SANITARY SEWER FEASIBILITY NARRATIVE

LANDS OF ARDROSSAN FARM

SUBMITTED AS PART OF
THE CONDITIONAL USE APPLICATION
FOR DENSITY MODIFICATION DEVELOPMENT

BY:

MOMENEE AND ASSOCIATES INC.
924 COUNTY LINE ROAD
BRYN MAWR, PA 19010

JULY 31, 2013

PROJECT SEWAGE FLOWS – ARDROSSAN FARM

The Ardrossan Family Trusts own the land known as the Ardrossan Farm in Radnor Township. The total tract, located at Newtown and Darby-Paoli Roads, contains 352.5 acres and is composed of several individual parcels. Parcel 'A' is the largest parcel containing 311.54 acres and is located on the south east corner of Darby-Paoli and Newtown Roads. Parcel 'A' is the subject of this report. The Trusts propose to develop the site in accordance with Radnor Township's Density Modification provisions of the zoning ordinance which permits cluster development with the provision of open space areas.

The site currently contains several residential and farm buildings. The majority of the site is open meadow with some wooded areas and areas of steep slopes. Darby-Paoli Road forms the western boundary of the site. The trust owns additional parcels on the west side of Darby-Paoli Road which extend to Darby Creek. Wigwam Run flows through the center of the property and Camp Run flows along the Southern portion of the site. The site will be developed with approximately 55 to 78 new single family dwellings on 64 to 87 new individual residential building lots. The existing manor house will remain as a separate 10 acre lot. The existing cottages and barns will remain on the site and individual lots will be created to accommodate these dwellings.

An existing sanitary sewer trunk line extends along Darby Creek traversing the adjacent Trust parcels located between Darby Creek and Darby-Paoli Road. An 8" collection line extends from the Darby Creek Interceptor across Darby Paoli Road into the site and serves the existing Dairy Barn on this site. It is proposed to extend the existing sewer line serving the dairy barn further into the site to serve the proposed development. As part of the development, the existing dairy barn is to be converted to a single family dwelling. The sewer extension will serve the Manor House and the 5 existing dwellings in the northeastern quadrant of the site. The sewer extension will also serve the majority of the new lots and provide availability for public sewer service for several large lots in the southern portion of the site.

Two additional extensions are also proposed through the adjoining Trust lands to serve the existing dwellings along Darby-Paoli Road and provide the availability of public sewer service for the larger lots being proposed to the east of these Darby-Paoli Road homes.

Under the development concept, 5 of the new lots may comprise 10+ acres. It is expected that because of their larger sizes, to be served by on-site septic systems. The location of the sewer lines are such that connections could be made to the new sewer extensions if desired.

The optional development calls for more smaller lots in place of the 10+ acre lots which are to be served by public sewer. The lines serving the other part of the development will be extended to service these smaller lots.

The manor house on this site is currently served by public water supplied by Aqua Pennsylvania, and water service will be extended to serve the existing dwellings in the northeast quadrant of the site and most of the new homes. The existing dwellings located along Darby-Paoli Road are currently on wells and well service is proposed to be maintained for these dwellings.

ESTIMATED SEWER FLOWS ACCORDING TO SEWER AUTHORITY STANDARDS:

Development With Large Lots:

Total Residential Units	64 EDU's
Estimated Flows/Unit	262.5 GPD
Total Estimated Flows	16,800 GPD (0.0168 MGD)

Optional Development Scenario:

Total Residential Units	87 EDU's
Estimated Flows/Unit	262.5 GPD
Total Estimated Flows	22,837.5 GPD (0.0228 MGD)

It is proposed to convey sewage flows to the existing Darby Creek Interceptor. This system conveys flows through lines operated by Radnor Township, the Radnor-Haverford-Marple Sewer Authority, Springfield Township, the Darby Creek Joint Authority and the Delaware County Regional Authority before final treatment by the City of Philadelphia. These authorities were contacted to determine if sufficient capacity exists within their facilities to handle the additional flows. DELCORA responded that capacity exists at their Darby Creek Pump Station to serve the additional flows and the Radnor-Haverford-Marple Sewer Authority responded that they currently have the capacity available but noted that the member townships needed to approve the flow allocation.

In discussions with the Radnor Township Public Works Department they noted that the had witnessed accumulation of grit within portions of the Darby-Creek Interceptor within the portion of the Ardrossan Lands south of Saw Mill Road where the size of the pipe changes as it flows downstream.

It was uncertain the grit accumulation was causing diminished capacity in this portion of the line and the township noted that further investigation was needed. As part of our review, we obtained copies of the original design plans for the Darby-Creek Interceptor to review pipe sizes and slopes to determine the approximate capacity of the line. Per the

design plans, each manhole is assigned a number which increases as the line moves upstream following the path of Darby Creek. The existing 8" line currently serving the Dairy Barn which is proposed to be extended to serve the site connects to the interceptor at manhole #57. The interceptor line is 16" in diameter at this location. Downstream of this location the size of the interceptor increases to 20" at manhole #54 which is located on the north side of the Saw Mill Road Bridge over Darby Creek. The township has noted the accumulation of grit within the five or so pipe runs downstream of Manhole #54.

