

Appendix E

Regional Connection to Chatham Memorandum

GHD developed a technical memorandum “Town of Harwich CWMP – Regional Connection Alternative to Chatham WPCF”, dated February 13, 2013, which discusses the options – including opinions and costs – for transporting a portion of sewerage wastewater from the Town of Harwich to the Chatham Water Pollution Control Facility (WPCF).



TECHNICAL MEMORANDUM

February 13, 2013

To	David Young, P.E., CDM Smith Inc.		
Copy to	Dr. Robert Duncanson, Town of Chatham		
From	J. Jefferson Gregg, P.E.	Tel	774-470-1640
Subject	Town of Harwich CWMP—Regional Connection Alternative to Chatham WPCF	Job No.	8614969

OBJECTIVE

The purpose of this memo is to evaluate options and provide opinions of costs for conveyance of approximately 300,000 to 340,000 gallons per day (gpd) of wastewater from the Town of Harwich to the Chatham Water Pollution Control Facility (WPCF). The consultant (CDM Smith) for the Town of Harwich has identified this flow range (reflecting whether the Great Sand Lakes area goes into the Pleasant Bay System or not) and tasked GHD with identifying the most appropriate route for this flow to be conveyed to the Chatham WPCF. The route will be selected to work in concert with the preliminary design of the collection system as depicted in the Chatham Comprehensive Wastewater Management Plan (CWMP). Collection system capital costs are developed based on the Chatham CWMP costs and on the proposed route outlined below. Capital costs and operations and maintenance (O&M) for treatment are based on the Harwich contribution to the overall flow amounts at the Chatham WPCF under full build-out conditions in Chatham.

This document reflects an update to the Preliminary Draft document provided to CDMSmith on May 16, 2012 to address their comments and comments from Chatham.

BACKGROUND

The Town of Harwich, and their consultant CDM Smith, is in the process of developing their CWMP and have requested information regarding the possible regional connection and treatment of flow from Harwich at the Chatham WPCF, which is located off of Sam Ryder Road and WPCF Drive in West Chatham. The facility is designed to treat 1.3 million gallons per day (mgd) and is currently permitted for 1.0 mgd. The facility is designed to reduce total nitrogen to 9,132 lb per year for the 1.0 mgd discharge limit. This corresponds to 3 mg/L total nitrogen on average. The facility is designed for a planned expansion to 1.9 mgd if and when Chatham implements the planned Phase 2 collection system expansion. This capacity is sufficient to treat the full build-out flow for the Chatham town-wide collection system, as outlined in the CWMP. However, the treatment facility has the ability to accept flow from Harwich, in the interim, as the collection system expands into new areas of Chatham. However, upon Chatham build-out, the average annual capacity would have to be increased to 2.2 to 2.24 mgd if the Harwich flow is accepted. Harwich has indicated that their summer peaking factor is 1.9 times average annual, which, as shown on the Chatham Final CWMP Table 2-4, is consistent with the Maximum Month peaking factor of 1.9 used for Chatham and as the basis for the flows and loads developed for the Chatham WPCF.



ROUTING & SIZING

Alternative 1: Pumping Station #63

Under this alternative, Harwich would convey flow to a manhole at the end of a proposed gravity line on State Route 137 (Meetinghouse Road) in Chatham. From here, the flow will travel through the Chatham collection system, and pump station proposed for this area, and be conveyed to the WPCF. Once treated, a pump station at the WPCF would convey a like volume of treated water back to Harwich via a force main for recharge.

Wastewater from Harwich would be collected and is anticipated to be conveyed across the border with Chatham at the intersection of Route 137 and Old Queen Anne Road. From here, a force main would continue until the flow is discharged into the gravity collection system in Chatham. As part of the CWMP, the Town of Chatham developed preliminary sewer layouts for the entire town¹. However, based on the addition of 300,000 gpd from Harwich, the layout needs to be modified to convey this larger flow to the WPCF efficiently.

