# COMMONWEALTH of VIRGINIA

*DEPARTMENT OF ENVIRONMENTAL QUALITY*

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

***PIEDMONT REGIONAL OFFICE***
4949-A Cox Road
Glen Allen, Virginia 23060
(804) 527-5020
Fax (804) 527-5106
www.deq.virginia.gov

Robert G. Burnley
Director

Gerard Seeley, Jr.
Piedmont Regional Director

December 29, 2005

King William County
Kennington Subdivision
Section ! Gravity Sewers

Jim Duke
Rodgers – Chenault, Inc.
7240 Lee Davis Road
Mechanicsville, Virginia 23111

Dear Mr. Duke:

This Office has received plans and specifications, as prepared by Timmons Group, for the referenced facility. The plans entitled "Kennington, Section 1, Acquinton District, King William County, Virginia" contain 19 sheets and are engineer stamp dated December 19, 2005. The specifications The specifications entitled "Kennington, Well House & Sewage Pump Station, Kennington Section !, Project Manual, Technical Specifications, King William County, Virginia

The project consists of construction of 7500 linear feet of 8-inch gravity sewer to serve a 21 unit residential subdivision, shopping center and public swimming pool. The system will be owned by King William County.

The evaluation of these plans and specifications has been confined to technical requirements and design criteria, as stipulated in the Commonwealth of Virginia *Sewage Collection and Treatment Regulations*.

In accordance with Virginia Water Control Law, *Code of Virginia*, 1950 as amended in Title 62.1, Section 62.1-44.19, this letter report is to advise that the previously mentioned plans and specifications are technically adequate and are approved by this office.

One copy of the previously described report with Virginia Department of Environmental Quality approval stickers is enclosed.

King William County
Kennington Subdivision
Section ! Gravity Sewers

Please be aware that disturbance of any streams and/or wetlands may also require permitting. If you believe that this may be the case, please contact Oula Shehab at the Piedmont DEQ Office, 804-527-5069, for further information on the permitting process.

For the Director, Department of Environmental Quality

Sincerely,

Raymond R. Barrows, Jr.

Raymond R. Barrows, Jr., P.E.
Area Engineer
Office of Wastewater Engineering

J. R. Bell Jr., DEQ-PRO
Oula K Shehab, DEQ-PRO
Reuben Varghese, M.D., M.P.H., Director, Three Rivers Health District
James C Pyne, Ph.D., P.E., HRSD
Frank A. Pleva, Administrator, King William County
Ivan M. Wu, P.E., Timmons Group

/01

Project: Remington 1

# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM

Page 1 OF 3
Date 10/17/05
DWE Engineer: RPB

| REQUIREMENT | REFERENCE | COMMENTS |
|---|---|---|
| Approved Standard Specifications: _____ | _____ | |
| Approval Date: _____ | | |

**GENERAL DESIGN**

Type: Lateral / Sub-Main / Main / Trunk / Interceptor _____

| Pipe Dia. (inches) | Quantity (feet) | Slope (ft./ft.) max./min. |
|---|---|---|
| 8 | 7550 | 8.0 / .4 |
| | | / |
| | | / |
| | | / |

See worksheet next page for details of the gravity sewer lines.

| | | |
|---|---|---|
| Appropriate sewer material: PVC/DI | OK | |
| Velocities when flowing full: _____ | OK | ≥ 2 fps or 1.3 fps for settled sewage |
| Anchoring of sewers on ≥ 20 % slope: _____ | N/A | |
| Special protection against internal erosion: _____ | N/A | (for ≥ 15 fps) |
| Minimum cover over sewer or special construction (DIP or concrete cap/encasement): _____ | DIP | prevent freezing and stress |
| Pipe strength evaluation: _____ | N/A | (depths > 20 feet) |
| Manholes for sewers ≥ 8-inches: | _____ | at all changes in grade, size, alignment, and at all intersections |
| ✓ ≤ 400 feet for sewers ≤ 15-inches in diameter | | |
| ___ ≤ 500 feet for sewers ≥ 18-inches and ≤ 30-inches | | |
| ___ ≤ 600 feet (appropriate cleaning equipment) | | |
| Ventilation provided for manholes where continuous watertight sections exceed 1000 feet: _____ | N/A | |
| Drop pipe provided for all sewers entering manhole ≥ 24-inches above manhole invert: _____ | N/A | |
| Provisions for water supply/line protection: separation | _____ | Per Regulations |

**SEWERS IN RELATION TO STREAMS, ETC.** N/A

| | | |
|---|---|---|
| Watertight manholes covers/inserts provided where tops are below 25-year flood/wave action: _____ | _____ | |
| Manholes with connections which will remain watertight under differential settlement (flexible connection) | _____ | Inlet/outlet pipes must be joined |
| If sewer crosses or enters stream, is 1-foot of cover in rock and 3-feet of cover in other material specified | _____ | unless concrete encasement is specified |
| If Piers or Inverted Siphons proposed, attach supplemental review sheet(s) as necessary | _____ | |

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# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM


Date 10/17/05
DWE Engineer: RRB

roject: Kennington Sec. 1

| lan Sheet No(s) | MH # | to | MH # | Length (ft) | Diameter (in) | Slope (%) | Pipe Material |
|---|---|---|---|---|---|---|---|
| 9 | 1 | | 2 | 120 | 8 | 1.5 | PVC |
| | 2 | | 3 | 264 | | 2.0 | |
| | 3 | | 4 | 369 | | 2.2 | |
| | 4 | | 5 | 134 | | 1.5 | |
| | 5 | | 6 | 320 | | 1.5 | |
| | 6 | | 7 | 160 | | 1.5 | |
| | 7 | | 8 | 246 | | 3.0 | |
| | 8 | | 9 | 367 | | 1.5 | |
| | 9 | | 10 | 137 | | 2.0 | |
| | 10 | | 11 | 135 | | 2.5 | |
| | 11 | | 12 | 275 | | 1.5 | DI |
| 10 | 1 | | 21 | 177 | 8 | 3.0 | PVC |
| | 21 | | 22 | 275 | | 2.5 | |
| | 22 | | 23 | 210 | | 5.5 | |
| | 23 | | 24 | 140 | | 4.0 | |
| | 24 | | 25 | 208 | | 8.0 | |
| | 25 | | 26 | 262 | | 3.0 | |
| | 26 | | 27 | 170 | | 1.2 | |
| 11 | 1 | | 28 | 313 | 8 | 1.0 | PVC |
| | 28 | | 29 | 345 | | 2.0 | |
| | 29 | | 30 | 197 | | 6.2 | |
| | 30 | | 31 | 239 | | 5.3 | |
| | 31 | | 32 | 109 | | .4 | DI |
| | 32 | | 33 | 113 | | .4 | |
| | 33 | | 34 | 226 | | 8.0 | PVC |
| | 33 | | 35 | 229 | | .4 | DI |
| 12 | 7 | | 18 | 232 | | 2.4 | |
| | 18 | | 19 | 231 | | 4.0 | |
| | 19 | | 20 | 323 | | 3.0 | |

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# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM

Page ____ OF ____
Date 10/17/05
DWE Engineer: RRB

ject: Kennington Sec 1

| an Sheet No(s) | MH # | to | MH # | Length (ft) | Diameter (in) | Slope (%) | Pipe Material |
|---|---|---|---|---|---|---|---|
| 12 | 11 | | 13 | 267 | 8 | 1.2 | PVC |
| | 13 | | 14 | 135 | | 5.7 | |
| | 14 | | 15 | 100 | | 2.8 | |
| | 14 | | 16 | 100 | | 1.2 | |
| 8 | 35 | | 36 | 139 | 8 | 1.3 | PVC |
| | 36 | | 37 | 136 | | 4.3 | |
| | 37 | | 38 | 101 | | 3.5 | |

TIMMONS GROUP

YOUR VISION ACHIEVED THROUGH OURS.

