FINAL REPORT
OF
PHASE 1 – PRELIMINARY ENGINEERING SERVICES

Golf Village Force Main Outfall and Downstream Sewer Improvements

PO No. P2502198

Liberty Township, Delaware County, Ohio

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1.0 INTRODUCTION & PURPOSE

Delaware County Regional Sewer District (DCRSD) has recently discovered several sewer assets associated with the 27-inch Jewett Road Trunk Sewer and the 15-inch Liberty Hills Sanitary Sewer which are experiencing corrosion and structural deterioration. DCRSD has contracted with DLZ Corporation (DLZ) to provide preliminary engineering services for the Golf Village Force Main Outfall and Downstream Sewer Improvements Project to document the existing conditions and provide detailed design recommendations. The following assets were requested to be included within the study:

Liberty Hills Sanitary Sewer (RP 001353)

- Manhole #04 (Asset ID 09MH001353000004) - Golf Village Force Main Outfall
- Manholes #02 and #03 (Asset ID's 09MH001353000003 & 09MH001353000002)
- Manhole #01 (Asset ID 09MH001353000001) – Junction Structure

Jewett Road Trunk Sewer (RP 001342)

- Manhole #13 (Asset ID 09MH001342000013) – Outside Drop Manhole
- 536 LF of 27" Sanitary Sewer (Asset ID 09LN001342013012)
- 1,146 LF of 27" Sanitary Sewer (Asset ID 09LN001342012011)

2.0 PROJECT APPROACH

DCRSD and DLZ developed a scope of work aimed at establishing the existing conditions and assessing key aspects of the site and sewer. Results of the assessments will be used to provide detailed design recommendations and a preliminary estimate of probable construction cost. The primary tasks of the study include the following:

- Review Existing Information (Section 3.0)
- Preliminary Site Survey (Section 4.0)
- Manhole Condition Assessments (Section 5.0)
- Sewer Condition CCTV Review (Section 6.0)
- Field Site Visits & Site Access (Section 7.0)

Final recommendations are presented and discussed in Section 8.0 and Section 9.0.

3.0 REVIEW EXISTING INFORMATION

DLZ reviewed the available records associated with the sanitary sewers and force mains under consideration for improvements. DCRSD provided the existing record plans, easements, subdivision plats (if available), in addition to CCTV for the Jewett Road Trunk Sewer segments under consideration for rehabilitation. DCRSD also provided site photographs for Golf Village Force Main Outfall Manhole #4 and Sanitary Sewer Manhole #3.

DLZ compiled various public data sources to establish a preliminary Civil3D CAD basemap for the site. Please **Appendix A – AutoCAD Civil3D GIS Basemap** for reference. The following data sources were used to establish the existing conditions prior to site survey:

- DCRSD GIS Data – DCRSD provided GIS shapefiles for all sewers and manholes
- Delaware County GIS Data Hub– Auditor provided GIS shapefiles for topographic features (Contours, Road Centerlines, Parcel Data, Building Outlines)
- Federal Emergency Management Agency (FEMA) GIS Data – Shapefiles for floodways and floodplains (if present)

4.0 PRELIMINARY SITE SURVEY

Following the development of a preliminary GIS basemap, DLZ performed a field survey to determine critical locations and elevations of the sewer components. The preliminary site survey also included the following tasks:

- Project Control – DLZ established four (4) primary control points and five (5) site benchmarks within the project site. Horizontal control was referenced to the Ohio State Plane Coordinate System, North Zone, NAD83 (2011). Benchmarks were referenced vertically to NAVD88 (GEOID18A)
- Records Research and Easement Verification – DLZ obtained the current deed of record for the adjacent parcels on which the sewers are located. Existing sewer easements were verified and digitally referenced
- Easement Staking – DLZ staked the outside limits of the existing easements adjacent to the proposed improvements. Stakes were provided at 50-foot maximum intervals as well as break points in the alignment

4.1 RESULTS AND FINDINGS

A plan and profile using the surveyed inverts and manhole locations has been generated. DLZ has also included the survey data as described above in an AutoCAD Civil3D drawing file. These can be found within **Appendix B – Survey Plan & Profile**. Surveyed data is also included below.

