavation (point repairs or service lateral renewals) is required
- Identification of land uses, such as schools, parks, industries, apartment complexes, etc., that may pose access or traffic control challenges during construction
- Identification of major roadways, such as TDOT roads or Metro "double yellow line" routes, that may pose traffic control challenges during construction

- Limited review of potential conflicts with surface structures, such as houses, sheds, or pools to assess their impact on the sewer rehabilitation work.
- Identification of other major utilities, i.e., transmission lines, to assess their impact on the sewer rehabilitation work.
- Identification of special use of open land, such as golf courses, common land of homeowner associations, etc., that may pose access or diversion pumping challenges during construction

The Designer is expected to utilize available information to efficiently develop the project's design. Utilization of Metro's GIS data, GPS survey data, record drawings, aerial photography, and publicly-available street-level imagery, such as Google Street View, or Bing Streetside, is encouraged to supplement and expedite/limit field investigations.

If the Designer is not familiar with the amount of construction traffic and sizes of vehicles associated with a specific aspect of the rehabilitation work, they are encouraged to visit a Program rehabilitation project that is currently under construction. The Program Project Manager can coordinate with the Construction Manager for visits to pertinent projects.

Section 4

Main Sewer Rehabilitation Considerations

4.1 Approach

The approach for rehabilitating main sewers in comprehensive and "find and fix" rehabilitation areas will remain as trenchless as practical within a reasonable cost. Cured-in-place pipe lining should be considered the default procedure for rehabilitation when full segment rehabilitation is required.

For 18-inch diameter sewers and smaller in comprehensive rehabilitation areas, if the existing sewer has been rehabilitated or is entirely PVC or cast/ductile iron pipe, then the CCTV inspection data should be used to evaluate the sewer's condition. For sewers constructed of those materials, if the inspection data indicates the sewer is in good condition, i.e., no structural defects, no infiltration/inflow sources, and no significant operations and maintenance defects, then no rehabilitation is required. For all other sewers 18-inches or smaller in diameter, rehabilitation should be included in the design. If no CCTV inspection data is available, the sewer should be identified for inspection during construction. For all sewers greater than 18-inch diameter, the available condition assessment data, such as CCTV inspection data, should be reviewed to justify and confirm the need to rehabilitate the sewer. If no CCTV inspection data is available, the sewer should be identified for inspection during construction.

When full or portions of project areas are identified as "find and fix" rehabilitation, the default approach that all small diameter sewer segments are rehabilitated (unless the sewer is previously lined, PVC, or cast/ductile iron pipe in good condition) does not apply. The Designer shall evaluate both small and large diameter sewers (regardless of pipe material) to determine where repairs are necessary and the most appropriate approach for those repairs. All observed sources of infiltration/inflow should be addressed, taking into consideration the possibility of flow migration along the trench, and applying engineering judgement for construction and maintenance access conditions, continuity of rehabilitation work, diversion pumping setups, etc. In those cases, expansion of the pipe segments to be rehabilitated should be presented to MWS for detailed review along with conceptual-level construction costs developed in conjunction with the Program Management Team. Repairs may range from point repairs (internal or external) to full segment lining with manhole and service lateral renewal. This information should be presented to MWS for review and concurrence.

If 6-inch diameter main sewers are identified in the rehabilitation area, the Designer is to verify the diameter and pipe material via limited field reviews and discuss these locations with the Project Manager. MWS may elect to retain the 6-inch diameter pipe or upsize these sewers via pipe bursting or open cut replacement. These situations will be handled on a case-by-case basis.

4.2 Cured-in-Place Pipe Lining

4.2.1 Structural Design Parameters

The Designer should determine the cured-in-place pipe lining's thickness using the American Society of Testing and Materials (ASTM) F1216 design guidance and assuming the following parameters. The resulting thicknesses will be used as the basis for bidding and should be provided on the drawings.