In reviewing the proposed collection system, and following discussions with the Town of Chatham, we recommend that flow be conveyed from Harwich south on Route 137 for approximately 2,000 feet before entering a gravity sewer. From here, the flow would be conveyed by gravity sewer south on Route 137 to the Commerce Park industrial park, where pump station #63 would be constructed. Pump station #63 flow would be conveyed east to the WPCF via force main. An existing utility easement connects Commerce Park to the WPCF site via Chick's Way (refer to Figure 1 for additional details). Under this alternative, pump station #63 is proposed to become a major pump station, collecting flow from areas in Chatham north of Route 28 and west of Sam Ryder Road, and along Old Queen Anne Road. This includes flow from pump stations 4, 5, 6, 7, 8, 12, 40, 41, 63, 64, and 65 as depicted on the Chatham town-wide preliminary layout, an excerpt of which is included in Figure 4. Including the Harwich flow, the total size of the station is approximately 1,300 gallons per minute.

Table 1 Pumping Station #63 Sizing and Design Parameters

Source	Average Annual Flow (gpd)
Harwich	300,000
Chatham	138,000
Total	438,000

Design Parameters	
Peak Hr Peaking Factor ²	4.2
Peak Hr Design Flow (gpm)	1,280

¹ Refer to Town of Chatham Preliminary Gravity Sewer and Low Pressure System Layout, April 14, 2006 an excerpt of which is included as part of Figure 4.

² Per TR-16, 2011 Edition, Page 2-3.



The industrial area surrounding pump station (PS) #63 was identified as a priority area for sewerage in the CWMP, and thus PS #63 may be a good candidate to receive the Harwich flow, depending on the anticipated timetable for construction. However, the topography within the industrial park limits the potential locations for the station. Given the size of the station at approximately 1,300 gallons per minute and using the preferred setup of a self-contained suction lift station, the standard Gorman-Rupp offering is an eight-foot by twelve-foot structure, not including the generator or wet-well. In the feasible locations, there is not a significant amount of space and so the Town of Chatham would need to negotiate the taking of a portion of one of the parcels for this location to be viable. Refer to Figure 2 for additional details.

From pump station #63, a force main would enter the west side of the WPCF site and connect to the influent building. After treatment, Chatham's treated effluent is routed to one of four sand beds via a distribution box. In order to re-collect the Harwich flow, a pump station would be required. The pump station could draw from the distribution box and then return flow to Harwich. It is proposed that the flow returned to Harwich by this station would equal the amount sent from Harwich to Chatham. The on-site force main routing and proposed pump station location are shown on Figure 3 and would return to Harwich via Middle Road and Route 137.

Given the possible constraints in siting pump station #63, the Harwich flow could be routed to proposed pump station #6 (Alternative 2), which is planned to be located further north on Route 137, as shown on Figure 1. There is more potential space at this location and several Town-owned parcels, though it is unknown whether the land is available for use as part of the Chatham collection system or if there are constraints on construction of a station at this site.

Alternative 2: Pumping Station #6

Alternative 2 utilizes planned pumping station 6 (PS#6) to receive the Harwich flow. The location of this site is shown on Figure 1. This site is larger than the site for station #53 and is closer to the Harwich-Chatham town line. However, it is further from the Chatham WPCF and thus requires a longer force main to reach the site. The layout with PS#6 as a major pumping station is shown in Figure 5. The Harwich force main would connect to a planned gravity sewer at the intersection of Old Queen Anne Road and Route 137. From here, gravity sewer would convey the flow to PS#6. From PS#6, flow is conveyed south on Route 137 and then east on Middle Road to the WPCF site. The return force main routing is unchanged as a result of this change in receiving pumping station.

COSTS

Costs developed include the impact of the additional Harwich flow on the Chatham WPCF and collection system but do not include the cost of conveyance of the flow back to Harwich. The costs associated with taking flow from Harwich impact Chatham in three possible ways. First are operations and maintenance costs associated with handling the additional flow such as increased chemical consumption, electricity use, pump run times, and operational overhead. Second, the flow from Harwich consumes capacity at the WPCF that was designed to accommodate the Town of Chatham's sewer expansion, and for which it has borne the costs to date. Lastly, a planned connection by Harwich will alter the plans Chatham had developed for sewerage the western portion of the Town where the Harwich flow would be received, potentially increasing the size or layout of the proposed infrastructure.