Table 1 - Surveyed Manholes

Survey Cogo Point	Manhole ID	MH ##	TC (ft)	Pipes (in)	Material	Flow Direction		Invert (ft)	Depth (ft)
#110	09MH001353 000005	MH 05	857.79	15	PVC	In	S	849.39	8.50
				15	PVC	Out	NW	849.29	
#109	**09MH001353 000004**	**MH 04**	**856.64**	**15**	**PVC**	**In**	**SE**	**848.99**	**7.65**
				14	**DIP**	**In**	**SW**	**UNK**	
				15	**PVC**	**Out**	**NE**	**848.99**	
#108	**09MH001353 000003**	**MH 03**	**860.15**	**15**	**PVC**	**In**	**SW**	**846.55**	**13.70**
				15	**PVC**	**Out**	**N**	**846.45**	
#107	**09MH001353 000002**	**MH 02**	**852.93**	**15**	**PVC**	**In**	**S**	**844.03**	**9.10**
				15	**PVC**	**Out**	**NE**	**843.83**	
#106	09MH001342 000011	MH 11	880.35	27	RCP	In	W	833.55	46.80
				6	PVC	In	SW	870.92	
				27	RCP	Out	E	833.55	
#105	09MH001342 000012	MH 12	861.38	27	RCP	In	NW	834.38	27.00
				6	PVC	In	SW	854.68	
				27	RCP	Out	E	834.38	
#104	09MH001353 000023	N/A	859.25	10	PVC	In	SW	850.65	8.70
				10	PVC	Out	E	850.55	
#103	**09MH001342 000013**	**MH 13**	**853.97**	**18**	**PVC**	**In**	**NW**	**839.67**	**18.60**
				27	**RCP**	**Out**	**SE**	**835.37**	
#102	**09MH001353 000001**	**MH 01**	**858.35**	**15**	**PVC**	**In**	**SW**	**840.4**	**18.30**
				10	**PVC**	**In**	**W**	**842.85**	
				18	**PVC**	**In**	**E**	**839.95**	
				18	**PVC**	**Out**	**SE**	**840.05**	
#101	09MH001704 000001	N/A	860.56	18	PVC	In	N	840.86	19.73
				8	PVC	In	NE	841.26	
				18	PVC	Out	W	840.83	

Note: Manholes denoted in bold are targeted sewers for manhole condition assessments

5.0 MANHOLE CONDITION ASSESSMENTS

Due to concerns with structural deterioration, DCRSD requested that DLZ perform level 1 manhole inspections on manholes 01, 02, 03, 04, and 13. The level 1 manhole inspections serve as a basic condition assessment which provides information to evaluate the general condition of each manhole from the ground surface. The inspections were completed without the use of any special equipment or manned entry into the manhole.

5.1 RESULTS AND FINDINGS

Level 1 manhole inspection reports are included within **Appendix C – Level 1 MACP Inspection Forms**. The inspection forms provide a basic condition assessment of each manhole including photographs and additional notes.

Table 2 - Overall Manhole Conditions

			Overall Condition					
MH ##	**Depth (ft)**	**Evidence of Surcharge?**	**Cover**	**Frame**	**Chimney**	**Cone**	**Wall**	**Notes**
MH 13	18.6	Yes	Corroded (Pitted)	Corroded (Pitted/Worn)	N/A	Defective	Defective	Poor Condition - Aggregate Exposed and Eroding)
MH 01	18.3	Yes	Corroded (Pitted)	Corroded (Pitted/Worn)	Defective	Defective	Defective	Poor Condition - Aggregate Exposed and Eroding)
MH 02	9.1	Yes	Corroded (Pitted)	Corroded (Pitted/Worn)	Appears Defective	Appears Defective	Appears Defective	Material & Paper Deposits Extend to Castings. Two (2) Infiltration Gushers at Pipes
MH 03	13.7	Yes	Corroded (Pitted)	Corroded (Pitted/Worn)	Appears Defective	Appears Defective	Appears Defective	Material & Paper Deposits Extend to Castings. Minor Infiltration Stains at Pipes
MH 04	7.65	Yes	Sound	Corroded (Pitted/Worn)	Defective	Defective	Defective	Material & Paper Deposits Extend to Castings

- All manhole frames and covers are corroded and pitted (except for MH 04 cover – appears to have been recently replaced) and in poor condition, likely due to a highly corrosive environment caused by hydrogen sulfide gases from the Golf Village 14-inch force main discharge.
- All manholes showed evidence of surcharging. A high concentration of deposited materials (mostly shredded paper products) was covering most of the manhole components. Structural assessment of the manhole components proved difficult.
- Although Manholes 01 and 13 showed evidence of surcharging, the condition of the manhole components were clearly defective. These manholes are generally in poor condition; Concrete spalling and exposure of aggregate necessitates the need for manhole rehabilitation or replacement.
- Manhole 03 was also observed to be located within stream bank (Tylers Run). The stream bank has caused erosion around the manhole, exposing the frame and cover, top cone, and top wall barrel. Without stream bank mitigation, it is likely that the manhole will continue to be exposed to erosion and undermining.