- The minimum acceptable cured-in-place pipe liner thickness for sewers 8-inches or larger in diameter is six millimeters following curing.
- Per the specifications, the default condition is assumed to be fully deteriorated for all 8-inch and 10-inch diameter segments because of the excavation potential of multiple services. Partially or fully deteriorated conditions for designing the cured-in-place pipe lining for 12-inch diameters should be determined by the Designer after reviewing CCTV inspection data and noted on the drawing tabulations. Partially deteriorated conditions for designing the cured-in-place pipe lining above 12-inch diameter is assumed unless otherwise determined by the Designer after reviewing CCTV inspection data. Partially or fully deteriorated conditions shall be noted on the drawing tabulations.
- To determine the groundwater height, if the sewer is located within 150 feet of a creek or other water body, the full distance between the pipe crown and the ground surface should be assumed. Otherwise, the groundwater level should be assumed as half the distance between the pipe crown and ground surface.
- The ovality for each sewer receiving cured-in-place pipe lining should be evaluated to the extent possible during design based on the CCTV inspection data. A minimum of two percent ovality should be used unless a larger value is determined. The Designer shall note pipe segments with ovalities exceeding the default value in the drawing tabulations.
- To determine soil depth, the depth from the manhole rim to the pipe invert at the upstream and downstream manholes should be evaluated. In most cases, this information will be provided as part of the CCTV inspection data. If depth information is not provided with the CCTV data and the missing depth information is significant, additional manhole depth data may be obtained from record drawings. Unless the area's topography indicates that a portion of the sewer may be significantly deeper, it should be assumed that the soil depth is the greater of the depths at the manholes.
- It should be assumed that the sewers beneath roadways carry AASHTO H-20 Live Loads with two trucks passing. Sewers passing under railroads should consider E80 Live Loads, unless the Designer verifies that the lined pipe will not experience these loads, e.g., the host pipe is in a casing or the railroad is an aerial crossing at the sewer location.
- A 1,000 pounds per square inch (psi) soil modulus should be used unless available data supports using a different value.
- The long-term flexural modulus should be estimated by multiplying the lowest short-term flexural modulus specified in ASTM F1216 by a 0.50 retention factor.
- To design the liner thicknesses for bidding, the minimum acceptable flexural modulus should be 300,000 psi, which assumes standard polyester resin. Specifications will offer the option to use an enhanced polyester resin for sewers with greater than 18-inch diameters to reduce liner wall thickness.
- A 2.0 safety factor should be applied to the thickness calculation.

4.2.2 Cleaning Prior to Lining

Prior to installing cured-in-place pipe lining, all sewers will undergo light or preparatory cleaning. In order to provide a bid quantity, the Designer should identify the need for heavy cleaning to remove roots, grease, or other debris based on the inspection data. Bid quantities may be increased over known quantities to account for areas where inspection data is not available. Known locations requiring heavy cleaning (not previously addressed by MWS from the CCTV reports) should be noted in the summary tables on the drawings.

Laterals protruding ½-inch or greater for pipe diameters smaller than 18 inches and ¾-inch or greater for pipe diameters equal to or greater than 18 inches will be removed by internal mechanical means aided by a CCTV camera prior to cured-in-place pipe lining. For locations where the configuration of the protruding service prohibits the passage of equipment to internally remove the protrusion, an external point repair may be required, The Designer should identify the need for removing protruding laterals and the required method. The protruding lateral locations should be quantified and tabulated in the summary tables on the drawings. Bid quantities may be increased over known quantities to account for areas where inspection data is not available.

4.2.3 Installation

Air inversion, water inversion, or pull-in-place installation is allowable for 15-inch diameter and smaller sewers. Water inversion is required for sewers of greater than 15-inch diameter. Water inversion is also required for segments with sags 30 percent or greater. These locations will require using jetting methods to remove the water in the sag. Any 15-inch diameter or smaller sewer where water inversion is required should be noted in the summary tables on the drawings.

4.2.4 Curing

Either hot water or steam curing is allowable for cured-in-place pipe sewers 15 inches in diameter and smaller. Hot water curing is required for sewers greater than 15-inch diameter. Hot water curing is also required for segments with sags 30 percent or greater. To address the potential influence on curing temperatures when high groundwater conditions are encountered, hot water curing is also required if the segment is under or in close proximity to a creek or other waterbody. Any 15-inch diameter or smaller sewer where hot water curing is required should be noted in the summary tables on the drawings.

Ultraviolet cured cured-in-place pipe lining is not approved.