In the first two instances, a flow-weighted approach has been employed to estimate the cost impacts. As an example, in a hypothetical scenario where the two towns share a facility that cost \$20 million to build and \$1 million to operate annually, and each contributed 50% of the total flow, the cost would be \$10 million to connect for the capital costs of the facility, and \$500,000 annually for operations costs.

Table 2 shows the costs estimated to reach the 2.2 mgd capacity required to accommodate the original Town of Chatham projections as well as the Harwich connection.

Table 2 WPCF Costs ³

Source	Current Construction	Planned Expansion	Expansion w/ Harwich
Capital Cost ⁴	\$33.5m	\$43.2m	\$50.0m
Design ⁵	\$1.8m	\$2.3m	\$2.6m
Construction Engr.	\$5.0m	\$6.5m	\$7.5m
Total Project Cost	\$40.3m	\$51.9m	\$60.1m
Capacity (mgd)	1.3	1.9	2.2

Total capital costs are estimated at \$60.1 million for the fully built-out facility. Utilizing the flow-based approach noted above, Harwich (at 0.3 mgd) would consume 13.6% of 2.2 mgd total capacity, corresponding to a cost of \$8.2 million. If this were increased to 340,000 gpd, Harwich would consume approximately 15.5% of the total flow (2.24 mgd) and have a corresponding cost of \$9.2 million. The exact timing and breakdown of this cost, relative to the timing of the connection and future upgrades of the WPCF, would require more detailed negotiation between the two towns. Further, the Chatham WPCF is currently designed with an expansion to 1.9 mgd in mind. For instance, piping and electrical equipment sizing is in place to accommodate a third clarifier and a fourth channel on the oxidation ditch reactor. If the facility must accommodate 2.2 mgd, additional facilities or alternative technologies may need to be employed and a more detailed evaluation would be required to characterize the layout, technologies, and costs for such a system. For this evaluation, we have simply expanded the projected 1.9 mgd facility costs on a flow-weighted basis to estimate costs for the 2.2 mgd facility. These costs also exclude the cost of the effluent disposal beds; if Chatham and Harwich negotiate the initial discharge at the existing sand beds, the Towns will have to establish a cost for their usage.

Operations and maintenance costs were projected for the CWMP and are reproduced in the following Table 3. The costs include treatment to the Chatham WPCF permit limits.

³ Modified to exclude the costs for effluent disposal beds, as Harwich does not benefit from these facilities – and based on 300,000 gpd.

⁴ Based on Bid Price and full USDA contingency of 10%

⁵ Based on preliminary and final design cost



Table 3 Annual O&M Costs

Source	Total O&M⁶	Harwich Share
Collection and Pump Stations ⁷	\$27,000	\$17,000
WPCF ⁸	\$1,600,000	\$230,000
Total Cost	\$1,630,000	\$250,000

As shown in Table 3, the Harwich flows are projected to increase O&M costs by \$250,000 per year on a flow weighted basis. For the WPCF this is on a flow-weighted basis for the entire facility; while for the collection system, Harwich is responsible for the flow weighted proportion of O&M costs within the relevant sewershed in Chatham and at pumping station #63 under this alternative.

For the collection system capital costs, we have compared the planned sewer costs for the Town of Chatham to the revised sewer costs with the Harwich connection. In the planned gravity sewer area connecting to pumping station #63, the pipe sizes have increased from 8-inches to 12-inches and the only cost assigned to Harwich is the incremental size of the pipe. The pumping station size has increased according to the flows in Table 1. There is an existing force main from the Chatham Fish and Lobster building in the industrial park that connects directly to the WPCF. With a smaller station, the Town could use this force main by allowing the Chatham Fish and Lobster to connect to pumping station #63 by gravity, and then using the force main to connect to the WPCF. However, with the Harwich flow and the increased pumping station size, the 4-inch diameter force main is not sufficient, and so the full cost for the 10-inch main is attributed to Harwich for a portion of the distance between the pumping station and the WPCF. Figure 1 shows the extent of the 4-inch and 10-inch mains.