6.0 SEWER CONDITION CCTV REVIEW

DCRSD has requested that the two (2) upstream sections of the Jewett Road Trunk Sewer (Asset ID #'s 09LN001342013012 & 09LN001342012011) be rehabilitated as part of detailed design. DLZ performed a review of the CCTV footage, survey data, and record plans for these sections to verify the request and to identify any potential concerns with rehabilitation activities.

6.1 RESULTS AND FINDINGS

Included below are the results of the review. CCTV footage was obtained in April and May of 2023:

Asset ID # 09LN001342013012 (Manhole 13 to Manhole 12)

- Per surveyed manhole locations - 537 LF of 27-inch RCP pipe (inner wall to inner wall)
- Per record plans, 27-inch RCP pipe was placed within a 60-inch tunneled steel casing pipe with annulus space grouted
- Per record plans, MH 13 was designed as an outside drop manhole (18-inch influent with 10-inch drop). After review of the CCTV footage and observations made during site visits, it is evident that a significant amount of flow is bypassing the 10-inch drop tee and flowing directly into the higher 18-inch influent, causing a high amount of turbulence due to a 4.3-foot vertical free-fall.

MH 13 Top View

CCTV Footage Looking Upstream Into MH 13

- Per record plans, a 6-inch service line for 2655 Wyndbend Blvd is tied into the sewer approximately 187-feet downstream of MH 13 or 350 feet upstream of Manhole 12 and is a protruding tap.

6-Inch PVC Service Line for 2655 Wyndbend

6-Inch PVC Service Line for 2655 Wyndbend

27-Inch Pipe Condition – Overall Assessment

- At the time of the CCTV video recording (4/10/23) the approximate flow line for the entire pipe segment was near the spring-line of the pipe; Structural assessment of the pipe components was only completed above the flow line
- At the time of the CCTV video recording (4/10/23), it does not appear any pre-cleaning occurred due to the presence of rags and encrustations
- Fine and coarse aggregates are exposed for the entire pipe run
- Reinforcement is exposed and/or has minimal concrete cover for the entire pipe run. In some sections, the rebar is partially exposed. The severity of exposure increases the closer to MH 13
- Several defective gaskets (dropped) are present near the upstream end of the pipe segment near MH 13. This is likely due to more corrosive gases near the drop manhole (MH 13). These defective gaskets at the joints are causing a large amount of deposits and rags to accumulate and impact the flow.

Fine & Course Aggregate Exposed

Defective Gaskets

Reinforcing Bars with Minimal Concrete Cover

Exposed Rebar Cages

Asset ID # 09LN001342012011 (Manhole 12 to Manhole 11)

- Per surveyed manhole locations - 1142 LF of 27-inch RCP pipe (inner wall to inner wall)
- Per record plans, 27-inch RCP pipe was placed within a 60-inch tunneled steel casing pipe with annulus space grouted
- Per record plans and survey, a 6-inch service line for 2650 Wyndbend Blvd is tied into MH 12 and a 6-inch service line for 2118 Jewett Road is tied into MH 11

27-Inch Pipe Condition – Overall Assessment

- At the time of the CCTV video recording (4/10/25) the approximate flow line for the entire pipe segment was below the spring-line; Structural assessment of the pipe components were only completed above the flow line
- At the time of the CCTV video recording, it does not appear any pre-cleaning occurred due to the presence encrustations and deposits at pipe joints
- Fine and course aggregates are exposed for the entire run, however less severe than the upstream segment 09LN001342013012 (MH 13 to MH 12).Most of the exposed aggregate is just above the flowline, indicating that pipe there is scouring and that corrosive gasses are still present
- Several locations of concrete spalling were observed

7.0 SITE ACCESS

Immediately following survey staking of the existing sewer easements, DLZ and DCRSD performed a site walk (May 9th, 2025) to observe the topographic conditions within the project corridor, determine appropriate site access for proposed construction activities, and to document any major conflicts which would impact future construction activities.

7.1 RESULTS AND FINDINGS

A photo log and exhibit were generated following the site visit which highlights the critical locations within the project corridor. Refer to **Appendix D – Site Access Photo Log** for representative photos (May 12th, 2025) and as indicated below.