4.2.5 Temperature Monitoring Systems

Temperature monitoring systems should be required during curing for sewers with diameter greater than 15-inches and for smaller diameter sewers that cross creeks or other water bodies. These locations should be noted in the summary tables on the drawings.

4.3 Point Repairs

When the main sewer will undergo cured-in-place pipe lining, the need for completing point repairs prior to lining should be assessed based on the CCTV inspection data. Point repairs should be included for the following scenarios:

- To accomplish the lining installation

- To remove notable intrusions of pipe, services, or foreign material that intrude into the pipe causing a significant reduction in capacity or preventing the installation of the liner
- To provide adequate clearance for normal setup CCTV inspection following lining installation
- To fill a large, visible void in the soil surrounding the pipe
- To address major sags where the normal setup CCTV camera lens is under water after lining
- To remove an area where a previous lining failure causing intrusion has occurred

When the main sewer will undergo cured-in-place pipe lining following the point repair, the point repair's length should be estimated based on the CCTV inspection data. If the main sewer will not undergo cured-in-place pipe lining and the sewer is either vitrified clay or unreinforced concrete pipe, point repairs should extend to the nearest joint.

Point repairs up to six feet long should be covered under a single bid item. For longer point repairs, the length in excess of six feet should be included in the excess point repair length bid item.

The point repair's depth and surface conditions should also be evaluated by using available data and limited field reviews. When developing bid quantities, point repairs delineated by surface type should be estimated by depth in two categories:

- Less than 10 feet deep
- Greater than 10 feet deep

Approximate locations, extents, and depths for point repairs should be included in the drawings.

Prior to initiating contractor-recommended point repairs not shown on the design drawings, the Construction Management Consultant shall review and verify their appropriateness.

4.4 Replacement

4.4.1 Approach

It is generally recommended to completely replace an existing manhole-to-manhole sewer segment using pipe bursting or open cut replacement when any of the following conditions apply:

- Three or more point repair locations are identified on an individual pipe segment
- The point repair length exceeds 25 percent of the sewer length
- The point repair cost exceeds 50 percent of the replacement cost

If 6-inch diameter main sewers are identified, MWS may choose to upsize or retain these sewers.

Locations identified for manhole-to-manhole replacement must be presented to the Project Manager. Following the Project Manager's concurrence, the replacement locations should be clearly identified on the drawings along with plans and profiles from the Designer's topographic survey.

4.4.2 Utilities

If pipe bursting or open cut replacement is required, major utilities in the replacement area and the potential impact to these utilities should be identified. A full utilities survey of the replacement area is not anticipated to be conducted, but known, major utilities should be included on the drawings to the extent that information is readily available.

4.4.3 Pipe Bursting

Pipe bursting is the preferred replacement method if significant above-ground obstacles exist and if the existing sewer alignment and/or grade is acceptable.

Although pipe upsizing is expected to be limited, pipe bursting to upsize sewers should be closely evaluated to assess potential disruption, trench rock wall confinement, and heaving of the above-ground terrain especially with shallow sewers. Also, the hindrance potential of existing concrete pipe encasement or ductile iron pipe material should be considered when evaluating pipe bursting to replace and/or increase the sewer size.

4.4.4 Open Cut Replacement

Open cut is the preferred replacement method if the length to be replaced is short or if the existing sewer's alignment and/or grade is unacceptable.

4.4.5 Laterals Associated with Main Sewer Replacement

If the main sewer is replaced via pipe bursting or open cut methods, the associated service laterals shall be replaced to the private property line or edge of easement.

4.5 Testing, Acceptance, and Documentation

4.5.1 Post-construction Video Inspection

The contractor is to conduct a post-construction CCTV inspection for each main sewer after completing all construction activities, including rehabilitating service laterals and manholes. The Construction Manager will review these videos for acceptance.

For cured-in-place pipe lining and replacement sewers with larger than 18-inch diameters, the contractor is to conduct a CCTV inspection of the manhole-to-manhole system after completing the laterals rehabilitation in a high groundwater condition.

4.5.2 Air Testing

For 18-inch diameter and smaller sewers undergoing cured-in-place pipe lining, the contractor is to conduct low-pressure air testing after completing the main sewer lining and prior to reinstating service laterals.

