MEMORANDUM

TO: Martin Trent, Suffolk County Department of Health Services
Mary Anne Taylor, Camp, Dresser and McKee

FROM: Steve Colabufo, Suffolk County Water Authority

DATE: June 11, 2009

SUBJECT: Suffolk County Water Resources Comprehensive Management Plan
Task 8 – Water Supply Management Options
Subtask 8.1 – Water Production Costs

The objective of this subtask is to compile new well and wellfield construction cost estimates over a range of production volumes for various geographic areas of the County. This assessment of well and pumping station costs has been compiled from actual project costs contained in Suffolk County Water Authority (SCWA) records applying to the construction of new wells and associated infrastructure to supply potable water to areas in need of additional capacity. Costs for other water supply delivery alternatives including wellhead treatment and water main transmission are evaluated in subsequent tasks.

This task was divided into two parts: well construction costs and pump station costs. Well construction costs were evaluated on a "per foot" and on a "per 1,000 gallon per minute (gpm)" basis for different geographic regions of Suffolk County over a range of well depths. As the cost of constructing a well is only one part of the overall cost of supplying water from a given location, the second part of the task evaluates the overall cost of constructing a pump station under a variety of settings and for a range of pumping capacities. Pump station costs include the well, the test boring, chemical treatment building and equipment, well head enclosure building, pump, piping, wiring, paving, grading, site restoration, landscaping and all other related items of expense.

1. Well Construction Costs

A. Background

The SCWA constructs approximately 15 to 20 new wells per year. Of these, approximately 10 to 15 new wells are constructed to increase the overall pumping capacity of the SCWA system. The remaining wells are typically constructed to replace older wells that, due to their age and condition, may have experienced a decrease in pumping capacity or experienced significant mechanical problems, i.e., holes in the casing, irreversibly clogged screen.

At new well sites, with no prior well construction activity, deep test borings are usually drilled to evaluate the stratigraphy at the site and determine the potential yield of any future production wells. As part of this process, one or more aquifer sections are typically pumped for approximately 40 hours prior to obtaining samples for water quality analysis. Stratigraphic and water quality information is then used to determine whether or not a new undeveloped site would be considered as a future SCWA well field. The cost of a deep test boring and the associated water quality analyses does not directly affect the cost of constructing a well, but ultimately factors into the overall cost of providing water from a

well field. On rare occasions, a "test/production" well is constructed, in which the two phases are combined into one project.

Most potential well sites in western and central Suffolk County have the capability to yield extremely large amounts of water. However, the well planning and construction process is guided by regulations that limit the capacity of a given well in order to protect the aquifer and water table. In general, any project which results in an increased groundwater withdrawal of 2 million gallons per day (mgd) or greater is considered to be a significant action by the state under the State Environmental Quality Review Act (SEQRA) and requires preparation of an Environmental Impact Statement (EIS). Due to the time and expense that can be involved in the SEQRA process, water suppliers often opt to limit well capacities to no greater than 1,388 gallons per minute (gpm) or just under 2 mgd.

Traditionally, the SCWA constructs all of its new wells with a design capacity of 1,300 gpm (1.87 mgd). Because the construction of many wells at the SCWA predated the promulgation of the SEQRA requirements and the 2 mgd limitation, these older wells may have capacities of 1,400 gpm or greater. Currently, only wells constructed to replace these older wells may have a capacity of more than 1,300 gpm without requiring preparation of an EIS.

B. Analysis of Well Costs.

A competitive bidding process is utilized by the SCWA in assigning well construction work. Each well is constructed under a contract which is awarded to the lowest responsible bidder. There are six well drilling firms based on Long Island that regularly construct wells, and several firms based elsewhere in the northeast that occasionally submit bids. The low bid award process, in conjunction with the number of contractors bidding the work, assures relatively low, competitive prices for wells. Variations in price from one well to another are usually due to the differences in depth of the well and/or subsurface conditions expected to be encountered during installation.