RECEIVED
SEP 06 2005
PRO

# TRANSMITTAL

TO: Reed Barrows DEQ
Jim Pyne HRSD
Charlie Riedlinger Resource
Mat Lillis

Date: 9/1/2005 Job #: 21776
Project: Kennington
Reference:
Copies Sent To:

☐ ENCLOSED PLEASE FIND:
☐ WE ARE SENDING UNDER SEPARATE COVER:

| COPIES | DATE | NUMBER | DESCRIPTION |
|---|---|---|---|
| 1 | | | Copy to each of the above |
| | | | Calculations Revision 1 |
| | | | Dated August 30, 2005 |
| | | | |
| | | | |
| | | | |

THESE ITEMS ARE TRANSMITTED:
*If enclosures are not as noted, please notify us at once.*

COMMENTS:

For your review

SIGNED:

9/1/05

1001 Boulders Parkway, Suite 300 | Richmond, VA 23225
TEL 804.200.6500 FAX 804.560.1016
www.timmons.com

Site Development | Residential | Infrastructure | Technology

# LETTER OF TRANSMITTAL

**TIMMONS GROUP**
YOUR VISION ACHIEVED THROUGH OURS.

1001 Boulders Parkway, Suite 300
Richmond, VA 23236
Phone (804) 200-6500

| | |
|---|---|
| DATE 6/30/06 | JOB NO. 22722 |
| ATTENTION REED BARROWS JR., P.E. | |
| RE: KENNINGTON SECTION 2 RESUBMITTAL | |
| FROM: BRIAN COPELAND (200-6525) | |

TO: DEPARTMENT OF ENVIRONMENTAL QUA.
4949-A COX ROAD
GLEN ALLEN, VA 23060

WE ARE SENDING YOU: ❑ Attached ❑ Under separate cover via _____ the following items:
❑ Shop drawings ❑ Prints ❑ Plans ❑ Samples ❑ Specifications
❑ Copy of letter ❑ Change order ❑ _____

| COPIES | DATE | NO. | DESCRIPTION |
|---|---|---|---|
| 1 | | | COVER SHEET |
| 1 | | | DEQ SUBMITTAL FORM |
| 1 | | | HYDRAULIC CALCULATIONS |
| 1 | | | REVISED CONSTRUCTION PLANS (ORIGINAL SIGNATURE) |
| | | | |
| | | | |
| | | | |
| | | | |

THESE ARE TRANSMITTED as checked below:
❑ For approval ❑ Approved as submitted ❑ Resubmit _____ copies for approval
❑ For your use ❑ Approved as noted ❑ Submit _____ copies for distribution
☑ For approval ❑ Approved as submitted ❑ Return _____ corrected prints
❑ For review and comment ❑ _____
❑ FOR BIDS DUE _____ ❑ PRINTS RETURNED AFTER LOAN TO US

REMARKS: _____

RECEIVED
JUN 30 2006
PRO

COPY TO: _____

SIGNED: _____

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

June 30, 2006

Mr. Raymond R. Barrows Jr., P.E.
Department of Environmental Quality
4949-A Cox Road
Glen Allen, VA 23060

RE: Kennington Section 2 gravity sewer review

Dear Mr. Barrows:

Enclosed with this letter you will find a DEQ Submittal Form for Kennington Section 2 to request a gravity sewer review for DEQ approval as an extension to Kennington Section 1 previously approved. For this review, you will find one (1) set of construction plans with one (1) set of hydraulic calculations. Kennington Section 2 has been reviewed once by both King William County and VDOT and should be close to approval from both.

Should you have any questions or need any additional information, please give me a call at (804) 200-6525 or Quincy Mason at 200-6539 if you can't reach me. Thanks for your time and consideration to this project.

Sincerely,

Brian Copeland
Residential Services – Project Manager

1001 Boulders Parkway, Suite 300 | Richmond, Virginia 23225
TEL 804.200.6500 FAX 804.560.1016
Site Development | Residential | Infrastructure | Technology
www.timmons.com

# DEQ SUBMITTAL FORM

## SEWERAGE PLANS AND/OR SPECIFICATIONS

County/City: King William County

Project: Kennington Section 2

I. The following items must be submitted with the plans and/or specifications.

- ✓ project cost = ≈ $1,000,000
- ✓ one set of design calculations
- N/A pump curve
- N/A flow certificate (requested or enclosed)
- N/A flow acceptance letter
- N/A portable equipment form
- ✓ correct number of plans and/or specifications* (King William Co. Standard Specs.)

* four sets of plans and/or three sets of specifications are required for approval, but one set can be submitted initially

II. The following items must be on the plans or in the specifications.

- ✓ original P.E. seal, signature, and date on each cover sheet (plans and specifications)
- ✓ facsimile P.E. seal, signature, and date on each subsequent plan sheet
- ✓ date on plans and specifications
- ✓ adequate title
- ✓ legible plans
- ✓ owner of the sewerage project with contact person and an address
- ✓ engineer with an address
- ✓ project location (site plan)
- ✓ site plan with topography
- ✓ plan and profile views
- ✓ City/County specifications identified (if used)
- ✓ manhole stationing and sewer slopes
- ✓ method of continuous operation = King William Co. maintenance
- N/A alarm system
- N/A electrical specifications
- N/A available power to the site = _____ volts and _____ phase

**Original Poor Quality**

All gravity sewer projects with a 40,000 gpd or greater average design flow or 100 or more connections must be submitted to the Department of Environmental Quality (DEQ) for review. All pump stations with a 20 gpm or more pump rate must be submitted to DEQ for review. All pump stations discharging into a force main must be reviewed by DEQ regardless of sizing. DEQ reviews all VPDES discharge sewage treatment facilities projects and vacuum sewerage systems.

# HYDRAULIC ANALYSIS FOR SANITARY SEWER DESIGN

| SERVICE AREA | MANHOLE NUMBER FROM | MANHOLE NUMBER TO | AREA SERVED (ACRES) GROSS INCR. | AREA SERVED (ACRES) NET TOTAL | AREA SERVED (Units) GROSS INCR. | AREA SERVED (Units) NET TOTAL | INCREMENTAL FLOW AVG. DAILY FLOW (MGD) | INCREMENTAL FLOW PEAK* FLOW (MGD) | TOTAL FLOW AVG. DAILY FLOW (MGD) | TOTAL FLOW DESIGN FLOW (MGD) | TOTAL FLOW DESIGN + RESERVE (MGD) | PIPE LENGTH (FEET) | PIPE DIAMETER (INCHES) | PIPE SLOPE (%) | TOTAL PEAK* FLOW (CFS) | FULL PIPE CAPACITY (CFS) | FULL PIPE CAPACITY** (MGD) | PIPE CAPACITY AS AVG. (MGD) | FULL PIPE VELOCITY** (FPS) | ACTUAL PIPE VELOCITY** (FPS) | GROUND ELEVATION AT UPPER END | INVERT ELEVATION UPPER END | INVERT ELEVATION LOWER END | DEPTH TO INVERT (FEET) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 41 | 40 | | 0 | 3 | 3 | 0.001 | 0.014 | 0.001 | 0.014 | 0.015 | 306 | 8 | 1.00% | 0.02 | 1.31 | 0.85 | | 3.76 | 1.4 | 148.8 | 144.13 | 141.07 | 4.6 |
| | 40 | 39 | | 0 | 6 | 9 | 0.002 | 0.024 | 0.003 | 0.038 | 0.042 | 380 | 8 | 0.40% | 0.06 | 0.83 | 0.54 | | 2.38 | 1.4 | 148.7 | 140.97 | 139.45 | 7.8 |
| | 39 | 38 | | 0 | 2 | 11 | 0.001 | 0.010 | 0.004 | 0.048 | 0.053 | 264 | 8 | 0.40% | 0.07 | 0.83 | 0.54 | | 2.38 | 1.4 | 147.0 | 139.35 | 138.29 | 7.6 |
| | 38 | 37 | | 0 | 2 | 13 | 0.001 | 0.010 | 0.005 | 0.058 | 0.064 | 318 | 8 | 0.40% | 0.09 | 0.83 | 0.54 | | 2.38 | 1.6 | 145.8 | 138.19 | 136.92 | 7.6 |
| | 37 | 36 | | 0 | 2 | 15 | 0.001 | 0.010 | 0.005 | 0.068 | 0.075 | 308 | 8 | 0.40% | 0.10 | 0.83 | 0.54 | | 2.38 | 1.6 | 142.3 | 136.82 | 135.59 | 5.5 |
| | 36 | 35 | | 0 | 2 | 17 | 0.001 | 0.010 | 0.006 | 0.078 | 0.086 | 248 | 8 | 0.40% | 0.12 | 0.83 | 0.54 | | 2.38 | 1.7 | 143.6 | 135.49 | 134.50 | 8.1 |
| | 35 | 34 | | 0 | 2 | 19 | 0.001 | 0.010 | 0.007 | 0.088 | 0.097 | 234 | 8 | 1.99% | 0.14 | 1.85 | 1.20 | | 5.30 | 3.1 | 139.4 | 134.40 | 129.74 | 5.0 |
| | 34 | 33 | | 0 | 2 | 21 | 0.001 | 0.010 | 0.007 | 0.098 | 0.107 | 218 | 8 | 0.40% | 0.15 | 0.83 | 0.54 | | 2.38 | 1.8 | 134.5 | 129.64 | 128.77 | 4.9 |
| | 33 | 32 | | 0 | 0 | 21 | 0.000 | 0.000 | 0.007 | 0.098 | 0.107 | 75 | 8 | 0.40% | 0.15 | 0.83 | 0.54 | | 2.38 | 1.8 | 135.6 | 128.67 | 128.37 | 6.9 |
| | 32 | 31 | | 0 | 3 | 24 | 0.001 | 0.014 | 0.008 | 0.112 | 0.123 | 176 | 8 | 0.40% | 0.17 | 0.83 | 0.54 | | 2.38 | 1.9 | 135.0 | 128.27 | 127.57 | 6.7 |
| | 31 | 30 | | 0 | 12 | 36 | 0.004 | 0.042 | 0.013 | 0.154 | 0.169 | 196 | 8 | 0.40% | 0.24 | 0.83 | 0.54 | | 2.38 | 2.1 | 133.3 | 127.47 | 126.68 | 5.8 |
| | 30 | 29 | | 0 | 2 | 38 | 0.001 | 0.010 | 0.013 | 0.164 | 0.180 | 208 | 8 | 0.40% | 0.25 | 0.83 | 0.54 | | 2.38 | 2.1 | 134.1 | 126.58 | 125.75 | 7.5 |
| | 29 | 28 | | 0 | 2 | 40 | 0.001 | 0.010 | 0.014 | 0.174 | 0.191 | 88 | 8 | 0.40% | 0.27 | 0.83 | 0.54 | | 2.38 | 2.1 | 132.3 | 125.65 | 125.29 | 6.6 |
| | 28 | 27 | | 0 | 3 | 43 | 0.001 | 0.014 | 0.015 | 0.188 | 0.206 | 386 | 8 | 0.40% | 0.29 | 0.83 | 0.54 | | 2.38 | 2.2 | 138.8 | 125.19 | 123.65 | 13.7 |
| | 27 | EX. | | 0 | 12 | 55 | 0.004 | 0.042 | 0.019 | 0.230 | 0.253 | 114 | 8 | 0.40% | 0.36 | 0.83 | 0.54 | | 2.38 | 2.3 | 138.1 | 123.55 | 123.10 | 14.6 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 55 | 0.000 | 0.000 | 0.019 | 0.230 | 0.253 | | | | 0.36 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |

*Peaking Formula = 3.5Q^0.807 (Q in MGD)

**Friction Factor n = 0.012

# HYDRAULIC ANALYSIS FOR SANITARY SEWER DESIGN

| SERVICE AREA | MANHOLE NUMBER FROM | MANHOLE NUMBER TO | AREA SERVED (ACRES) GROSS INCR. | AREA SERVED (ACRES) NET TOTAL | AREA SERVED (Units) GROSS INCR. | AREA SERVED (Units) NET TOTAL | INCREMENTAL FLOW AVG. DAILY FLOW (MGD) | INCREMENTAL FLOW PEAK* FLOW (MGD) | TOTAL FLOW AVG. DAILY FLOW (MGD) | TOTAL FLOW DESIGN FLOW (MGD) | TOTAL FLOW DESIGN + RESERVE (MGD) | PIPE LENGTH (FEET) | PIPE DIAMETER (INCHES) | PIPE SLOPE (%) | TOTAL PEAK* FLOW (CFS) | FULL PIPE CAPACITY (CFS) | FULL PIPE CAPACITY** (MGD) | PIPE CAPACITY AS AVG. (MGD) | FULL PIPE VELOCITY** (FPS) | ACTUAL PIPE VELOCITY** (FPS) | GROUND ELEVATION AT UPPER END | INVERT ELEVATION UPPER END | INVERT ELEVATION LOWER END | DEPTH TO INVERT (FEET) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 26 | 25 | | 0 | 3 | 3 | 0.001 | 0.014 | 0.001 | 0.014 | 0.015 | 211 | 8 | 5.60% | 0.02 | 3.11 | 2.01 | | 8.90 | 2.5 | 153.1 | 148.50 | 136.66 | 4.6 |
| | 25 | 24 | | 0 | 2 | 5 | 0.001 | 0.010 | 0.002 | 0.024 | 0.026 | 289 | 8 | 2.71% | 0.04 | 2.16 | 1.40 | | 6.19 | 2.4 | 145.2 | 136.56 | 128.71 | 8.6 |
| | 24 | 23 | | 0 | 8 | 13 | 0.003 | 0.030 | 0.005 | 0.054 | 0.060 | 245 | 8 | 0.40% | 0.08 | 0.83 | 0.54 | | 2.38 | 1.5 | 139.4 | 128.61 | 127.63 | 10.8 |
| | 23 | 22 | | 0 | 4 | 17 | 0.001 | 0.017 | 0.006 | 0.072 | 0.079 | 219 | 8 | 0.40% | 0.11 | 0.83 | 0.54 | | 2.38 | 1.7 | 140.5 | 127.53 | 126.65 | 12.9 |
| | 22 | 21 | | 0 | 0 | 17 | 0.000 | 0.000 | 0.006 | 0.072 | 0.079 | 147 | 8 | 0.40% | 0.11 | 0.83 | 0.54 | | 2.38 | 1.7 | 140.0 | 126.55 | 125.96 | 13.5 |
| | 21 | 20 | | 0 | 4 | 21 | 0.001 | 0.017 | 0.007 | 0.089 | 0.098 | 213 | 8 | 0.40% | 0.14 | 0.83 | 0.54 | | 2.38 | 1.8 | 140.0 | 125.86 | 125.01 | 14.2 |
| | 20 | 19 | | 0 | 5 | 26 | 0.002 | 0.021 | 0.009 | 0.110 | 0.121 | 66 | 8 | 0.40% | 0.17 | 0.83 | 0.54 | | 2.38 | 1.9 | 135.7 | 124.91 | 124.65 | 10.8 |
| | 19 | 18 | | 0 | 1 | 27 | 0.000 | 0.006 | 0.009 | 0.116 | 0.127 | 164 | 8 | 0.40% | 0.18 | 0.83 | 0.54 | | 2.38 | 1.9 | 134.9 | 124.55 | 123.89 | 10.4 |
| | 18 | 17 | | 0 | 2 | 29 | 0.001 | 0.010 | 0.010 | 0.126 | 0.138 | 136 | 8 | 0.40% | 0.19 | 0.83 | 0.54 | | 2.38 | 1.9 | 133.7 | 123.79 | 123.25 | 9.9 |
| | 17 | 16 | | 0 | 1 | 30 | 0.000 | 0.006 | 0.011 | 0.131 | 0.144 | 116 | 8 | 3.58% | 0.20 | 2.48 | 1.61 | | 7.12 | 4.3 | 130.4 | 123.15 | 119.00 | 7.3 |
| | 16 | 15 | | 0 | 1 | 31 | 0.000 | 0.006 | 0.011 | 0.137 | 0.151 | 187 | 8 | 3.28% | 0.21 | 2.38 | 1.54 | | 6.81 | 4.2 | 124.1 | 118.90 | 112.77 | 5.2 |
| | 15 | 14 | | 0 | 6 | 37 | 0.002 | 0.024 | 0.013 | 0.161 | 0.177 | 97 | 8 | 0.40% | 0.25 | 0.83 | 0.54 | | 2.38 | 2.1 | 125.9 | 112.67 | 112.28 | 13.2 |
| | 14 | 13 | | 0 | 1 | 38 | 0.000 | 0.006 | 0.013 | 0.167 | 0.183 | 56 | 8 | 0.40% | 0.26 | 0.83 | 0.54 | | 2.38 | 2.1 | 126.1 | 112.18 | 111.96 | 13.9 |
| | 13 | 12 | | 0 | 39 | 77 | 0.014 | 0.109 | 0.027 | 0.276 | 0.304 | 211 | 8 | 0.40% | 0.43 | 0.83 | 0.54 | | 2.38 | 2.4 | 125.5 | 111.86 | 111.01 | 13.7 |
| | 12 | 11 | | 0 | 5 | 82 | 0.002 | 0.021 | 0.029 | 0.297 | 0.327 | 308 | 8 | 0.40% | 0.46 | 0.83 | 0.54 | | 2.38 | 2.4 | 130.3 | 110.91 | 109.68 | 19.4 |
| | 11 | 10 | | 0 | 2 | 84 | 0.001 | 0.010 | 0.029 | 0.307 | 0.338 | 207 | 8 | 2.34% | 0.48 | 2.01 | 1.30 | | 5.75 | 2.5 | 117.5 | 109.58 | 104.73 | 7.9 |
| | 10 | 9 | | 0 | 14 | 98 | 0.005 | 0.048 | 0.034 | 0.355 | 0.390 | 258 | 8 | 0.40% | 0.55 | 0.83 | 0.54 | | 2.38 | 2.5 | 116.5 | 104.63 | 103.60 | 11.9 |
| | 9 | 8 | | 0 | 9 | 107 | 0.003 | 0.034 | 0.037 | 0.388 | 0.427 | 127 | 8 | 0.40% | 0.60 | 0.83 | 0.54 | | 2.38 | 2.6 | 116.8 | 103.50 | 102.99 | 13.3 |
| | 8 | 7 | | 0 | 1 | 108 | 0.000 | 0.006 | 0.038 | 0.394 | 0.434 | 356 | 8 | 0.40% | 0.61 | 0.83 | 0.54 | | 2.38 | 2.6 | 116.3 | 102.89 | 101.47 | 13.4 |
| | 7 | 6 | | 0 | 1 | 109 | 0.000 | 0.006 | 0.038 | 0.400 | 0.440 | 164 | 8 | 0.40% | 0.62 | 0.83 | 0.54 | | 2.38 | 2.6 | 111.3 | 101.37 | 100.71 | 9.9 |
| | 6 | 5 | | 0 | 7 | 116 | 0.002 | 0.027 | 0.041 | 0.427 | 0.470 | 268 | 8 | 0.40% | 0.66 | 0.83 | 0.54 | | 2.38 | 2.6 | 112.4 | 100.61 | 99.54 | 11.8 |
| | 5 | 4 | | 0 | 1 | 117 | 0.000 | 0.006 | 0.041 | 0.433 | 0.476 | 147 | 8 | 0.40% | 0.67 | 0.83 | 0.54 | | 2.38 | 2.6 | 108.7 | 99.44 | 98.85 | 9.2 |
| | 4 | 3 | | 0 | 0 | 117 | 0.000 | 0.000 | 0.041 | 0.433 | 0.476 | 121 | 8 | 0.40% | 0.67 | 0.83 | 0.54 | | 2.38 | 2.6 | 111.1 | 98.75 | 98.26 | 12.4 |
| | 3 | 2 | | 0 | 1 | 118 | 0.000 | 0.006 | 0.041 | 0.439 | 0.482 | 303 | 8 | 0.40% | 0.68 | 0.83 | 0.54 | | 2.38 | 2.7 | 112.2 | 98.16 | 96.95 | 14.0 |
| | 2 | 1 | | 0 | 1 | 119 | 0.000 | 0.006 | 0.042 | 0.444 | 0.489 | 291 | 8 | 3.03% | 0.69 | 2.28 | 1.48 | | 6.55 | 5.7 | 107.7 | 96.85 | 88.05 | 10.9 |
| | 1 | EX. | | 0 | 0 | 119 | 0.000 | 0.000 | 0.042 | 0.444 | 0.489 | 242 | 8 | 0.95% | 0.69 | 1.28 | 0.83 | | 3.67 | 3.7 | 94.1 | 87.95 | 85.65 | 6.1 |
| | | | | 0 | | 119 | 0.000 | 0.000 | 0.042 | 0.444 | 0.489 | | | | 0.69 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 119 | 0.000 | 0.000 | 0.042 | 0.444 | 0.489 | | | | 0.69 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 119 | 0.000 | 0.000 | 0.042 | 0.444 | 0.489 | | | | 0.69 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |

*Peaking Formula = 3.5Q^0.807 (Q in MGD)