In an effort to review the capacity of the existing interceptor, preliminary review of full flow capacity was performed using the Manning Equation. Based on the shallowest pipe slope of the 16' pipe downstream of manhole #57, it was calculated that the full flow capacity of this section of the 16" line is 1.71 million gallons per day (MGD). Based on the shallowest pipe slope of the 20' pipe downstream of manhole #54, it was calculated that the full flow capacity of this section of the 20" line is 1.80 million gallons per day (MGD). The proposed total flow from the optional development scenario of 0.0228 MGD represents less than 1.3% of the total capacity of this line.

Radnor Township noted that the accumulation of grit in the lines downstream of manhole #54 may have an impact on the actual available capacity of the line. It appears from the design plans that this point is a natural settling point for materials flowing through the line because of the actual design of the line at this point. As noted, the interceptor increases in size from 16" to 20" at manhole #54. In addition there is a significant slope change at the manhole whereby the incoming slope of 3.50% changes to 0.32% for the outgoing pipe. Review of full flow velocities show that the incoming 16" pipe velocity of 10.28 feet per second (FPS) is reduced to 3.61 fps through the 20" downstream pipe. Velocity is an important factor in conveying suspended solids as part of sewage flows since higher velocities will help keep heavier partials in suspension. The fact that there is grit accumulation downstream on manhole #54 is evidence that the change in both pipe size and slope and the resultant decrease in velocity is causing the heavier partials (grit) to fall out of suspension at this location. Lack of periodic maintenance and cleaning is most likely the cause of the accumulation and spread of the materials downstream of this location.

Additional investigation is required to determine the reduction in capacity resulting from the deposits and the need for their removal to accommodate the additional follows from this project Removal of the accumulated materials would restore this section of the sewer line to its design capacity.

Capacity and velocity calculations are attached as part of this narrative.

AQUA

Aqua Pennsylvania, Inc.
762 W. Lancaster Avenue
Bryn Mawr, PA 19010

www.aquapennsylvania.com

February 4, 2008

David R. Fiorello, P.E.
Momenee & Associates, Inc.
924 County Line Road
Bryn Mawr, PA 19010

Re: Water Availability
Ardrossan Farm
Radnor Township, Delaware County, Pennsylvania

Dear Mr. Fiorello:

This letter will serve as confirmation that the above referenced project is situated within Aqua Pennsylvania, Inc.'s service territory. Service would be provided in accordance with Aqua Pennsylvania Inc.'s Rules and Regulations.

Service to this project will require a main extension. Main extension projects are completed under a Builder's Extension Agreement. Under this agreement, the Builder is responsible for installing the main extension, including fire hydrants and service connections, with a pre-qualified contractor that he or she hires. In addition, the Builder is required to have his or her engineer prepare main extension plans in accordance with Aqua Pennsylvania, Inc. plan specifications and submit these plans to Aqua Pennsylvania, Inc. for review and approval. To proceed with this project please forward a full set of land development and main extension plans to my attention.

Once all of the requirements have been met and the main extension plans have been approved the builder will be able to enter into a Builder's Extension Agreement. Please refer to the New Business Package on disk enclosed for the specific requirements.

Flow data information for this area, if required, can be obtained upon written request to Lisa Thomas-Oliva of our Production Department so that you may determine the adequacy of our supply for your project's needs. If you have specific questions related to flow test requests, you may reach Mrs. Oliva at (610) 645-1034.

If you require further information, please contact me at (610) 645-4230.

Sincerely,

Gary J. Horne
New Business Representative

DELAWARE COUNTY REGIONAL WATER QUALITY CONTROL AUTHORITY
P.O. Box 999 • Chester, PA 19016-0999

May 3, 2013

Mr. David Fiorella, P.E.
Momenee and Associates, Inc.
924 County Line Road
Bryn Mawr, PA 19010

RE: Sewer Availability – Ardrossan Farm
Radnor Township

Dear Mr. Fiorella:

Per your request to verify sewer service, DELCORA has capacity at its Darby Creek Pump Station to serve the 102 proposed houses in the Ardrossan Farm development. Please also note that this letter does not serve as formal approval in the PaDEP Sewage Facilities Planning Module process. Please contact Christine Volkay-Hilditch, P.E., Director of Engineering at 610-876-5523, extension 116, if you have any questions.

Thank you for your attention.

Sincerely,

Joseph L. Salvucci
Executive Director

JLS:smf

cc: File

RADNOR • HAVERFORD • MARPLE
SEWER AUTHORITY
600 GLENDALE ROAD • HAVERTOWN, PA 19083
(610) 446-0867
FAX (610) 446-4926

Mr. David R. Fiorello, P.E.
Momenee and Associates
924 County Line Road
Bryn Mawr, Pa. 19010

05/24/2013

RE: Sewer Availability - Ardrossan Farm
Radnor Township, Delaware County

File #16-012

Dear Mr. Fiorello:

In response to your April 22, 2013 letter to the Radnor Haverford Marple Sewer Authority (RHM) for flow capacity, within the RHM pipeline, for a feasibility study of your project. RHM currently has the capacity available for allocation within its service area. The Board will take no action on requested flow until its member Townships up stream (depending on the flow path, it may be more than one Township) approve flow allocation to the project first before it is sent to RHM for flow allocation, then it has to be approved by all entities downstream to the Philadelphia Treatment Plant before connecting to the system.