For this examination, an effort was made to evaluate recently constructed wells that are geographically distributed throughout Suffolk County. Figure 1 shows the locations of the 33 SCWA wells contained in the analysis. The wells that were considered for this study were grouped by geographic zones within the County, with each zone being reflective of a slightly different set of geologic conditions and well screen depths. These localized conditions and characteristics impact the cost of a well. The geographic zones correspond to general areas of the county as follows:

- North Shore West Zone
- North Shore East Zone
- Central Island Zone
- East End Zone
- South Shore West Zone
- South Shore East Zone

Table 1 describes the general characteristics of each geographic zone of the County in terms of subsurface geology and well depth tendencies. The deepest wells tend to be constructed on the south shore, while the shallowest wells tend to be constructed on the North and South Forks on the County's eastern end.

FIGURE 1

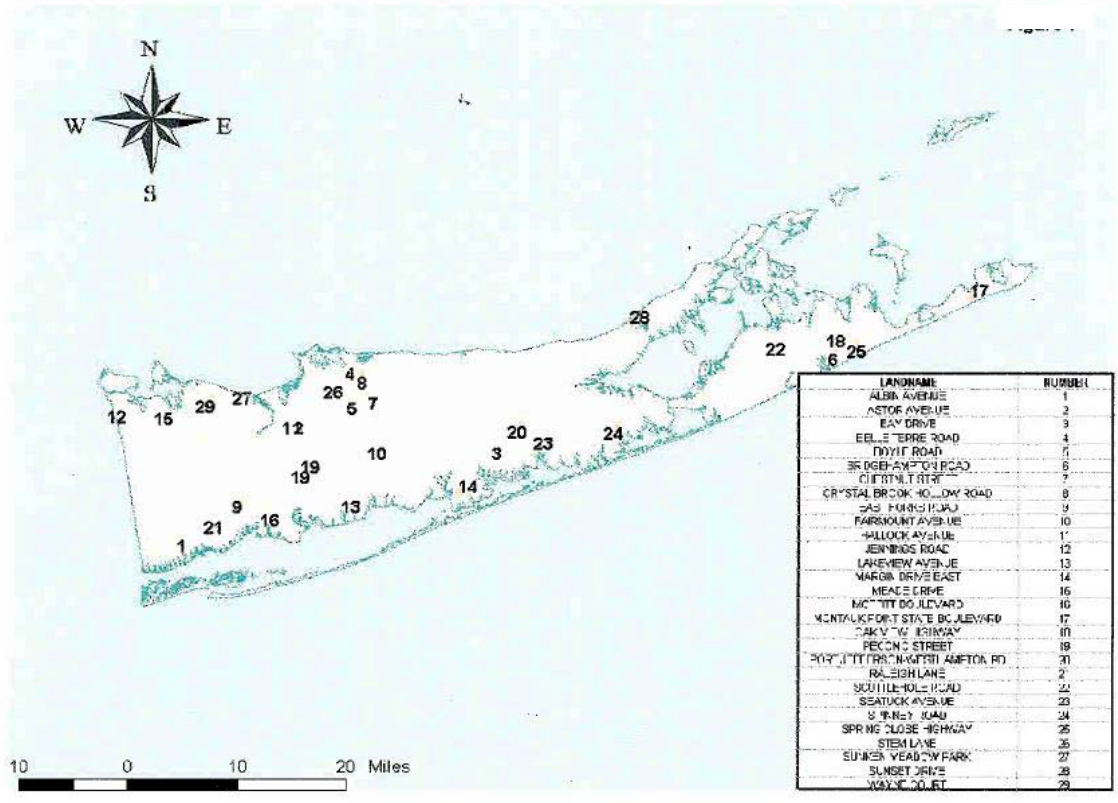


Figure 1: Well fields with wells evaluated for new well construction costs

Drilling conditions are often more difficult on the north shore than the south shore, reflecting the preponderance of glacial material, e.g. large boulders, cemented gravel beds, and hard clay lenses known as “hardpan,” on the north shore. Both the north shore and south shore zones were further subdivided into an “eastern” and a “western” area to account for travel distances and other factors that influence the costs of wells, such as clearing and areal limitations. A total of 33 wells, all constructed in the past six years, were examined for this evaluation. The cost of constructing wells was surprisingly consistent across the County, although differences with depth, capacity and geographic location are evident. The average cost of the 33 new wells across the county was $142,117, with an average depth of 442 feet and average capacity of 1,107 gpm.