Project Access – Manhole 01 and Manhole 13

Manhole 01 (**Photo 10**) serves as the junction chamber and singular discharge point for three (3) separate sanitary sewers which serve the Liberty Hills and Falcon Ridge subdivision communities as well as two (2) separate force mains for the Golf Village and Lakes of Powell subdivisions. Manholes 01 and 13 will serve as the primary point of construction activities and is generally flat and within a grassy area. There are three separate access routes to these manholes using existing easements from the rights-of-way to be considered:

1. Route 1 – Shale Ridge Access West: (**Photos 11-13**) An existing 25-feet wise access easement for an abandoned pump station is located between 365 and 375 Shale Ridge Court. Previously, there was a gravel drive leading to a pump station (abandoned) and the junction manhole (Manhole 1). The gravel drive has since been removed and replaced with seeding or turf. Adjacent property owners have planted several pine trees and mulch beds which appear to be encroaching within the easement.
2. Route 2 – Shale Ridge Access East: (**Photos 1-6**) An existing sewer easement for an active 18-inch sanitary sewer (Falcon Ridge Section 1) is located east of 375 Shale Ridge Court. The sewer/easement then follows the backyards of several homes (384 & 395 Englewood Court) back to the junction manhole (Manhole 01). Generally, the easement is open grassy areas, however there are several trees near the northern end of the easement that may require removal. There is also playground equipment and a planter garden located within the backyard of 385 Shale Ridge Court which would need to be removed for construction access.
3. Route 3 – Englewood Court Access: (**Photos 8-9**) An existing 20-foot wide sewer easement for an active 12-inch sanitary sewer (Falcon Ridge Section 4) is located between 384 and 395 Englewood Court). There is a brick retaining wall supporting the driveway for 395 Englewood Court which falls within the easement. The easement is generally clear from the driveway to the junction manhole (Manhole 01).

Project Access – Liberty Hills Sanitary Sewer (Manholes 02, 03, 04, & 05)

Rehabilitation activities for the manholes associated with the Liberty Hills sanitary sewer should primarily make use of the existing twenty (20) foot wide easement which is centered on the 15-inch sewer. South of the junction manhole (Manhole 01), the Liberty Hills sanitary sewer is located within a deep ravine adjacent to the Tylers Run stream. An unnamed stream also flows from Manhole 23 through a culvert and converges with Tylers Run south of the junction manhole (Manhole 01) (**Photos 14-16**). There are three stream crossings which will need to be navigated along the Liberty Hills sanitary sewer:

1. Unnamed Stream (Tributary to Tylers Run) – Approx. 70-feet upstream of Manhole 01 (**Photo 17**), an at-grade crossing is required
2. Tylers Run – Approx. 75-feet upstream of Manhole 02, an at-grade crossing is required
3. Tylers Run has meandered and formed a bend at Manhole 03 and has propagated stream bank erosion directly above the 15-inch sanitary sewer (**Photos 21-22**)

South of Manhole 01, the Liberty Hills sanitary sewer and existing 20-foot-wide easement is located within a highly dense, forested area. Although surveyors staked the existing easement for visual verification, foliage was dense and finding the manholes and easement stakes was challenging. There were numerous felled trees along the alignment. There are numerous large diameter trees exceeding 36-inch trunk sizes.

Project Access – Jewett Road Trunk Sewer (Manholes 11, 12, 13)

Although there is an existing 20-foot wide sanitary sewer easement covering the 27-inch Jewett Road Trunk Sewer, record plans and topographic conditions observed in the field indicate that access to each manhole cannot be achieved by using the existing sewer easement. The original construction of the sewer was tunneled, rather than open cut.

- Between Manhole 11 and 12, there is a deep ravine, approximately 30 feet deep, spanning over several hundred feet. There is also several hundred feet where the sewer falls directly under a steep cliff, adjacent to Tylers Run
- Between Manholes 12 and 13, there are several steep cliffs, and most of the alignment falls under Tylers Run

Route to Manhole 11: (**Photos 30-34**) Access to Manhole 11 can be achieved using PID 31944206012001 at 2114 Jewett Road. There is an existing gravel access drive along the frontage of the property. A grass clearing along the property line north to Manhole 11 was used to access the site. There are also power lines that are directly adjacent and parallel to the sewer. The access as described does not currently have any easements along the route from the Jewett Road right-of-way.

Route to Manhole 12: (**Photos 24-29**) Access to Manhole 12 can be achieved by used an existing shared common drive & utility easement for 2655 and 2650 Wyndbend Blvd. The common drive & utility easement for these properties end at a driveway split. There is a metal fence and dense woods on the eastern edge of the property and surrounding Manhole 12. The access as described does not currently have any easements along the route from the shared common drive & utility easement to Manhole 12.

Route to Manhole 13: Route 01 as described above for the primary point of construction.