Additionally, for lining and replacement sewers with 18-inch and smaller diameters, the contractor is to conduct low-pressure air testing of the manhole-to-manhole system or each lateral connection individually after completing lateral rehabilitation.

If a liner does not pass the test, the contractor may be provided the following options to address the issue as approved by MWS:

- Address the connection area or the lateral if determined that is the issue.
- Issue a credit if MWS determines that the potential impact is minor
- Reline the segment after removal of the defective liner

It is generally not desired by MWS to repair a failing lined segment with a second liner due to the resulting decreased internal pipe size and flow capacity. An assessment of the hydraulic limitations

relative to the site conditions is necessary prior to installing a second liner or lining a previously lined segment.

Section 5

Service Lateral Rehabilitation Considerations

5.1 Approach

In areas targeted for comprehensive rehabilitation and/or sewer segments fully rehabilitated under the "find and fix" approach, rehabilitation of active service laterals within the right-of-way or easement should occur through lateral cured-in-place pipe lining or replacement. Cleanouts should be installed on all rehabilitation service laterals at the point of re-connection.

Aside from the installation of cleanouts, the general approach for rehabilitating service laterals should remain as trenchless as practical within a reasonable cost. When the lateral's condition is acceptable for lining, service laterals under roadways should be rehabilitated through cured-in-place pipe lining. Service laterals located outside of the roadway in easement areas may be replaced in lieu of cured-in-place pipe lining. However, in many cases, field/ surface conditions or the condition of the lateral itself may necessitate alternate rehabilitation approaches. **Figure 4-1** depicts the design approach and the decision tree that will be also used during construction to select the appropriate lateral rehabilitation method for given lateral site conditions. For the purposes of developing contract documents, the Designer should review available data to estimate bid quantities associated with service lateral rehabilitation. The lateral rehabilitation technique for each individual lateral does not need to be shown on the drawings; however, if special circumstances observed during the review of available data require a certain rehabilitation technique for an individual lateral, this should be noted in the summary tables of drawings.

All lateral locations observed in CCTV inspection data should generally be tabulated on the drawings. The numerical sum of laterals on each side of the segment should be shown on the drawings. Known service repairs will be shown on the drawings. The Designer should consider the construction method of services stubbed-out of manholes (such as in cul-de-sacs and ends of lines) for quantity and representation also. If CCTV inspection data is incomplete or unavailable, the number of laterals should be estimated and should correspond to the building units unless better information is available.