The East End Zone wells which are located on the North and South Forks of the County had the shallowest average depth of 234 feet and the greatest average cost per foot of $534. The South Shore Western Zone had the deepest average depth at 538 feet and the lowest per foot costs averaging $309. Table 2 illustrates the per foot costs of the individual wells in the evaluation and the geographic zone averages.

Table 1.

Geographic Zone	General Characteristics
South Shore West	Deeper Magothy wells, largely due to shallow subsurface contamination; shallow water table, some positive heads requiring extensive site grading or "build-up"; space limitations common, minimal clearing required
South Shore East	Deeper Magothy wells largely to minimize surface water Impacts; shallow water table, some positive heads requiring "build-up; extensive clearing sometimes needed, few space limitations
North Shore West	Wells typically deep due to shallow subsurface contamination; extensive boulders and glacial material; surface water interactions common, extensive grading often required due to hilly terrain; space limitations common
North Shore East	Wells typically deep with some exceptions, less shallow subsurface contamination, extensive boulders and glacial material, extensive grading often required due to hilly terrain, few space limitations
Central Island	Combination of north and south shore features, more shallow wells due to sparser population and less shallow subsurface contamination, more remote areas often require supply wells for drilling water.
East End	Shallowest wells, lowest capacity, smallest diameter, Magothy often salty, glacial material common, especially in Montauk

The most important factor from an infrastructure planning perspective is the cost of a well relative to its pumping capacity, i.e. the volume of water that can be produced. The same well data set can be analyzed to develop cost estimates per 1,000 gpm of pumping capacity. The data indicates that the East End Zone wells, with their generally higher per-foot costs and lower capacities, were also the most expensive wells to construct relative to their pumping capacity with an average cost of $327,707 per 1,000 gpm. The geographic areas with the lowest cost per 1,000 gpm were found in the Central Island Zone at an average cost of $99,721 per 1,000 gpm and the South Shore East Zone with an average of $107,438 per 1,000 gpm. Table 2 also illustrates this data.

Table 3 summarizes all zones in terms of costs per foot and costs per 1,000 gpm. Strictly from a well construction perspective, (i.e. discounting transmission and treatment costs), wells in the South Shore Eastern and Central Island Zones are most cost effective for increasing available well capacity to an area.

II. Pumping Station Construction Costs

The construction of a well represents only one portion of the overall expenses involved in providing water for public consumption. In addition to new wells, the SCWA constructs approximately one to two new pumping stations (wellfields) every year. Building a new pumping station involves construction of a large building which houses all water treatment equipment and electrical controls, one or more smaller "well head enclosure" buildings to house the pumping equipment, driveways, piping, electrical wiring, and numerous other

Table 2.					
Central Island Zone					
Wellfield & well #	**Depth**	**Capacity**	**Total Cost**	**Cost / Foot**	**Cost / 1,000 GPM**
Peconic St. #2	603	1300	$142,560	$236	$109,661
Hallock Ave. #3	503	1300	$164,540	$327	$126,569
Astor Ave. #3	303	1400	$140,610	$464	$100,435
Fairmount Ave. #3	167	1300	$96,200	$576	$74,000
C. R. 111 #2	193	1300	$114,325	$592	$87,942
Zone Average	354	1320	-	$439	$99,721
East End Zone					
Scuttlehole Rd #3	453	1300	$145,948	$322	$112,268
Oak View Hwy #2A	480	700	$191,737	$399	$273,910
Montauk PSB #1A	196	150	$86,613	$441	$577,420
Sunset Drive #1A	180	150	$104,325	$579	$695,500
Montauk PSB #2	186	150	$110,748	$595	$738,320
Spring Close Hwy #3	129	1300	$80,540	$624	$61,954
Spring Close Hwy #1A	128	1000	$83,303	$650	$83,303
Bridgehampton Rd #3A	123	1020	$80,560	$654	$78,980
Zone Average	234	721	-	$533	$327,707
North Shore East Zone					
Belle Terre Rd #3	690	1300	$168,285	$243	$129,450
Stem Lane #3	513	1300	$125,585	$244	$96,603
Boyle Road #3	608	1300	$153,925	$253	$118,403
Chestnut St #3	583	1300	$154,970	$265	$119,207
Crystal Brook Hollow #4	315	1300	$124,350	$394	$95,653
Zone Average	542	1,300	-	$370	$111,863
North Shore West Zone					
Sunken Meadow #1	622	1300	$166,266	$267	$127,897
Jennings Rd #3	373	700	$122,630	$328	$175,186
Sunken Meadow #2	620	1300	$214,200	$345	$164,769
Wayne Ct #1	587	650	$208,024	$354	$320,037
Meade Dr #4	510	1000	$185,300	$363	$185,300
Zone Average	542	990	-	$346	$194,638
South Shore East Zone					
Margin Drive #1A	620	1300	$148,450	$239	$114,192
Seatuck Ave #1	620	1300	$149,460	$241	$114,969
Spinney Road #3	533	1300	$132,093	$247	$101,610
Seatuck Ave #2	490	1300	$155,260	$316	$119,430
Bay Drive #1	263	1300	$113,090	$430	$86,992
Zone Average	505	1,300	-	$312	$107,438
South Shore West Zone					
East Forks Rd #6	818	1300	$165,040	$201	$126,954
Raliegh Lane #1	710	1300	$211,843	$298	$162,956
Moffit Blvd #3	520	1300	$157,630	$303	$121,254
Albin Ave #9A	598	1000	$182,141	$304	$182,141
Lakeview Ave #6	352	1300	$109,300	$310	$84,077
Zone Average	600	1,240	-	$308	$135,476