Project Access – Tree Removals

The project site is within the vicinity of records for the tricolored, Indiana bat northern long-eared bat, and the little brown bat species. The ODNR Division of Wildlife will recommend that a desktop habitat assessment is conducted, followed by a field assessment if needed, to determine if a potential hibernaculum is present within the project area. The construction schedule should be sequenced to allow for tree clearing to occur between October 1st and March 31st. It is anticipated that an abundance of tree clearing will be required to facilitate the sewer improvements.

8.0 RECOMMENDED SEWER IMPROVEMENTS

Following review of the manhole condition assessments (Manholes 01, 02, 03, 04, and 13) as performed in Section 5.1 and CCTV video review of the Jewett Road Trunk Sewer as performed in Section 6.1, DLZ recommends the following sewer improvements to address structural deficiencies observed:

Manhole 01 (Asset ID 09MH001353000001) – Manhole Rehabilitation

- Remove & Replace Manhole Frame & Cover
- Cementitious Coating System – Spray or Trowel Applied
  - Note: Due to the highly corrosive nature of the influent sewers and force mains due to the release of hydrogen sulfide gas, it is highly recommended that additional measures are taken to provide corrosion resistance. Common concrete admixtures (anti-corrosion) include, but are not limited to:
    - ConBlock (MIC)
    - ConShield Crystalline X
    - Xypex Bio-San C500
  - In lieu of concrete admixtures, it is recommended that alternative corrosion resistant rehabilitation measures are considered. These include, but are not limited to:
    - Polymer & Geopolymer Coating Systems – Epoxy or Urethane Substrates
    - Concrete Inserts – Polymer or Fiberglass

Manhole 02 (Asset ID 09MH001353000002) – Manhole Rehabilitation

- Remove & Replace Manhole Frame & Cover
- Remove and Replace Defective Manhole Steps
- Cutoff Manhole Grouting – Curtain Grouting or Chemical Grouting Near Pipe Penetrations (Boots)
- Cementitious Coating System – Spray or Trowel Applied
  - Note: Due to the highly corrosive nature of the influent sewers and force mains due to the release of hydrogen sulfide gas, it is highly recommended that additional measures are taken to provide corrosion resistance. Common concrete admixtures (anti-corrosion) include, but are not limited to:
    - ConBlock (MIC)
    - ConShield Crystalline X
    - Xypex Bio-San C500
  - In lieu of concrete admixtures, it is recommended that alternative corrosion resistant rehabilitation measures are considered. These include, but are not limited to:
    - Polymer & Geopolymer Coating Systems – Epoxy or Urethane Substrates
    - Concrete Inserts – Polymer or Fiberglass

Manhole 03 (Asset ID 09MH001353000003) – Manhole Rehabilitation

- Remove & Replace Manhole Frame & Cover
- Remove and Replace Defective Manhole Steps
- Cutoff Manhole Grouting – Curtain Grouting or Chemical Grouting Near Pipe Penetrations (Boots)
- Cementitious Coating System – Spray or Trowel Applied
  - Note: Due to the highly corrosive nature of the influent sewers and force mains due to the release of hydrogen sulfide gas, it is highly recommended that additional measures are taken to provide corrosion resistance. Common concrete admixtures (anti-corrosion) include, but are not limited to:
    - ConBlock (MIC) or Conshield Crystalline X
    - ConShield Crystalline X

        - Xypex Bio-San C500
    - In lieu of concrete admixtures, it is recommended that alternative corrosion resistant rehabilitation measures are considered. These include, but are not limited to:
        - Polymer & Geopolymer Coating Systems – Epoxy or Urethane Substrates
        - Concrete Inserts – Polymer or Fiberglass

Manhole 04 (Asset ID 09MH001353000004) – Force Main Discharge Manhole – Remove & Replace Manhole

- Option 1 – Remove and replace existing manhole with new manhole. This will require a temporary diversion of the force main for sewer bypass purposes while the manhole is replaced.
    - Due to the corrosive nature of the force main discharge, it is highly recommended that the manhole is designed to provide resistance to hydrogen sulfide induced corrosion. Alternative designs could include, but are not limited to:
        - Corrosion Resistant Chemical Admixtures for Cast-In-Place or Precasted Manholes
        - Alternative Type Manhole – Polymer or Fiberglass
        - Precasted or Post-Installed Manhole Inserts
- Option 2 – Install a new discharge manhole on the force main upstream of Manhole 04. Run a new gravity sewer from the discharge manhole to a new junction manhole which replaces Manhole 04. A sewer bypass can be run from the new force main discharge manhole.