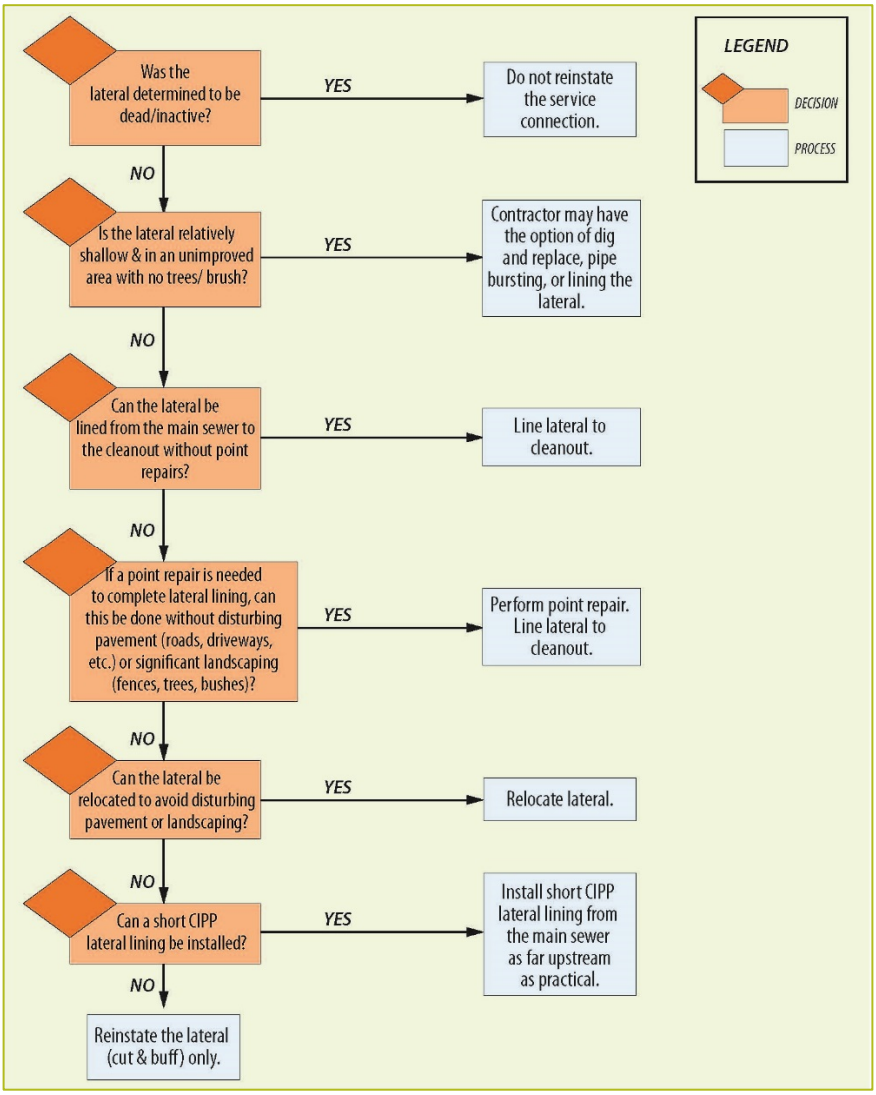

Figure 5-1 Approach for Selecting Lateral Rehabilitation Methods

5.2 Active Laterals and Inactive/Dead Laterals

By default, active service laterals within the right-of-way or easement will be rehabilitated to the private property or easement line. Inactive/dead laterals should generally not be rehabilitated or reinstated by the contractor following rehabilitation of the main sewer. Buildable parcels may have the inactive lateral renewed upon field determination on a case-by-case basis by the Construction Manager to maintain the existing MWS level of service to the parcel. No new installation provision for laterals to undeveloped parcels should be included in the rehabilitation project.

Single laterals serving more than one parcel or building will not be automatically updated to allow each parcel to be served separately. In most cases, if the lateral is located in public roadway areas, it will not be separated; however, locations in easements may be separated unless the depth or location is prohibitive. Special provisions around the cleanout may be determined such as installation of separated cleanouts on each service. These will be decided on a case-by-case basis in the field by the Construction Manager. If the project area is known to have such cases, pay items may be established by the Designer in consultation with the Project Manager to address this issue.

5.3 Lateral Cured-in-Place Pipe Lining

Lateral cured-in-place pipe lining is the preferred method for lateral rehabilitation under public pavement unless a lateral defect requires open cut repair. Alternative trenchless lining means may be also field considered in accordance with Figure 4-1. Although inspection data for the full lateral is unavailable to the Designer, the Designer should review the CCTV inspection data for the main sewer in order to assess the viability of using cured-in-place pipe lining in the lateral in order to estimate bid quantities.

Cured-in-place pipe lining in the lateral should also be specified in easement areas where lateral replacement may disturb utilities or significant private property, such as structures, pavement, or landscaping or be of prohibitive excavation depth. Laterals crossing "blue line" streams, creeks, or water bodies should also be considered for trenchless renewals to minimize environmental disturbance. "Blue line" streams are defined as any water body shown as a blue line on a USGS topographic map. To the extent possible, the Designer should assess these locations to establish bid quantities, to define locations where further investigation by the contractor is required, and to properly depict them on the drawings.

5.4 Lateral Replacement

Lateral replacement via open cut or pipe bursting methods is permitted in easement areas where replacement will not disturb significant private property, such as structures, roadway pavement, or landscaping.

Lateral replacement may also be necessary for laterals that cannot be lined due to condition. However, to the extent possible, lateral work should remain trenchless.

5.5 Short Lateral Cured-in-Place Pipe Lining

Short cured-in-place pipe lateral lining may also be used when full-length cured-in-place pipe lining and replacement are not viable methods for lateral rehabilitation. No cleanout will be required for these locations. Because data describing the condition and configuration of laterals is generally unavailable, the Designer in consultation with Project Manager should estimate bid quantities for short lateral cured-in–place pipe lateral lining.