Table 3.

Average Well Costs Per Foot & Per 1,000 GPM				
Zone	**Avg Depth**	**Avg Capacity**	**Avg Cost / Ft**	**Avg Cost / 1,000 GPM**
Central Island	354	1,320	$439	$99,722
South Shore East	505	1,300	$312	$107,439
North Shore East	542	1,300	$370	$111,864
South Shore West	600	1,240	$308	$135,476
North Shore West	542	990	$346	$194,638
East End	234	721	$533	$327,707
County-wide Average	442	1,107	$385	$162,808

appurtenances. Grading and site restoration are also significant costs associated with pump station construction. Land costs for pump station siting vary greatly and are not included as part of this analysis. Sites are obtained depending on location and needs of the water supplier, and at times are obtained at no cost to the SCWA. Arrangements are often made with a property developer so that the costs of installation of new water mains, hydrants, etc., for a development are bartered for a parcel of land of the same value that will be developed into a wellfield. The SCWA also utilizes properties obtained with Suffolk County Water Quality Protection and Restoration program funds (1/4 cent sales tax), and the cost to the SCWA is for an easement on those lands, rather than the true real estate value of the acreage. Recently, the SCWA and Suffolk County have discussed establishing an agreement whereby the County would provide easements on some county parkland sites. Advance planning (often decades in advance) by the SCWA should allow it to purchase strategically located sites throughout the county for future use a public water supply wellfields.

Costs for 13 recently constructed pumping stations were evaluated. The wellfields are located throughout the county and their locations are depicted in Figure 2. These 13 pump stations were separated into three groups of common construction scenarios for cost evaluations:

Group 1	Single well pumping stations represented at five sites
Group 2	Two well pumping stations represented at four sites
Group 3	Single well pumping stations where a second well was later added, representing four sites