Manhole 13 (Asset ID 09MH001342000013) – Drop Manhole – Remove & Replace Manhole

- As discussed in Section 6.1, the outside drop manhole is not conveying flow from the 18-inch influent to the 27-inch discharge line adequately. Most of the flow is bypassing or overtopping the 10-inch outside drop pipe.
- A portion of the 18-inch influent sewer pipe should be removed and replaced to facilitate connection to a replacement manhole. Due to the 18-inch pipe grade (1.79%), the flow velocity necessitates the installation of a small weir just downstream of the 18-inch x10-inch drop. This weir will direct dry weather flow into the 10-inch drop pipe rather than bypassing the drop pipe and free-falling within Manhole 13.
- Due to hydrogen sulfide gasses because of the drop, there is severe corrosion within the manhole and castings. There is deep pitting and spalling of concrete that has eroded the manhole walls to coarse aggregate. There are infiltration gushers at the wall joints as well. A full replacement of the manhole is recommended due to the accelerated deterioration.

27-Inch Jewett Road Trunk Sewer (Asset ID 09LN001342013012) – Sewer Rehabilitation

- Approximately 537 linear feet of 27-inch cured-in-place pipe (CIPP) sewer lining. Due to the existence of a 60-inch steel casing pipe and annulus grouting, it is recommended that a partial deteriorated pipe design be assumed for CIPP liner thickness calculations. Assume a 15 MM liner.
- Trim Protruding Tap – 6-Inch PVC service line for 2655 Wyndbend Blvd is protruding into the sewer and should be trimmed flush with the 27-inch sewer prior to lining.

27-Inch Jewett Road Trunk Sewer (Asset ID 09LN001342012011) – Sewer Rehabilitation

- Approximately 1,142 linear feet of 27-inch cured-in-place pipe (CIPP) sewer lining. Due to the existence of a 60-inch steel casing pipe and annulus grouting, it is recommended that a partial deteriorated pipe design be assumed for CIPP liner thickness calculations. Assume a 15 MM liner.

9.0 SITE SPECIFIC RECOMMENDATIONS

Following a high-level review of the recommended sewer improvements (Section 8.0), DLZ has identified the following site constraints that will need to be addressed during detailed design and construction.

- Flow Maintenance Plan (Section 9.1)
- Tylers Run Stream Bank Mitigation (Section 9.2)
- Site Access & Property Acquisition (Section 9.3)

According to the National Hydrography Dataset found within the United States EPA Watershed Report, Tylers Run is categorized as first order stream (stream level 6) with a mean annual flow volume of 2.22 cfs and mean annual flow velocity of 0.82 fps. Tylers Run is tributary to Bartholomew Run and the Olentangy River. For any temporary or permanent work within the stream, including stream bank mitigation, environmental permitting and assessment work may be required and should be considered for the detailed design stage.

9.1 FLOW MAINTENANCE AND BYPASS PLAN RECOMMENDATIONS

A major requirement for any replacement or rehabilitation work associated with the proposed improvements is development of an adequate flow maintenance plan. DCRSD provided preliminary flows, average and peak for the tributary sewers and force mains per **Table 3**. The flow maintenance plan should be designed to convey the peak flows during construction.

Table 3 - Average and Peak Flows for Tributary Sewers and Force Mains at MH 01

	Flows (MGD)	
Sewer Segment	**Average**	**Peak**
14" Golf Village Force Main	-	2.05 MGD
8" Lakes of Powell Force Main	-	0.72 MGD
15" Liberty Hills Section 1 South Leg	0.0086 MGD	0.0681 MGD
10" Liberty Hills Section 1 West Leg	0.30 MGD	1.1 MGD
18" Falcon Ridge Section 1	0.75 MGD	3.7 MGD
12" Falcon Ridge Section 4	0.0084 MGD	0.096 MGD
Total Required at MH 01:	**8**	**MGD**