⁶ Adapted from Chatham CWMP Table 11-1

⁷ For sewers serving pumping station #63 only

⁸ Does not include effluent pumping station and force main or effluent disposal at the existing beds



Table 4 Alternative 1 Collection System Costs⁹

Infrastructure with Harwich Connection	Quantity	Total Unit Cost	Total Cost (\$m)	Impact Due to Harwich Connection	Incremental Unit Cost	Harwich Share of Cost
12" Gravity Sewer	3760 (ft)	\$322	\$1.2	Increase from 8" Sewer	\$8	\$30,000
Upgrade PS63 to 1,300 gpm ¹⁰	1 (ea)	\$1.1m	\$1.1	Increase from 400 gpm station	\$530,000	\$530,000
Upgrade to 10" Forcemain in Industrial Park	450 (ft)	\$175	\$0.08	Increase from 4" force main	\$59	\$30,000
Additional 10" Forcemain to WPCF	950 (ft)	\$175	\$0.17	Install Pipe Not Needed Originally	\$175	\$170,000
10" Forcemain in Route 137	2,000 (ft)	\$215	\$0.43	Install Pipe Not Needed Originally	\$215	\$430,000
Subtotal			\$3,000,000	Subtotal		\$1,200,000
Contingency (25%)			\$750,000	Contingency (25%)		\$300,000
Design (10%)			\$300,000	Design (10%)		\$120,000
Fiscal, Legal, Construction Engineering (15%)			\$450,000	Fiscal, Legal, Construction Engineering (15%)		\$180,000
Total			\$4,500,000	Total		\$1,800,000

Combining the collection system upgrades, WPCF costs, and annual O&M, the total costs for Harwich to connect are estimated to be \$10 million in capital expenditure (\$1.8 million for the collection system and \$8.2 million for the WPCF) and \$250,000 annually to assist the Town of Chatham in operating and maintaining the system. This does not include the costs for the effluent pumping station and the force main which will return flow to Harwich. These costs are being developed separately and should be added to the costs shown here to estimate the full cost if Harwich plans to pursue this alternative.

Alternative 2 costs are summarized in Table 5

⁹ Does not include the cost of effluent pumping station and force main

¹⁰ Does not include the cost of land acquisition



Table 5 Alternative 2 Collection System Costs¹¹

Infrastructure with Harwich Connection	Quantity	Total Unit Cost	Total Cost	Impact Due to Harwich Connection	Incremental Unit Cost	Harwich Share of Cost
12" Gravity Sewer	960 (ft)	\$292	\$280,000	Increase from 8" Sewer	\$8	\$8,000
Upgrade PS#6 to 900 gpm ¹²	1 (ea)	\$0.9m	\$900,000	Increase from 125 gpm station	\$510,000	\$510,000
Upgrade to 10" Forcemain	1,100 (ft)	\$215	\$240,000	Increase from 4" force main	\$59	\$70,000
Additional 10" Forcemain to WPCF	3,040 (ft)	\$175	\$530,000	Install Pipe Not Needed Originally	\$175	\$530,000
10" Forcemain in Route 137	2,190 (ft)	\$215	\$470,000	Install Pipe Not Needed Originally	\$215	\$470,000
Subtotal			\$2,300,000	Subtotal		\$1,600,000
Contingency (25%)			\$610,000	Contingency (25%)		\$400,000
Design (10%)			\$240,000	Design (10%)		\$160,000
Fiscal, Legal, Construction Engineering (15%)			\$360,000	Fiscal, Legal, Construction Engineering (15%)		\$240,000
Total			\$3,600,000	Total		\$2,400,000

Under this alternative, the total cost of the infrastructure to connect Harwich to the WPCF is less, but the share to Harwich is more than under the PS#63 alternative. There are other advantages under this alternative. First, the PS#6 site has more space available than the site at the industrial park. Also, siting a major pumping station at PS#6 eliminates the need for several pipe runs within Route 137.

Under the Chatham Preliminary Design, pumping stations 6, 7, and 64 were all to connect to gravity sewer within the same short stretch of Route 137, just south of Paulding Drive (refer to Figure 4). Thus, if Harwich connected as well, there would be three 4-inch force mains (pumping stations 6, 7, and 64) two 10-inch force mains (from Harwich to PS#63, from the WPCF back to Harwich) and an 8-inch gravity sewer. The road right-of-way may not be wide enough to support all such utilities in addition to the water and gas mains that are present in this stretch of roadway, and so other accommodations or routing may be necessary.