5.6 Cleanouts

Cleanouts will be installed on all service laterals as close as practical to the private property/right-of-way line or easement line unless field conditions prohibit installation. It is NOT desirable to place the cleanout in a ditch or waterway, and those locations should be avoided for construction. The installed cleanouts will be able to sweep towards the main sewer or towards the house (double-sweep) and will be installed in a cleanout box. The cleanout box will be a fiberglass/composite material unless located in pavement or an area ostensibly used for regular vehicle egress/ingress or parking. For those locations, a metal box will be installed. The Designer should estimate the number of metal cleanout boxes to be installed to establish bid quantities.

5.7 Cleanout and Lateral Repairs on Private Property

For locations where smoke testing data is available as indicated in the Project Summary, the Designer will review and summarize the location and type of positive smoke tests located outside right-of-way or MWS's easement. The summary provided to MWS should include the Designer's evaluation of the

likelihood of the defect allowing infiltration or inflow to enter the sewer, i.e., high, medium, low from the smoke testing data and limited field reviews. MWS will review this summary information to determine if pursuing repairs on private property is warranted. This decision will occur on a project-by-project basis. If repairs are warranted, MWS may contact the property owner to notify them to make the required repair (typically limited to commercial and industrial customers) or gain Right of Entry(s) to perform the repair in conjunction with the rehabilitation project (typically residential customers). If the repair work will be conducted as part of the rehabilitation project, the Designer shall provide information on the defects and necessary repairs on the plans and summary tables included in the drawings.

5.8 Testing, Acceptance, and Documentation

5.8.1 Post-construction Video Inspection

The rehabilitated lateral will undergo CCTV inspection, conducted by the contractor, extending 10 feet past the end of the rehabilitation work, such as past the installed cleanout re-connection point. The Construction Manager will review these videos for acceptance.

5.8.2 Air Testing

Following lateral rehabilitation, the full system (main sewers and laterals) will undergo a low-pressure air test. The contractor may have the option to test each lateral-main sewer connection individually in lieu of a full system test. On sewers larger than 18-inch diameter, air testing individual service/connections shall be performed.

If a lateral does not pass the test, the contractor typically may be provided the following options to address the issue as approved by MWS:

- Issue a credit if MWS determines that the potential impact is minor
- Correct the leak using chemical grouting
- Reline the lateral
- Replace the lateral

It is generally not desired by MWS to repair a failing lined, lateral with replacement by open cut methods, especially if it is located within the public roadway.

Section 6

Manhole Rehabilitation Considerations

6.1 Approach

In areas targeted for comprehensive sewer rehabilitation or "Find and Fix" approach, all manholes for which sewer segment lining is proposed should also be rehabilitated. In addition, defective manholes on PVC, iron, or previously lined segments shall be rehabilitated.

6.2 Manhole Lining

Manholes should predominately have cementitious lining installed. A ½-inch thick cementitious liner should be installed in concrete manholes in good condition. For brick manholes or concrete manholes with structural defects or noticeable infiltration, a 1-inch thick cementitious lining should be installed.

Epoxy or polyurethanes liners should only be required in the following specific situations:

- Manholes downstream of force mains
- Manholes greater than 12 feet deep
- Manholes on sewers greater than 12-inch diameter
- Manholes with appreciable corrosion

The Designer should review available CCTV inspection data or perform limited, non-comprehensive individual manhole inspections to assess the type of lining required. Manhole inspection data per se is not typically available. If manhole depths were not collected as part of the CCTV inspection and missing depths are significant and cannot be reasonably estimated, manhole depths may be obtained from available record drawings. The Designer should show the enhanced type of manhole lining on the drawings.

6.3 Manhole Curtain Grouting

Exterior manhole curtain grouting (acrylamide) will be required prior to manhole lining when infiltration runners or gushers are observed. Using available inspection data or data obtained through limited manhole inspections, the Designer should assess the need for manhole curtain grouting to establish a bid item and bid item quantities.

6.4 Manhole Replacement

Manhole lining is preferred over manhole replacement. Manhole replacement should be included when the existing manhole shows enough severe structural deterioration that the lining alone would be inadequate. Manhole replacement may be considered and will be required for intermediate manholes when the adjacent sewer is being replaced via open cut or pipe bursting.