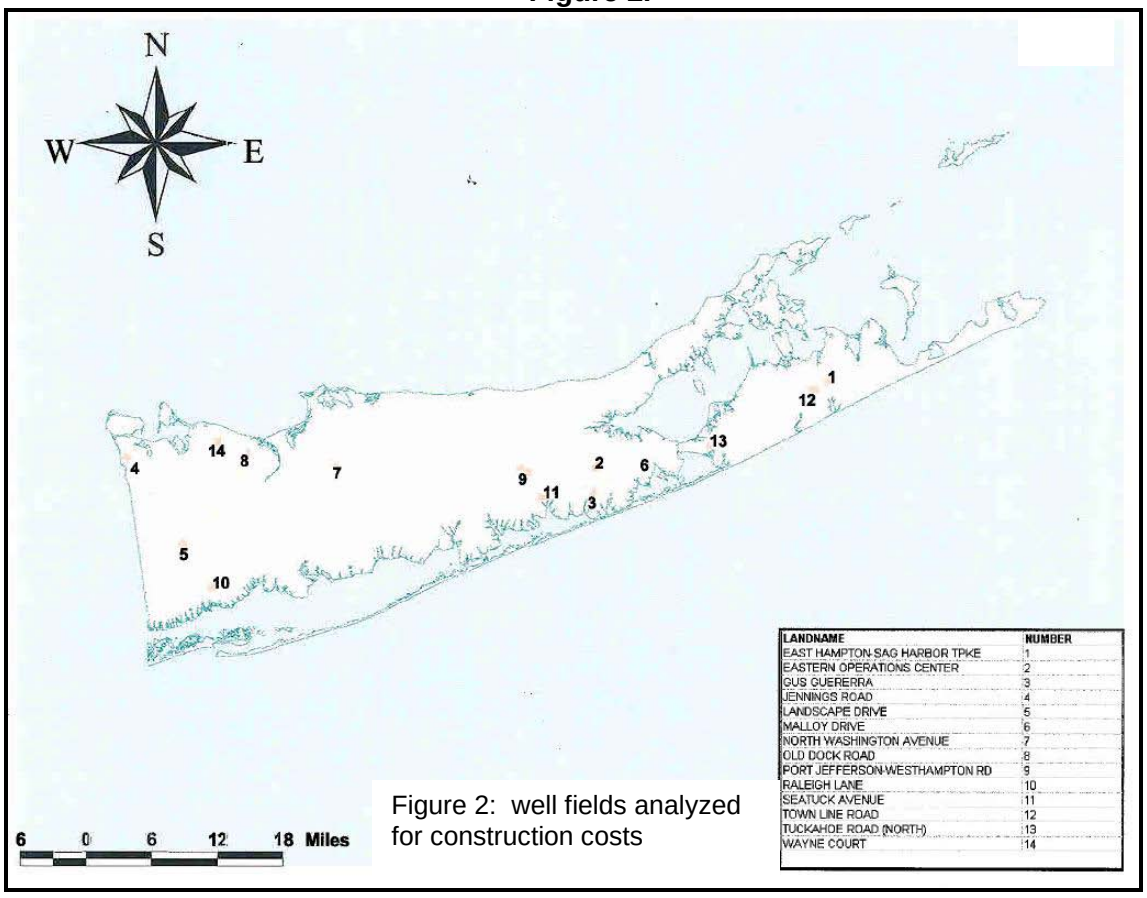
Sites containing two pumping wells are most commonly found in the eastern portion of Suffolk, where aquifer conditions do not permit the development of a higher capacity, e.g. 1,300 gpm well. Therefore, two wells are often constructed to obtain the desired 1,300 gpm of pumping capacity. Table 4 summarizes the overall construction costs of pump stations under these three sets of conditions.

The average cost to construct Group 1, a one well pumping station, was $1.21 million. Based on the capacities of the wells at the four pumping stations in this category, this equates to $1.36 million per 1,000 gpm of installed capacity. At Group 2, the five two-well

pumping stations examined, the total cost for wellfield development and construction was $1.29 million while the cost was $1.05 million per 1,000 gpm of installed capacity. The majority of these stations are located in eastern Suffolk County. Most are situated in areas where the use of a higher capacity well, i.e. 1,300 gpm, is ill-advised due to hydrogeologic constraints of the aquifer system.

At the Group 3 pumping stations in which a second well was installed to supply additional capacity, the overall cost for the first well averaged $1.08 million while the total project cost including the second well was $1.43 million. Three of these four pumping stations where a second well was later installed were able to utilize high capacity (1,300 gpm) wells, thus decreasing the cost per 1,000 gpm in comparison to the two-well pump stations where individual well capacity was limited. The average cost per 1,000 gpm for

Figure 2.



LANDNAME	NUMBER
EAST HAMPTON-SAG HARBOR TPKE	1
EASTERN OPERATIONS CENTER	2
GUS GUERRA	3
JENNINGS ROAD	4
LANDSCAPE DRIVE	5
MALLOY DRIVE	6
NORTH WASHINGTON AVENUE	7
OLD DOCK ROAD	8
PORT JEFFERSON-WESTHAMPTON RD	9
RALEIGH LANE	10
SEATUCK AVENUE	11
TOWN LINE ROAD	12
TUCKAHOE ROAD (NORTH)	13
WAYNE COURT	14

Figure 2: well fields analyzed for construction costs

Group 3 pump stations was $0.71 million, 23 to 48 percent less than costs for Groups 2 and 1, respectively.