With PS#6 as a major station, flow from stations 7 and 64 can be re-routed to PS#6 and the PS#6 force main is combined with the large force main carrying the flow from Harwich. This eliminates three 4-inch force mains, making construction of the sewer infrastructure in this area much more straightforward.

The total costs to each town under the different options are shown in the following Table 6.

¹¹ Does not include the cost of effluent pumping station and force main

¹² Does not include the cost of land acquisition



Table 6 Collection System Costs Comparison

Alternative	Chatham Cost	Harwich Cost	Total Cost
1 (PS#63)	\$2.7 million	\$1.8 million	\$4.5 million
2 (PS#6)	\$1.2 million	\$2.4 million	\$3.6 million

SUMMARY

The Chatham WPCF is currently designed for 1.3 mgd and permitted for 1.0 mgd and could receive flow from Harwich in the near future without encountering capacity issues. However, as sewer expansion in Chatham continues, the facility will approach its design capacity. At that point, an upgrade would be pursued to accommodate the planned flows from both towns. Further, the Chatham collection system proposed to serve this area can receive flow from Harwich, but modifications will be required to the preliminary design developed as part of the CWMP. This portion of the collection system has not been constructed and so this memorandum summarizes the changes that would be required when infrastructure is installed in the area in question. The total cost is estimated to be \$10.6 million, with an additional \$250,000 in yearly operating and maintenance costs as shown in the following Table 5. These costs are estimated based on an ENR index of 9475 as provided by the consultant (CDM Smith) for the Town of Harwich and should be inflated as costs rise. Costs will also need to be adjusted as the scope of work for the infrastructure and WPCF expansion in question is finalized and design decisions alter any projections made during the planning process.

Table 7 Cost Summary

Item	Total	Harwich Share (300,000 gpd)	Harwich Share (340,000 gpd)
WPCF Costs	\$60,100,000	\$8,200,000	\$9,200,000
Collection System Costs ¹³	\$3,600,000	\$2,400,000	\$2,400,000
Total Capital Cost	\$64,600,000	\$10,600,000	\$11,600,000
Operation and Maintenance (yearly) ¹⁴	\$1,630,000	\$250,000	\$260,000

Overall, transport from Harwich to Chatham for treatment and back again for disposal offers both towns an advantage. Chatham receives additional flow and an expanded user base sooner without the capital expenditure of accelerating their own collection system expansion, taking advantage of its installed capacity. Harwich could accelerate their implementation schedule by avoiding the need to site and construct a facility with limit of technology nitrogen removal capabilities.