6.5 Chimney Seals

Chimney seals are not required or promoted. The manhole lining will overlap the connection between the casting/frame and the manhole wall to accomplish a similar seal of the chimney.

6.6 Manhole Frames and Covers

Using CCTV inspections and other available data, the Designer should evaluate the existing frame and cover assembly to determine whether or not it is at the proper elevation. Any manholes known to require grade adjustment should be identified on the drawings. A bid quantity should be established that includes both known and estimated grade adjustments

Using CCTV inspections and other available data, the Designer should review manhole covers to determine if they are sound and are the appropriate type for the location, e.g., watertight covers near creeks. If the existing cover is defective or is not the appropriate type, the Designer should identify on the drawings an appropriate frame and cover assembly for replacement and establish the bid quantity with additional assumed cover replacements for discovered inappropriate type or defective manhole covers.

Using CCTV inspections, limited field reviews, and other available data, the Designer should also identify known locations of defective or broken frames or covers where replacement is necessary. These should be included on the drawings and in the bid quantities.

6.7 Ladder Rungs/Steps

Manhole ladder rungs/steps in rehabilitated manholes should be removed for safety and rainfall-derived infiltration and inflow control unless the Designer, in consultation with the Project Manager, excludes for a specific reason.

6.8 Manhole Benches

When located on sewers downstream of a force main discharge or on sewers 12-inches in diameter or larger, manhole benches should be raised to match to the crown of the outlet pipe, thus providing improved hydraulic capacity for full pipe flow. Manholes where the sewer turns may also need to be considered for enhancements to the bench and channel to improve hydraulics. These should be included on the drawings and in the bid quantities. The Designer should consult with the Project Manager for such situations on a project.

6.9 Testing, Acceptance, and Documentation

6.9.1 Post-construction Inspection

The Construction Manager will visually inspect manholes post-construction for acceptance. If needed to complete the visual inspection, the Construction Manager will request a CCTV inspection by the contractor for rehabilitated manholes that are difficult to access or view.

6.9.2 Vacuum Testing

A low-pressure vacuum test will be required for all manhole lining types on manholes with lines less than 18-inches in diameter. Visual high groundwater observations will be performed by the Construction Manager on larger line diameter manholes.

Section 7

Quantity Estimates

7.1 Approach

Using the above guidance, the Designer is expected to provide a complete list of estimated quantities utilizing the standard bid items provided, as requested in the Scope of Work. Additional bid items may be added to this list as needed. This list will allow the Program to update the Opinion of Probable Construction Costs (OPCC) for the proposed rehabilitation improvements. If defined in the Scope of Work, the Designer may be required to develop the OPCC in lieu of the Program.

The quantity list should include estimated quantities of work to be performed in areas where CCTV inspection or other condition assessment data is not available. The Designer shall also provide a description of the assumptions used to develop quantity estimates and, to the extent possible, delineate observed / known quantities versus assumed or extrapolated quantities to facilitate the Program's review.

The availability of condition assessment data, such as CCTV inspection data, will vary by project. In some locations, CCTV inspection data may be available for nearly every sewer segment. Other projects may have limited, scattered, aged, or no CCTV inspection data. The Designer is expected to analyze the available condition assessment data provided, make design recommendations, and produce the required deliverables. For locations where CCTV inspection or other condition assessment data is not available during design, the Designer is expected to estimate quantities utilizing available data, such as geographic information system (GIS) data, record drawings, or condition assessment data from adjacent sewers within the project area. This includes estimating quantities for point repairs, heavy cleaning, lateral renewal, stormwater infrastructure impacts, and other work that may be anticipated during construction. The available information may be supplemented with limited field investigations by the Designer; however, full assessment is not expected.

7.2 Additional Guidance

Additional guidance on bid items and associated estimated quantities typically required during construction can be provided by MWS based on similar, completed rehabilitation projects.

Where condition assessment data is unavailable, the awarded rehabilitation contractor will be required to complete CCTV inspection for review and verification by the Construction Manager prior to rehabilitation. In those cases, it is recognized by MWS and the Program that this design approach shifts parts of the rehabilitation analysis to field decisions during the construction phase and that the final quantities will vary from the design quantities.