Where greater pumping capacities are needed to meet consumer demands, pumping stations containing two wells represent a significantly lower cost per 1,000 gpm capacity.

III. Conclusions

The County-wide average cost per well installation per 1,000 gpm in recent years is $162,807. Well costs ranged from a high in the East End geographic zone of $327,707 per 1,000 gpm, which is more than 200% above the County-wide average cost, to a low of $99,722 per 1,000 gpm in the Central Island Zone, which is 39% less than the County-wide average. Wells in the South Shore Eastern and Central Island Zones are most cost effective for increasing available capacity to a given area excluding wellfield development, treatment and transmission costs. These two zones contain large tracts of prime watershed lands protected for future water supply development in the Pine Barrens area.

The average cost to develop a new wellfield ranges from $1.2 to $1.4 million. Well construction costs alone account for only 13-26 percent of this total. Based upon the data compiled, it is evident that the most cost effective method to increase capacity in a given area is to construct additional wells at existing pump stations where possible. Where greater pumping capacities are needed to meet consumer demands, pumping stations containing two wells represent a significantly lower cost per 1,000 gpm capacity.

Table 4.

Table 7: Summary of cost data for construction of SCWA well fields

A. 1 well stations

Site	wells incl. in project	test boring cost	Tot.cost of project	Well #1 cap. (gpm)	cost per 1000 gpm
Raliegh lane	#1	$ 90,540.00	$ 988,959.81	1300	$ 830,384
Seatuck Ave.	#1	$ 101,685.98	$ 1,230,373.33	1300	$ 1,024,661
Wayne court	#1	$ 101,188.40	$ 1,506,645.91	650	$ 2,473,591
Old Dock Road	TB, #1	included	$ 1,111,802.81	1000	$ 1,111,803
Average initial cost for a 1 well pump station, per 1000 gpm					**$ 1,360,110**

B. 2 well stations

Site	wells incl. in project	test boring cost	Tot.cost of project	Well #1 cap. (gpm)	Well #2 cap. (gpm)	Tot. station cap. (gpm)	Project cost per 1000 gpm	avg. cost savings for 2 wells vs. 1 well
Towline Rd. EH	TB, #1, #2	included	$ 1,567,229.64	650	650	1300	$ 1,205,561	
Malloy Drive	#1, #2	$ 96,310.00	$ 1,551,690.86	650	650	1300	$ 1,267,693	
Jennings Road	#1, #2	$ 52,264.00	$ 993,600.32	650	650	1300	$ 804,511	
C.R. 31	#1, #2	$ 100,475.00	$ 1,062,083.23	650	650	1300	$ 894,276	
C. R. 31 South	#1, #2	$ 118,110.00	$ 1,285,122.67	650	650	1300	$ 1,079,410	
Average initial cost for a 2 well pump station, per 1000 gpm							**$ 1,050,290**	**23%**

C. Originally 1 well stations, with addition of a 2nd well

Site	wells incl. in project	test boring cost	Tot.cost of project	Well #1 cap. (gpm)	cost per 1000 gpm	Well #2 total cost	Project cost incl. 2nd well	Well #2 cap. (gpm)	Tot. station cap. (gpm)	Project cost per 1000 gpm	incremental cost svgs. for 2nd well
N. Washington St.	#1	$ 93,499.00	$ 1,076,298.10	1300	$ 899,844	$ 564,444	$ 1,640,742	1300	2600	$ 667,016	26%
Sag harbor Tpke.	#1	$ 83,110.00	$ 1,009,287.09	700	$ 1,560,567	$ 361,298	$ 1,370,585	700	1400	$ 1,038,353	33%
C. R. 111	#1	$ 127,122.00	$ 1,124,736.88	1300	$ 962,968	$ 114,325	$ 1,239,062	1300	2600	$ 525,455	45%
Landscape Dr.	#1	$ 95,114.00	$ 1,120,173.53	1300	$ 934,837	$ 348,831	$ 1,469,005	1300	2600	$ 601,584	36%
Average initial cost per 1000 gpm for first well					**$ 1,089,554**						
Average overall cost per 1000 gpm for two wells										**$ 708,102**	**35%**