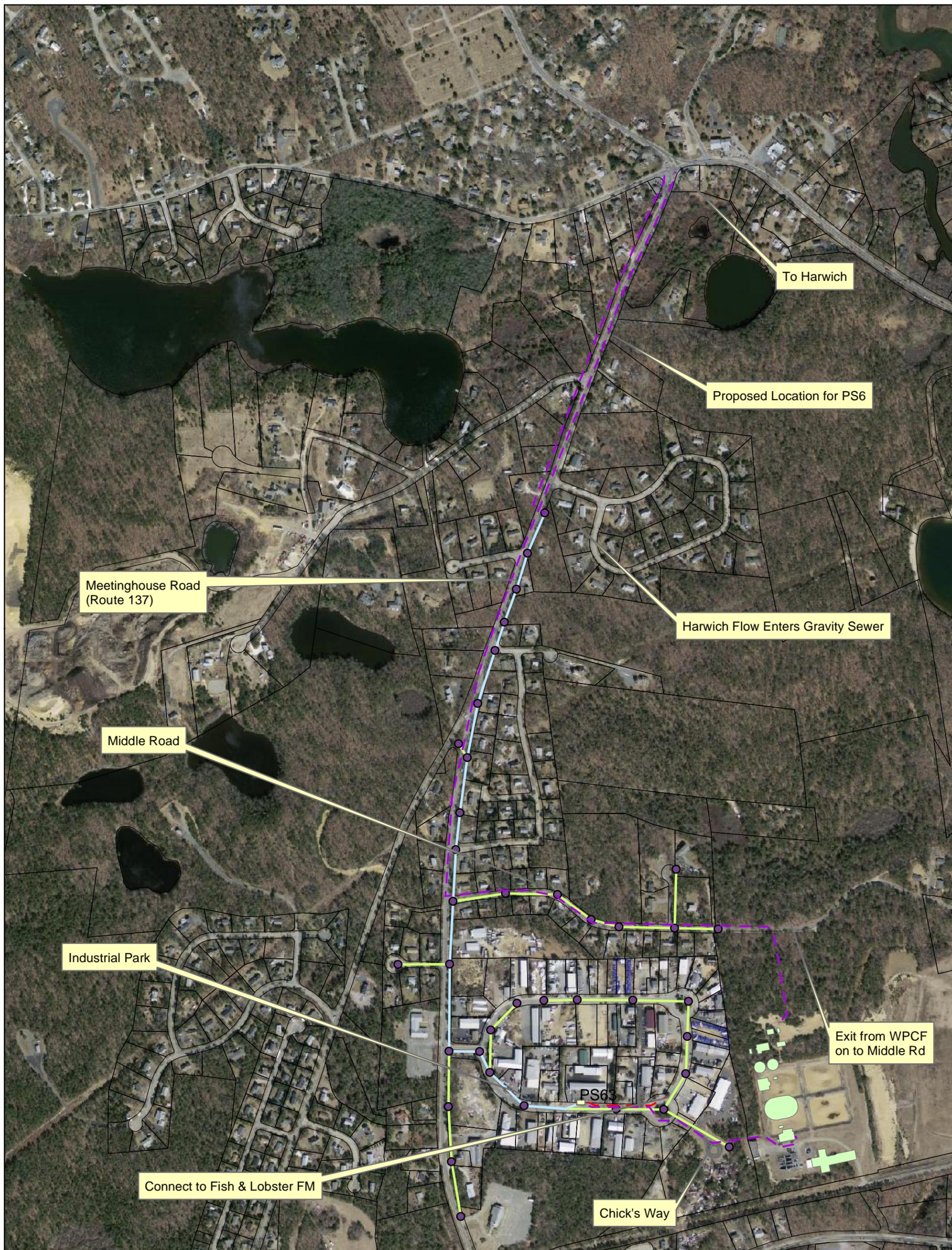
¹³ Collection system elements associated with the Harwich connection only. Does not include effluent pumping station and force main.

¹⁴ WPCF costs and collection system costs associated with pumping station #63/#6 only. Does not include effluent disposal at Chatham WPCF.



Chatham's town-wide CWMP is a 30-year master plan, with Phase 1 to meet the nitrogen TMDLs in the Town's embayments planned for the first 20 years. Upon completion of Phase 1 the town would look to implement the Phase 2 treatment facility expansion and sewer extensions. Harwich's phasing plan should be able to be coordinated with Phase 1. The addition of flow from Harwich may result in the planned expansion of the treatment facility (to Phase 2 capacity) occurring earlier (by several (3-5) years) than originally planned. However, other nutrient mitigation actions being evaluated by the two towns may factor into this timing.

The Boards of Selectmen in Harwich and Chatham recently signed a joint statement acknowledging the benefits to each community by continuing to evaluate cooperative approaches to wastewater management.



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Map Projection: Lambert Conformal Conic
 Horizontal Datum: North American 1983
 Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

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 Harwich Comprehensive
 Wastewater Management Plan

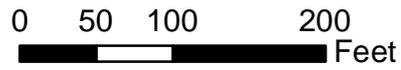
Job Number | 86-14969
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**Force Main Routing
 and Gravity Sewer Extents**

Figure 1



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Harwich Comprehensive
Wastewater Management Plan

Job Number	86-14969
Revision	A
Date	11 May 2012

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1927
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Potential Locations
Pump Station 63

Figure 2

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1545 Iyannough Road, Hyannis Massachusetts 02601 USA T 1 508 362 5680 F 1 508 362 5684 E hyamail@ghd.com W www.ghd.com