To aid the Designer, the Program has developed a decision tree with recommendations on how to estimate quantities for major bid items in comprehensive rehabilitation areas where little CCTV inspection data is available. The decision tree is included as **Figure 7-1**.

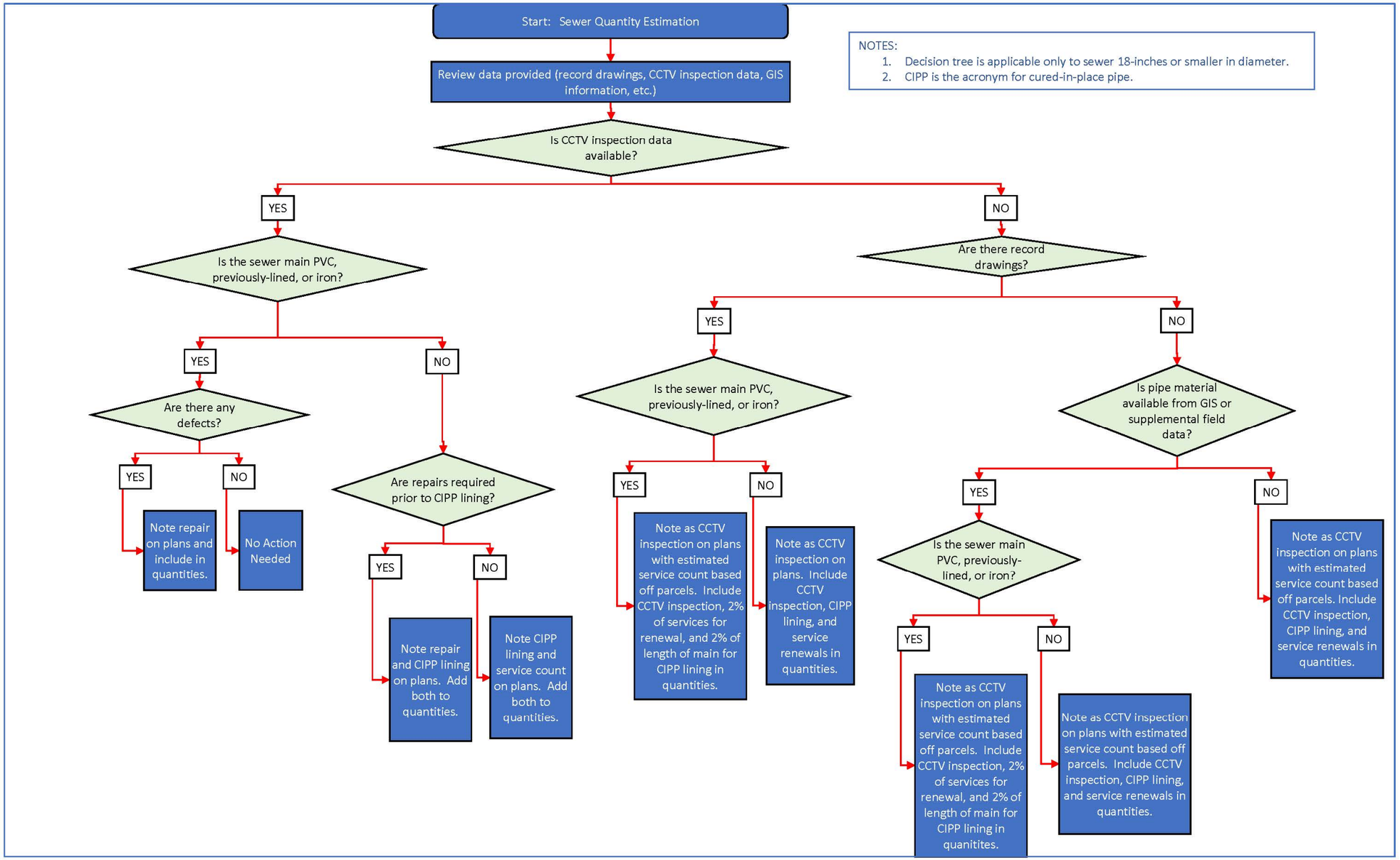

Figure 7-1 Sewer Rehabilitation Quantities Decision Tree