If I can provide any further clarification to you with regards to the above information, Please do not hesitate to telephone me at 610-446-0867.

Very truly yours,
RHM Sewer Authority

David E. Adams, Manager

MOMENEE AND ASSOCIATES, INC.
Consulting Engineers

924 COUNTY LINE ROAD • BRYN MAWR, PA 19010
420 EXTON SQUARE PARKWAY • EXTON, PA 19341

DATE ______ SHEET 1 OF ______
NAME OF CLIENT ______ COMPUTED BY ______
PROJECT ______ CHECKED BY ______
SUBJECT ______

DARBY CREEK INterceptor

Pipe size change at MH # 54

(W. side Sawmill Road Bridge)

From plans of DARBY Creek & Little DARBY Creek

INterceptor Sewer DAted 11/21/1956 Rev 1/29/57

Approach Line

16" Asbestos Cement pipe @ $R = 0.035$

Capacity: (full flow)

$\frac{1.486}{n} A R^{2/3} S^{1/2}$

n = 0.011 minimum 0.013 Normal 0.015 maximum

A = 16" pipe = 1.396 SF

Wetted Perimeter (WP) = circumference = 4.187

$R = A/WP = 1.396/4.189 = 0.3333$

$R^{2/3} = 0.481$

$S = 0.035$ $S^{1/2} = 0.187$

$Q = \frac{1.486}{.013} \times 1.396 \times 0.481 \times 0.187$

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DATE _____ SHEET 2 OF _____

NAME OF CLIENT _____ COMPUTED BY _____

PROJECT _____ CHECKED BY _____

SUBJECT _____

Q = 14.35 CFS

1 CFS = 0.646 MGD

14.35 CFS = 9.27 MGD

Assume peak flow = 2.5 x Average flow

Average flow capacity = 3.71 MGD

Discharge Line

20" Asbestos Cement @ GR = 0.0032

full flow capacity = $\frac{1.486}{n} A R^{2/3} S^{1/2}$

n use 0.013 Manning

A - 20" pipe - 2.181 SF

WP = Circumference - 5.236

R = A/WP - 2.181 / 5.236 = 0.4165

$R^{2/3}$ = 0.5577

S = .0032 $S^{1/2}$ = 0.0566

$Q = \frac{1.486}{.013} \times 2.181 \times 0.5577 \times 0.0566$

Q = 7.87 mgd

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DATE _____ SHEET 3 OF _____

NAME OF CLIENT _____ COMPUTED BY _____

PROJECT _____ CHECKED BY _____

SUBJECT _____

$Q_{full} = 7.87$ CFS

1 CFS = 0.646 MGD

∴ Full flow capacity = 5.084 MGD

Assume peak flow = 2.5 x Ave flow

∴ Ave flow = 2.03 MGD

Dewatering pipe restrictions:

Shallowest slope = 0.0025

$S = 0.0025$ $S^{1/2} = 0.05$

$$Q = \frac{1.486}{.013} \times 2.181 \times 0.5577 \times .05$$

$Q = 6.95$ CFS

1 CFS = 0.646 MGD

∴ Full flow capacity = 4.49 MGD

Assume Peak flow = 2.5 x Ave flow

∴ Ave flow = 1.80 MGD

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DATE _____ SHEET 4 OF _____

NAME OF CLIENT _____ COMPUTED BY _____

PROJECT _____ CHECKED BY _____

SUBJECT _____

Revised Pipe Velocities @ MH # 34

Inflow pipe:

16" Asbestos cement pipe @ 0.035

Velocity = Q/A

Q full (peak) = 14.35 cfs

A = 1.396 sf

∴ V = 14.35 / 1.396 = 10.28 FPS

outflow pipe

20" Asbestos cement pipe @ 0.0032

Velocity = Q/A

Q full (peak) 7.87 cfs

A = 2.181

V = 7.87 / 2.181 = 3.61 FPS

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DATE _____ SHEET 5 OF _____

NAME OF CLIENT _____ COMPUTED BY _____

PROJECT _____ CHECKED BY _____

SUBJECT _____

Pipe Capacity at MH 57

16" Asbestos Cement Pipe (Min grade) 0.0075

full flow capacity

$\frac{1.486}{n} A R^{2/3} S^{1/2}$

$n = .013$

$A = 1.396$

$R^{2/3} = 0.481$

$S = .0075$ $\quad S^{1/2} = 0.0866$

$Q = \frac{1.486}{.013} \times 1.396 \times .481 \times .0866 = 6.65 CFS$

$1 CFS = .646 MGD$

$6.65 CFS = 4.29 MGD$ peak

Assume peak flow = 2.5 x Average flow

$\therefore$ Ave flow = 1.71 MGD