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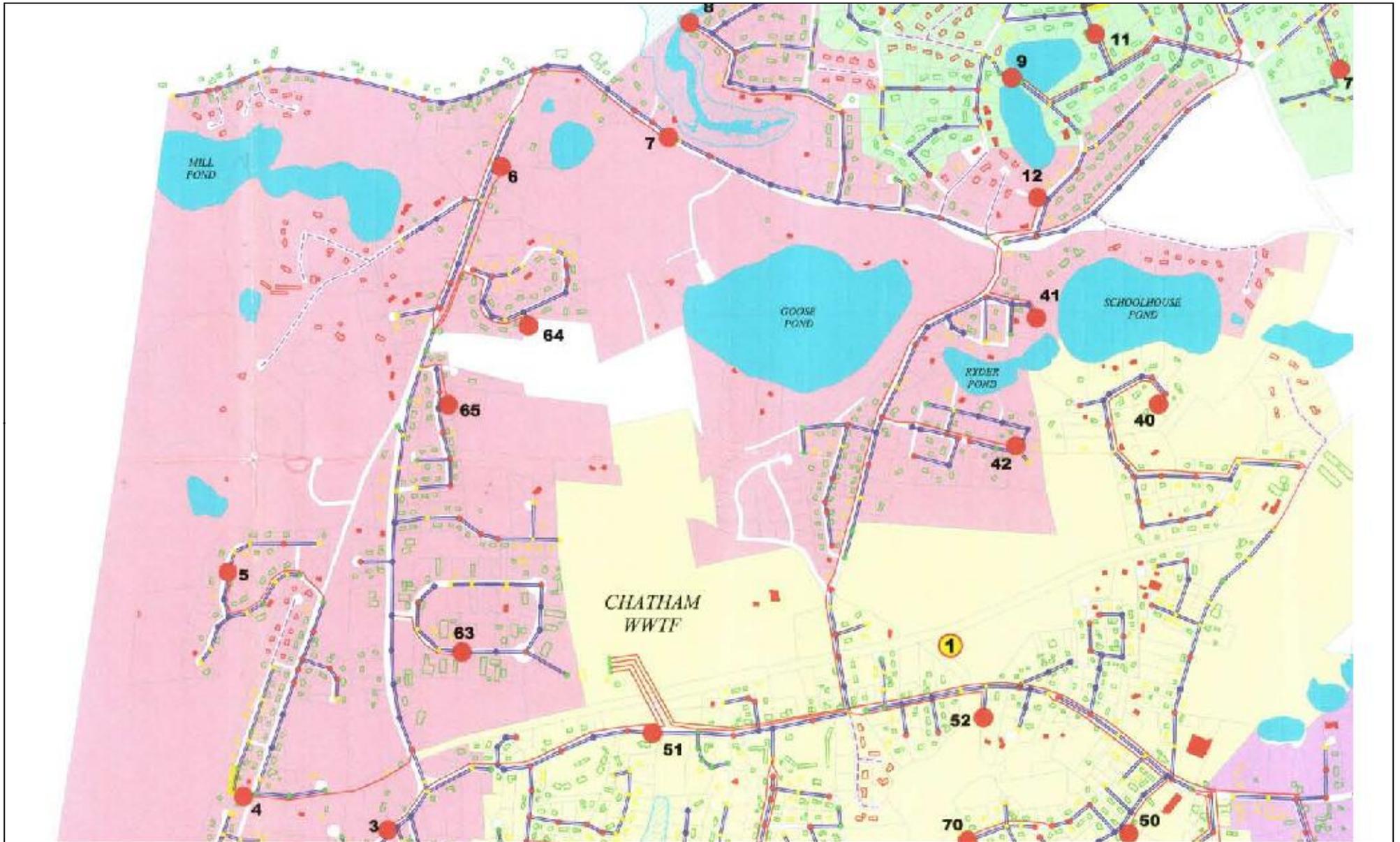
Proposed Force Main Routing
 and Pump Station Location