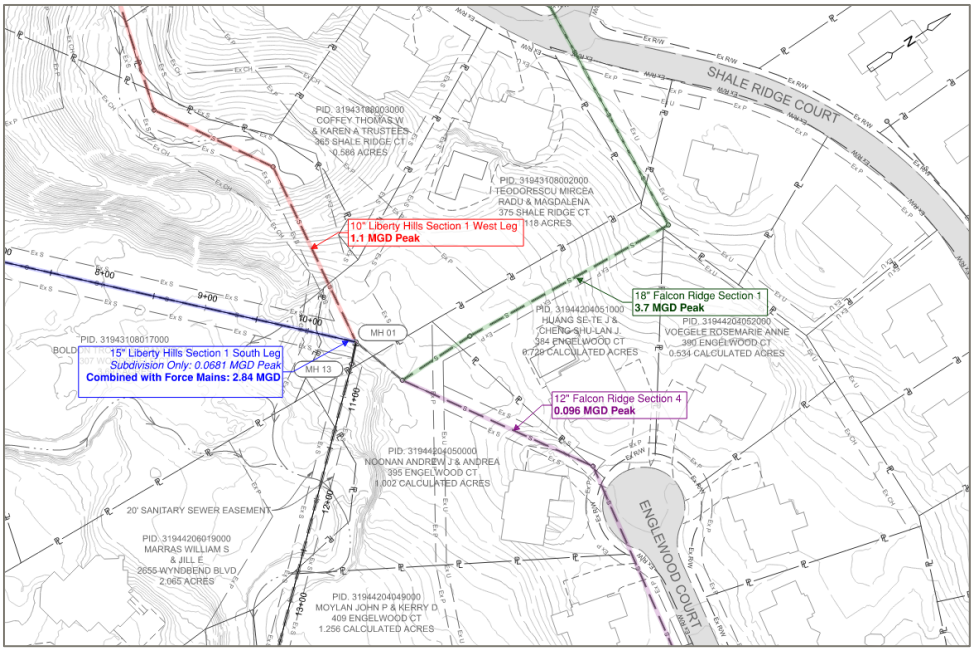

Figure 1 - Peak Flows Tributary to Manhole 1

Phase 1 - Flow Maintenance Plan – Jewett Road Trunk Sewer Rehabilitation

To bypass sewer flows discharging into the Jewett Road Trunk Sewer and to replace Manhole 13, it is recommended that the junction manhole (Manhole 01 - Asset ID 09MH001353000001) be used for the primary location for a singular bypass system. The operating conditions of the bypass system will need to be checked during detailed design to ensure any surcharging within the manhole does not induce any water-in-basements (WIBs).

Although the primary suction location at Manhole 01 provides adequate space for the bypass pumps and equipment, the most challenging aspect of the project will be providing a route for the bypass discharge line(s). Ideally, keeping the sewer bypass discharge lines located within existing easements or public right-of-way is preferred. However, due to the topographic conditions, using the existing easements for the Jewett Road Trunk Sewer will not be feasible. A significant portion of the sewer easement falls within Tylers Run stream and along a steep cliff. Construction of a sewer bypass line along the existing easement is not feasible. DLZ has identified three (3) preliminary alternatives for sewer bypass piping routes based on the existing topography of the site. See **Appendix E – Proposed Sewer Bypass Routes** for reference.

1. Bypass Route 1 – Public Right-of-Way and Existing Easements (Green)
    a. 11,395 linear feet of discharge piping required within the existing public right-of-way
    b. Must cross existing streets, intersections, and residential driveways
    c. Two railroad crossings necessary and will require trenchless construction for temporary bypass pipes. If topographic conditions permit, explore placing bypass piping adjacent to existing railroad to avoid crossings.
2. Bypass Route 2 – Private Property (Blue)
    a. 2,630 linear feet of discharge piping required within private property.
    b. Three (3) temporary easements for discharge piping required:
        i. PID 31944206019000 – 2655 Wyndbend Blvd

   ii. PID 31944206016000 – 2650 Wyndbend Blvd
   iii. PID 319944206012001 – 2114 Jewett Road
3. Bypass Route 3 – Existing Easements & Private Property (Red)
   a. 3,195 linear feet of discharge piping required within private property.
   b. One (1) temporary easement for discharge piping required:
      i. PID 319944206012001 – 2114 Jewett Road

Bypass Route 1 is not an economically feasible option due to the high risk associated with such a long sewer bypass length. Bypass piping will cause a major disruption to the public right-of-ways, including but not limited to the following concerns:

- Driveway, Street, and Intersection Crossings – Trenched Crossings and/or Temporary Ramps
- Railroad Crossings – Lengthy Permitting Process and High Costs Associated with Trenchless Installation
- Larger Bypass System – High Performance Pumps and/or Boosters Required Due to Friction Losses Expected with the Additional Pipe Length.

DLZ recommends that either Bypass Route 2 or 3 be considered for detailed design due to the considerably less footage required for the bypass than Route 1. Temporary easements will be required for either route. It is recommended that the easements necessary be discussed with the property owners prior to proceeding with detailed design.

Phase 2 - Flow Maintenance Plan – Liberty Hills Sewer Rehabilitation

Following the completion of Phase 1 – Jewett Road Trunk Sewer Rehabilitation, the Liberty Hills Sewer and Manholes 01, 02, 03, and 04 must be bypassed to complete the improvements. Manhole 05 should be used to bypass the Liberty Hills Sewer. The manholes upstream of each sewer tributary to Manhole 01 will be used to bypass sewer flows and will discharge into the replacement drop manhole 13. The 14-inch force main for Golf Village will also be required to be bypassed to complete the replacement of Manhole 04.

9.2 TYLERS RUN STREAM BANK MITIGATION

As discussed in Section 5.1, Tylers Run stream bank continues to meander east into Manhole 03 and directly above the 15-inch Liberty Hills Sanitary Sewer. Based on the GIS contours and the surveyed inverts of the 15-inch sewer, there is only approximately 4-5 feet of ground cover over the existing sewer. The stream bank has eroded above the existing sewer and continues east into undisturbed soil. There is between 7-10 feet (vertical column) of exposed stream bank that will continue to erode and wash into Tylers Run. Adjacent tree roots are completely exposed as the stream bank continues to undermine the root systems. There is approximately 60-70 linear feet of the sewer that falls under Tylers Run and the eroding stream bank.

Without any stream bank erosion mitigation or protection measures, Manhole 03 is at future risk of continued erosion. Further erosion could undermine the bank and subsurface support of the manhole, leading to a structural failure of the manhole. It is recommended hard armor slope and channel protection be installed surrounding Manhole 03. It is also recommended that slope and channel protection be installed along the stream bank north of Manhole 03 until the 15-inch sewer is outside the influence of the eroded stream bank.

Alternatively, Tylers Run could be re-aligned to straighten the stream out and pushed further away from DCRSD's infrastructure. There will be additional costs, property owner coordination, and potentially permitting required to accomplish this solution.

9.3 SITE ACCESS AND EASEMENT RECOMMENDATIONS

DLZ has developed preliminary recommendations for proposed access and temporary construction easements. See **Appendix F - Proposed Easements and Access Plan** for reference. DLZ also recommends that for any access routes

which make use of open grassy areas or yards of residents make use of plywood or wood matting to assist in preventing rutting of topsoil and to minimize damage to the properties.

The majority of the existing sewer easements are 20-feet in width and centered on the alignments. To make efficient use of the existing easements during construction as well as ensuring proper access to each work location, DLZ recommends the following temporary construction easements be obtained to ensure adequate project limits are achieved:

Manhole Work Areas (CIPP Sewer Rehabilitation)

- 50-foot width (minimum)
- Allows for adequate space for removal and replacement of manhole cones; It is not possible for the CIPP liners to be installed through the existing frame and castings.
- Allows for adequate space for CIPP lining equipment, including sewer cleaning/jetting trucks, CCTV equipment, and boilers.
- Allows for delivery and storage of equipment and materials.

Access Routes

- 20-foot width (minimum)
- Adjacent to existing sewer easements where possible
- Allows for selective tree clearing, allowing large diameter trees within easements to be protected during construction
- Allows for installation of stabilized access route, including temporary culverts at stream crossings

Bypass Piping Routes

- 20-foot width (minimum)
- Allows for adequate space for installation of bypass discharge piping (likely fused HDPE)
- Allows for installation of stabilized access route

Table 4 - Recommended Temporary Easements for Access and Work Areas

Easement ID	PID	Owner	Acreage	Easement Width	Description
T-1	31943108017000	BOLDON TROY M & FRANCISCA L	0.1696	20’	Access and Work Area
T-2	31943108018000	CARTER ASHITA & AUSTIN S	0.1493	20’	Access and Work Area
T-3	31943108018000	CARTER ASHITA & AUSTIN S	0.0508	20’	Stream Bank Mitigation
T-4	3194310801900	HARDY AMBER JOANNA & DANIEL JOSEPH	0.0132	20’	Access and Work Area
T-5	31943108031000	JOHNSON ROBERT & TAYLOR LYNN	0.1472	20’	Access and Work Area
T-6	31944206016000	FINDLEY VINCENT E & MARIA J	0.0655	20’	Access
T-7	31944206012001	SHADY CAROL S	0.0940	50’	Access and Work Area
T-8	31944206012001	SHADY CAROL S	1.2136	20’ & 50’	Access and Work Area

Table 5 - Recommended Temporary Easements for Bypass Route 2

Easement ID	PID	Owner	Acreage	Easement Width	Description
B-1	31943108017000	BOLDON TROY M & FRANCISCA L	0.0440	20’	Bypass Piping
B-2	31944206019000	MARRAS WILLIAM S & JILL E	0.1748	20’	Bypass Piping
B-3	31944206012001	SHADY CAROL S	0.6338	20’	Bypass Piping

Table 6 - Recommended Temporary Easements for Bypass Route 3

Easement ID	PID	Owner	Acreage	Easement Width	Description
B-1	31944206012001	SHADY CAROL S	0.4981	20’	Bypass Piping