**Friction Factor n = 0.012

# HYDRAULIC ANALYSIS FOR SANITARY SEWER DESIGN

| SERVICE AREA | MANHOLE NUMBER FROM | MANHOLE NUMBER TO | AREA SERVED (ACRES) GROSS INCR. | AREA SERVED (ACRES) NET TOTAL | AREA SERVED (Units) GROSS INCR. | AREA SERVED (Units) NET TOTAL | INCREMENTAL FLOW AVG. DAILY FLOW (MGD) | INCREMENTAL FLOW PEAK* FLOW (MGD) | TOTAL FLOW AVG. DAILY FLOW (MGD) | TOTAL FLOW DESIGN FLOW (MGD) | TOTAL FLOW DESIGN + RESERVE (MGD) | PIPE LENGTH (FEET) | PIPE DIAMETER (INCHES) | PIPE SLOPE (%) | TOTAL PEAK* FLOW (CFS) | FULL PIPE CAPACITY (CFS) | FULL PIPE CAPACITY** (MGD) | PIPE CAPACITY AS AVG. (MGD) | FULL PIPE VELOCITY** (FPS) | ACTUAL PIPE VELOCITY** (FPS) | GROUND ELEVATION AT UPPER END | INVERT ELEVATION UPPER END | INVERT ELEVATION LOWER END | DEPTH TO INVERT (FEET) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 27D | 27C | | 0 | 5 | 5 | 0.002 | 0.021 | 0.002 | 0.021 | 0.023 | 209 | 8 | 1.25% | 0.03 | 1.47 | 0.95 | | 4.20 | 1.7 | 143.8 | 138.90 | 136.28 | 4.9 |
| | 27C | 27B | | 0 | 2 | 7 | 0.001 | 0.010 | 0.002 | 0.031 | 0.034 | 180 | 8 | 1.25% | 0.05 | 1.47 | 0.95 | | 4.20 | 2.0 | 141.9 | 136.18 | 134.03 | 5.7 |
| | 27B | 27A | | 0 | 3 | 10 | 0.001 | 0.014 | 0.004 | 0.045 | 0.049 | 200 | 8 | 2.00% | 0.07 | 1.86 | 1.20 | | 5.32 | 2.5 | 139.7 | 133.83 | 129.83 | 5.9 |
| | 27A | 27 | | 0 | 2 | 12 | 0.001 | 0.010 | 0.004 | 0.055 | 0.060 | 185 | 8 | 3.29% | 0.08 | 2.38 | 1.54 | | 6.82 | 3.2 | 137.3 | 129.73 | 123.65 | 7.6 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 24B | 24A | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 81 | 8 | 1.50% | 0.02 | 1.61 | 1.04 | | 4.61 | 1.6 | 137.2 | 130.96 | 129.71 | 6.2 |
| | 24A | 24 | | 0 | 2 | 4 | 0.001 | 0.010 | 0.001 | 0.020 | 0.022 | 150 | 8 | 0.60% | 0.03 | 1.02 | 0.66 | | 2.91 | 1.3 | 139.8 | 129.61 | 128.71 | 10.2 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 31D | 31B | | 0 | 4 | 4 | 0.001 | 0.017 | 0.001 | 0.017 | 0.019 | 167 | 8 | 0.69% | 0.03 | 1.09 | 0.70 | | 3.12 | 1.4 | 142.8 | 138.16 | 137.00 | 4.6 |
| | 31B | 31A | | 0 | 2 | 6 | 0.001 | 0.010 | 0.002 | 0.027 | 0.030 | 75 | 8 | 10.78% | 0.04 | 4.31 | 2.79 | | 12.35 | 3.9 | 141.6 | 136.90 | 128.80 | 4.7 |
| | 31A | 31 | | 0 | 3 | 9 | 0.001 | 0.014 | 0.003 | 0.041 | 0.045 | 186 | 8 | 0.61% | 0.06 | 1.03 | 0.66 | | 2.94 | 1.6 | 139.1 | 128.70 | 127.57 | 10.4 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 31C | 31A | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 177 | 8 | 3.00% | 0.02 | 2.27 | 1.47 | | 6.51 | 2.0 | 140.6 | 134.10 | 128.80 | 6.5 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 32A | 32 | | 0 | 3 | 3 | 0.001 | 0.014 | 0.001 | 0.014 | 0.015 | 77 | 8 | 1.00% | 0.02 | 1.31 | 0.85 | | 3.76 | 1.4 | 135.3 | 129.18 | 128.37 | 6.1 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 40C | 40B | | 0 | 1 | 1 | 0.000 | 0.006 | 0.000 | 0.006 | 0.006 | 81 | 8 | 2.00% | 0.01 | 1.86 | 1.20 | | 5.32 | 1.4 | 155.3 | 148.50 | 146.89 | 6.8 |
| | 40B | 40A | | 0 | 2 | 3 | 0.001 | 0.010 | 0.001 | 0.016 | 0.017 | 164 | 8 | 2.00% | 0.02 | 1.86 | 1.20 | | 5.32 | 1.7 | 154.9 | 146.79 | 143.52 | 8.1 |
| | 40A | 40 | | 0 | 1 | 4 | 0.000 | 0.006 | 0.001 | 0.021 | 0.023 | 134 | 8 | 1.75% | 0.03 | 1.74 | 1.12 | | 4.97 | 1.9 | 150.7 | 143.42 | 141.07 | 7.3 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 42 | EX. | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 153 | 8 | 2.35% | 0.02 | 2.01 | 1.30 | | 5.76 | 1.8 | 139.2 | 133.50 | 129.91 | 5.7 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |

*Peaking Formula = 3.5Q^0.807 (Q in MGD)

**Friction Factor n = 0.012

# HYDRAULIC ANALYSIS FOR SANITARY SEWER DESIGN

| SERVICE AREA | MANHOLE NUMBER FROM | MANHOLE NUMBER TO | AREA SERVED (ACRES) GROSS INCR. | AREA SERVED (ACRES) NET TOTAL | AREA SERVED (Units) GROSS INCR. | AREA SERVED (Units) NET TOTAL | INCREMENTAL FLOW AVG. DAILY FLOW (MGD) | INCREMENTAL FLOW PEAK* FLOW (MGD) | TOTAL FLOW AVG. DAILY FLOW (MGD) | TOTAL FLOW DESIGN FLOW (MGD) | TOTAL FLOW DESIGN + RESERVE (MGD) | PIPE LENGTH (FEET) | PIPE DIAMETER (INCHES) | PIPE SLOPE (%) | TOTAL PEAK* FLOW (CFS) | FULL PIPE CAPACITY (CFS) | FULL PIPE CAPACITY** (MGD) | PIPE CAPACITY AS AVG. (MGD) | FULL PIPE VELOCITY** (FPS) | ACTUAL PIPE VELOCITY** (FPS) | GROUND ELEVATION AT UPPER END | INVERT ELEVATION UPPER END | INVERT ELEVATION LOWER END | DEPTH TO INVERT (FEET) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13I | 13H | | 0 | 4 | 4 | 0.001 | 0.017 | 0.001 | 0.017 | 0.019 | 275 | 8 | 0.85% | 0.03 | 1.21 | 0.78 | | 3.47 | 1.5 | 142.2 | 133.10 | 130.76 | 9.1 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 13L | 13K | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 100 | 8 | 1.00% | 0.02 | 1.31 | 0.85 | | 3.76 | 1.4 | 144.5 | 139.48 | 138.48 | 5.0 |
| | 13K | 13J | | 0 | 2 | 4 | 0.001 | 0.010 | 0.001 | 0.020 | 0.022 | 88 | 8 | 0.40% | 0.03 | 0.83 | 0.54 | | 2.38 | 1.1 | 143.8 | 138.38 | 138.03 | 5.4 |
| | 13J | 13H | | 0 | 3 | 7 | 0.001 | 0.014 | 0.002 | 0.034 | 0.037 | 389 | 8 | 1.84% | 0.05 | 1.78 | 1.15 | | 5.10 | 2.2 | 144.9 | 137.93 | 130.76 | 6.9 |
| | 13H | 13G | | 0 | 5 | 12 | 0.002 | 0.021 | 0.004 | 0.055 | 0.060 | 57 | 8 | 7.23% | 0.08 | 3.53 | 2.28 | | 10.11 | 3.6 | 136.5 | 130.66 | 126.55 | 5.8 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 13P | 13O | | 0 | 1 | 1 | 0.000 | 0.006 | 0.000 | 0.006 | 0.006 | 121 | 8 | 5.70% | 0.01 | 3.13 | 2.03 | | 8.98 | 2.0 | 143.3 | 138.50 | 131.61 | 4.8 |
| | 13O | 13N | | 0 | 4 | 5 | 0.001 | 0.017 | 0.002 | 0.023 | 0.025 | 219 | 8 | 0.85% | 0.04 | 1.21 | 0.78 | | 3.47 | 1.6 | 136.5 | 131.51 | 129.65 | 5.0 |
| | 13N | 13M | | 0 | 2 | 7 | 0.001 | 0.010 | 0.002 | 0.033 | 0.036 | 195 | 8 | 0.85% | 0.05 | 1.21 | 0.78 | | 3.47 | 1.7 | 135.9 | 129.55 | 127.90 | 6.3 |
| | 13M | 13G | | 0 | 3 | 10 | 0.001 | 0.014 | 0.004 | 0.047 | 0.052 | 313 | 8 | 0.40% | 0.07 | 0.83 | 0.54 | | 2.38 | 1.4 | 135.2 | 127.80 | 126.55 | 7.4 |
| | 13G | 13F | | 0 | 23 | 33 | 0.008 | 0.071 | 0.012 | 0.118 | 0.130 | 210 | 8 | 0.40% | 0.18 | 0.83 | 0.54 | | 2.38 | 1.9 | 135.2 | 126.45 | 125.61 | 8.7 |
| | 13F | 13D | | 0 | 2 | 35 | 0.001 | 0.010 | 0.012 | 0.128 | 0.141 | 220 | 8 | 0.40% | 0.20 | 0.83 | 0.54 | | 2.38 | 2.0 | 131.6 | 125.51 | 124.63 | 6.1 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 13E | 13D | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 113 | 8 | 7.42% | 0.02 | 3.58 | 2.31 | | 10.24 | 2.8 | 140.4 | 133.00 | 124.63 | 7.4 |
| | 13D | 13C | | 0 | 29 | 31 | 0.010 | 0.086 | 0.011 | 0.096 | 0.106 | 82 | 8 | 0.50% | 0.15 | 0.93 | 0.60 | | 2.66 | 2.0 | 133.3 | 124.53 | 124.12 | 8.8 |
| | 13C | 13B | | 0 | 1 | 32 | 0.000 | 0.006 | 0.011 | 0.102 | 0.112 | 75 | 8 | 1.01% | 0.16 | 1.32 | 0.85 | | 3.78 | 2.6 | 130.9 | 124.02 | 123.26 | 6.9 |
| | 13B | 13A | | 0 | 5 | 37 | 0.002 | 0.021 | 0.013 | 0.123 | 0.135 | 238 | 8 | 1.54% | 0.19 | 1.63 | 1.05 | | 4.67 | 3.1 | 130.0 | 123.16 | 119.50 | 6.9 |
| | 13A | 13 | | 0 | 1 | 38 | 0.000 | 0.006 | 0.013 | 0.128 | 0.141 | 126 | 8 | 5.90% | 0.20 | 3.19 | 2.06 | | 9.13 | 5.1 | 127.5 | 119.40 | 111.96 | 8.1 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |

*Peaking Formula = 3.5Q^0.807 (Q in MGD)

**Friction Factor n = 0.012

# HYDRAULIC ANALYSIS FOR SANITARY SEWER DESIGN

| SERVICE AREA | MANHOLE NUMBER FROM | MANHOLE NUMBER TO | AREA SERVED (ACRES) GROSS INCR. | AREA SERVED (ACRES) NET TOTAL | AREA SERVED (Units) GROSS INCR. | AREA SERVED (Units) NET TOTAL | INCREMENTAL FLOW AVG. DAILY FLOW (MGD) | INCREMENTAL FLOW PEAK* FLOW (MGD) | TOTAL FLOW AVG. DAILY FLOW (MGD) | TOTAL FLOW DESIGN FLOW (MGD) | TOTAL FLOW DESIGN + RESERVE (MGD) | PIPE LENGTH (FEET) | PIPE DIAMETER (INCHES) | PIPE SLOPE (%) | TOTAL PEAK* FLOW (CFS) | FULL PIPE CAPACITY (CFS) | FULL PIPE CAPACITY** (MGD) | PIPE CAPACITY AS AVG. (MGD) | FULL PIPE VELOCITY** (FPS) | ACTUAL PIPE VELOCITY** (FPS) | GROUND ELEVATION AT UPPER END | INVERT ELEVATION UPPER END | INVERT ELEVATION LOWER END | DEPTH TO INVERT (FEET) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6A | 6 | | 0 | 5 | 5 | 0.002 | 0.021 | 0.002 | 0.021 | 0.023 | 283 | 8 | 10.60% | 0.03 | 4.27 | 2.76 | | 12.24 | 3.5 | 135.6 | 130.73 | 100.71 | 4.9 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 9C | 9B | | 0 | 1 | 1 | 0.000 | 0.006 | 0.000 | 0.006 | 0.006 | 150 | 8 | 6.29% | 0.01 | 3.29 | 2.13 | | 9.43 | 2.1 | 145.0 | 140.00 | 130.55 | 5.0 |
| | 9B | 9A | | 0 | 5 | 6 | 0.002 | 0.021 | 0.002 | 0.027 | 0.029 | 186 | 8 | 3.82% | 0.04 | 2.57 | 1.66 | | 7.35 | 2.7 | 137.1 | 130.45 | 123.34 | 6.7 |
| | 9A | 9 | | 0 | 2 | 8 | 0.001 | 0.010 | 0.003 | 0.037 | 0.040 | 151 | 8 | 13.00% | 0.06 | 4.73 | 3.06 | | 13.56 | 4.7 | 130.8 | 123.24 | 103.60 | 7.6 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 9D | 9B | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 115 | 8 | 1.00% | 0.02 | 1.31 | 0.85 | | 3.76 | 0.6 | 136.8 | 131.70 | 130.55 | 5.1 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 10D | 10E | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 100 | 8 | 4.75% | 0.02 | 2.86 | 1.85 | | 8.20 | 2.4 | 141.9 | 135.06 | 130.32 | 6.8 |
| | 10E | 10F | | 0 | 2 | 4 | 0.001 | 0.010 | 0.001 | 0.020 | 0.022 | 109 | 8 | 5.00% | 0.03 | 2.94 | 1.90 | | 8.41 | 2.7 | 137.1 | 130.22 | 124.76 | 6.8 |
| | 10F | 10C | | 0 | 3 | 7 | 0.001 | 0.014 | 0.002 | 0.034 | 0.037 | 193 | 8 | 2.72% | 0.05 | 2.16 | 1.40 | | 6.20 | 2.6 | 132.8 | 124.66 | 119.40 | 8.1 |
| | 10C | 10B | | 0 | 4 | 11 | 0.001 | 0.017 | 0.004 | 0.051 | 0.056 | 150 | 8 | 1.53% | 0.08 | 1.62 | 1.05 | | 4.65 | 2.4 | 130.2 | 119.30 | 117.00 | 10.9 |
| | 10B | 10A | | 0 | 1 | 12 | 0.000 | 0.006 | 0.004 | 0.057 | 0.063 | 238 | 8 | 4.05% | 0.09 | 2.64 | 1.71 | | 7.57 | 3.5 | 121.9 | 116.90 | 107.26 | 5.0 |
| | 10A | 10 | | 0 | 1 | 13 | 0.000 | 0.006 | 0.005 | 0.063 | 0.069 | 222 | 8 | 1.09% | 0.10 | 1.37 | 0.89 | | 3.93 | 2.3 | 115.8 | 107.16 | 104.73 | 8.6 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 10G | 10C | | 0 | 3 | 3 | 0.001 | 0.014 | 0.001 | 0.014 | 0.015 | 125 | 8 | 6.50% | 0.02 | 3.35 | 2.16 | | 9.59 | 2.6 | 134.0 | 127.50 | 119.40 | 6.5 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 12C | 12B | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 122 | 8 | 4.59% | 0.02 | 2.81 | 1.82 | | 8.06 | 2.3 | 146.3 | 141.38 | 135.80 | 4.9 |
| | 12B | 12A | | 0 | 1 | 3 | 0.000 | 0.006 | 0.001 | 0.016 | 0.017 | 187 | 8 | 2.35% | 0.02 | 2.01 | 1.30 | | 5.76 | 1.8 | 140.6 | 135.70 | 131.31 | 4.9 |
| | 12A | 12 | | 0 | 1 | 4 | 0.000 | 0.006 | 0.001 | 0.021 | 0.023 | 103 | 8 | 19.59% | 0.03 | 5.81 | 3.75 | | 16.64 | 4.4 | 143.1 | 131.21 | 111.01 | 11.9 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 15C | 15B | | 0 | 3 | 3 | 0.001 | 0.014 | 0.001 | 0.014 | 0.015 | 97 | 8 | 0.80% | 0.02 | 1.17 | 0.76 | | 3.36 | 1.3 | 123.2 | 116.34 | 115.56 | 6.8 |
| | 15B | 15A | | 0 | 1 | 4 | 0.000 | 0.006 | 0.001 | 0.019 | 0.021 | 208 | 8 | 0.40% | 0.03 | 0.83 | 0.54 | | 2.38 | 1.1 | 128.7 | 115.46 | 114.63 | 13.3 |
| | 15A | 15 | | 0 | 2 | 6 | 0.001 | 0.010 | 0.002 | 0.029 | 0.032 | 126 | 8 | 1.40% | 0.05 | 1.55 | 1.00 | | 4.45 | 2.0 | 123.2 | 114.53 | 112.77 | 8.7 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | 20B | 20A | | 0 | 2 | 2 | 0.001 | 0.010 | 0.001 | 0.010 | 0.011 | 165 | 8 | 2.12% | 0.02 | 1.91 | 1.24 | | 5.48 | 1.8 | 146.6 | 139.91 | 136.40 | 6.7 |
| | 20A | 20 | | 0 | 2 | 4 | 0.001 | 0.010 | 0.001 | 0.020 | 0.022 | 206 | 8 | 5.49% | 0.03 | 3.08 | 1.99 | | 8.81 | 2.8 | 143.6 | 136.30 | 125.01 | 7.3 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |
| | | | | 0 | | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | | 0.0 |

*Peaking Formula = 3.5Q^0.807 (Q in MGD)

**Friction Factor n = 0.012

6/01

# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM



Project: Kennington Sec 2

Date 7/26/06

DWE Engineer: MG RRP

| REQUIREMENT | REFERENCE | COMMENTS |
|---|---|---|
| Approved Standard Specifications: _____ Approval Date: _____ | | |
| **GENERAL DESIGN** | | |
| Type: Lateral / Sub-Main / Main / Trunk / Interceptor | | |
| Pipe Dia. (inches) / Quantity (feet) / Slope (ft./ft.) max./min.: 12,000 / 19.6 / -4 | | See worksheet next page for details of the gravity sewer lines. |
| Appropriate sewer material: PVC/DI | | |
| Velocities when flowing full: | GK | ≥ 2 fps or 1.3 fps for settled sewage |
| Anchoring of sewers on ≥ 20 % slope: | N/A | |
| Special protection against internal erosion: | N/A | (for ≥ 15 fps) |
| Minimum cover over sewer or special construction (DIP or concrete cap/encasement): | | prevent freezing and stress |
| Pipe strength evaluation: | N/A | (depths > 20 feet) |
| Manholes for sewers ≥ 8-inches: ✓ ≤ 400 feet for sewers ≤ 15-inches in diameter; ___ < 500 feet for sewers ≥ 18-inches and ≤ 30-inches; ___ < 600 feet (appropriate cleaning equipment) | | at all changes in grade, size, alignment, and at all intersections |
| Ventilation provided for manholes where continuous watertight sections exceed 1000 feet: | N/A | |
| Drop pipe provided for all sewers entering manhole ≥ 24-inches above manhole invert: | N/A | |
| Provisions for water supply/line protection: sewer easements | | Per Regulations |
| **SEWERS IN RELATION TO STREAMS, ETC.** N/A | | |
| Watertight manholes covers/inserts provided where tops are below 25-year flood/wave action: | | |
| Manholes with connections which will remain watertight under differential settlement (flexible connection) | | Inlet/outlet pipes must be joined |
| If sewer crosses or enters stream, is 1-foot of cover in rock and 3-feet of cover in other material specified | | unless concrete encasement is specified |
| If Piers or Inverted Siphons proposed, attach supplemental review sheet(s) as necessary | | |

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Project: Kensington Sec 2

# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM



Date 7/26/06

DWE Engineer: ~~MG~~ RRB

| Plan Sheet No(s) | MH # | to | MH # | Length (ft) | Diameter (in) | Slope (%) | Pipe Material |
|---|---|---|---|---|---|---|---|
| 20 | 42 | | Sec 1 | 153 | 8 | 2.35 | PVC |
| | " | | " | | | | |
| 22 | 40C | | 40B | 80 | | 2.00 | |
| | 40B | | 40A | 164 | | 2.00 | |
| | 40A | | 40 | 155 | | 1.75 | |
| 22 | 41 | | 40 | 307 | | 1.06 | |
| | 40 | | 39 | 380 | | .40 | |
| | 39 | | 38 | 264 | | .40 | |
| | 38 | | 37 | 318 | | .40 | |
| 23 | 37 | | 36 | 307 | | | |
| | 36 | | 35 | 248 | | | |
| | 35 | | 34 | 234 | | 1.99 | |
| | 34 | | 33 | 218 | | .40 | |
| | 33 | | 32 | 75 | | | |
| | | | | | | | |
| | 32A | | 32 | 77 | | 1.06 | |
| | | | | | | | |
| 23 | 32 | | 31 | 176 | | .40 | |
| | | | | | | | |
| 22 | 31D | | 31B | 167 | | .69 | |
| | 31B | | 31A | 75 | | 10.78 | |
| | 31C | | 31A | 177 | | 3.00 | |
| | 31A | | 31 | 186 | | .6 | |
| 23 | 31 | | 30 | 196 | | .40 | |
| | 30 | | 29 | 208 | | .40 | |
| | 29 | | 28 | 88 | | | |
| | 28 | | 27 | 386 | | | DI |

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# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM



Date 7/26/06

DWE Engineer: ~~MG~~ RBD

Project: Kensington Sec 2

| Plan Sheet No(s) | MH # | to | MH # | Length (ft) | Diameter (in) | Slope (%) | Pipe Material |
|---|---|---|---|---|---|---|---|
| 22 | 27D | | 27C | 209 | 8 | 1.25 | PCV |
| | 27C | | 27B | 182 | | 1.19 | |
| | 27B | | 27A | 200 | | 2.06 | |
| | 27A | | 27 | 185 | | 3.29 | |
| 23 | 27 | | Seal | 114 | | .40 | DI |
| | | | | | | | |
| 21 | 26 | | 25 | 212 | | 5.6 | PVC |
| | 25 | | 24 | 290 | | 2.71 | |
| | 24 | | | | | | |
| 15 | 24B | | 24A | 83 | 8 | 1.5 | PVC |
| | 24A | | 24 | 150 | | .6 | |
| | | | | | | | |
| 16 | 24 | | 23 | 245 | | .4 | |
| 18 | 23 | | 22 | 220 | | .4 | |
| | 22 | | 21 | 147 | | | |
| | 21 | | 20 | 213 | | | |
| 16 | 20B | | 20A | 116.5 | | 2.12 | |
| 21 | 20A | | 20 | 206 | | 5.49 | |
| | | | | | | | |
| 18 | 20 | | 19 | 166 | | .4 | |
| | 19 | | 18 | 164 | | | |
| | 18 | | 17 | 136 | | | |
| | 17 | | 16 | 116 | | | |
| | 16 | | 15 | 187 | | 3.28 | |
| | | | | | | | |
| 16 | 15C | | 15B | 97 | | .80 | |
| | 15B | | 15A | 208 | | .4 | |
| | 15A | | 15 | 126 | | | |
| | | | | | | | |
| 18 | 15 | | 14 | 97 | | .4 | |
| | 14 | | 13 | 56 | | | |

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# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM

Page 4 OF 6
Date 7/26/06
DWE Engineer: ~~MG~~ RRB

Project: Kensington Sec 2

| Plan Sheet No(s) | MH # | to | MH # | Length (ft) | Diameter (in) | Slope (%) | Pipe Material |
|---|---|---|---|---|---|---|---|
| 20 | 13P | | 13O | 121 | 8 | 5.7 | PVC |
| | 13O | | 13N | 219 | | .85 | |
| | 13N | | 13M | 195 | | .85 | |
| | 13M | | 13G | 313 | | .40 | |
| 20 | 13L | | 13K | 100 | | 1.00 | PVC |
| | 13K | | 13J | 88 | | .40 | |
| | 13J | | 13H | 389 | | 1.84 | |
| | 13I | | | | | | |
| | 13I | | 13H | 275 | | .85 | |
| | 13H | | 13G | 57 | | 7.23 | |
| | 13G | | 13F | 210 | | .40 | |
| | 13F | | 13D | 220 | | | |
| 17 | 13E | | 13D | 113 | 8 | 7.42 | PVC |
| 17 | 13D | | 13C | 82 | 8 | 1.5 | PVC |
| | 13C | | 13B | 75 | | 1.01 | |
| | 13B | | 13A | 238 | | 1.54 | |
| | 13A | | 13 | 126 | | 5.9 | |
| | 13 | | 12 | 210 | | .4 | DI |
| | 12 | | 12F | | | | |
| | 12G | | 12A | | | | |
| | 12A | | 12 | | | | |

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# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM

Page 5 OF 6
Date 7/26/00
DWE Engineer: ~~MG~~ MLB

Project: Kensington Sec

| Plan Sheet No(s) | MH # | to | MH # | Length (ft) | Diameter (in) | Slope (%) | Pipe Material |
|---|---|---|---|---|---|---|---|
| 18 | 13 | | 12 | 210 | 8 | .4 | DI |
| 19 | 12C | | 12B | 122 | | 4.59 | PVC |
| | 12B | | 12A | 187 | | 2.35 | |
| | 12A | | 12 | 103 | | 19.6 | DI ? |
| 18 | 12 | | 11 | 308 | | .4 | DI |
| | 11 | | 10 | 207 | | 2.34 | PVC |
| | 10D | | 10E | 100 | 8 | 4.75 | PVC |
| | 10E | | 10F | 109 | | 5.00 | |
| | 10F | | 10C | 193 | | 2.22 | |
| | 10F | | | | | | |
| | 10G | | 10C | 125 | | 6.5 | |
| 19 | 10G | | 10B | 150 | | 1.53 | |
| | 10B | | 10A | 238 | | 4.05 | |
| | 10A | | 10 | 222 | | 1.09 | DI |
| 18 | 10 | | 9 | 258 | | .4 | PVC |
| 19 | 9D | | 9B | 115 | | 1.00 | PVC |
| | 9C | | 9B | 150 | | .29 | PVC |
| | 9B | | 9A | 186 | | 3.82 | |
| | 9A | | 9 | 151 | | 13.00 | |

6/01

# GRAVITY SEWERS WITH STD. SPECS
## REVIEW FORM

Page 6 OF 6
Date 7/26/00
DWE Engineer: ~~MG~~ RRB

Project: Kensington Sec 2

| Plan Sheet No(s) | MH # | to | MH # | Length (ft) | Diameter (in) | Slope (%) | Pipe Material |
|---|---|---|---|---|---|---|---|
| 18 | 9 | | 8 | 127 | 8 | .4 | PVC |
| | 8 | | 7 | 356 | | | |
| | 7 | | 6 | 164 | | 2.4 | |
| 21 | 6A | | 6 | 283 | | 10.6 | |
| 19 | 6 | | 5 | 268 | | .4 | |
| | 5 | | 4 | 147 | | | |
| | 4 | | 3 | 121 | | | |
| | 3 | | 2 | 303 | | | DIP |
| | 2 | | 1 | 291 | | 3.03 | PVC |
| | 1 | | Sec 1 | 242 | | .95 | |

Kennington

## PREPARATION

1. Gather plans.
2. Alert remote station to testing.
3. Get a 25' tape or measuring rod.
4. Get s stop watch.
5. Fill wet well to nearly alarm level.
6. Have enough standby water to completely fill wet well.

## TEST ALARM

1. Add enough water to cause alarms to sound and verify remote.

## TEST PUMPING RATES

13.00
11.98
= 12 x 52 ~ 600

1. Pump down the well enough to clear alarm
2. Measure from lip of well to water.
3. Pump with one pump for one minute.
4. Calculate pumped volume from chart.

13.98
13.00
x 12 x 50' ~ 600.
12'

| | 3' | 4' | 5' | 6' | 8' |
|---|---|---|---|---|---|
| • **Wet well diameter** | | | | | |
| • **Gal/in drawdown** | 4.4 | 7.8 | 12 | 18 | 31 |

x 4
52

5. Repeat with second. pump.
   If there are three pumps, do procedure with each pair of pumps.

## TEST "OFF"

1. With both pumps running, pump down to cutoff.

## TEST "ON"

1. Fill until lead pump starts.
2. Turn off lead pump.
3. Continue to fill until lag pump starts.

## TEST ALTERNATE

1. Pump down to cutoff.
2. Fill a second time until pumps alternate.