Figure 3

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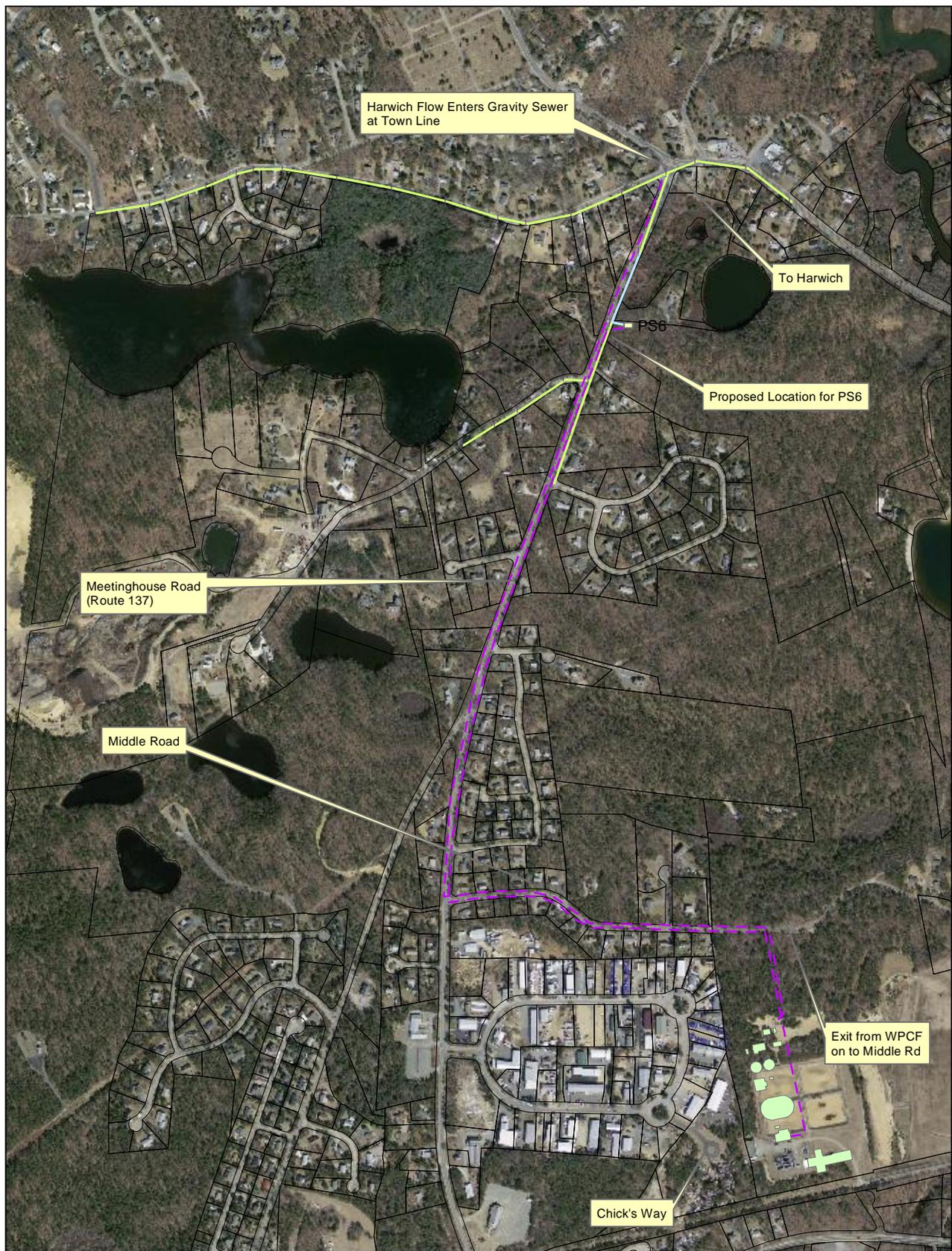


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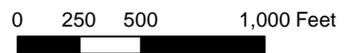
Prelim. Design Pump
Station Locations

Figure 4



Legend

Force Main	Gravity Sewer	Manholes	●
10" - - - -	8" - - - -	New Buildings	■
	12" - - - -		



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Harwich Comprehensive
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Date | 11 Jun 2012

**Site 6 Gravity
and Force Main Extents**

Figure 5

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet