May 15, 2012

Subject: **Review and Evaluation of the Study of Alternatives for Management of Impacted Groundwater at Bethpage; prepared by TetraTech for Naval Facilities Engineering Command Mid-Atlantic dated January 2012.**

The subject document was reviewed. The following observations and comments are provided for your consideration.

1. General Observations:

a) The costs provided in this study were revised to reflect a 30 year basis. Attached is the tabulated cost table for the alternatives. These costs do not include continued cost of operation, maintenance, groundwater monitoring of existing water plants, and any source or plume control measures in non-OU-2 sources, as these costs are common across all alternatives.

b) The "Remedy Optimization Team Report for the Bethpage Groundwater Plume Remedy" recommended that this report also consider connection to another water resource/utility versus the alternatives proposed. This recommendation could be an efficient alternative and it is recommended to pursue this as appropriate.

c) The general consensus, in both the "Remedy Optimization Team Report for the Bethpage Groundwater Plume Remedy" and in the "Study of Alternatives for Management of Impacted Groundwater at Bethpage" that plume containment in total is not likely achievable, is reflected in this document, and continues to be true. For all of the alternatives, the increased pumping does not eliminate the potential for downgradient wells to become impacted by the Bethpage plume.

d) There is insufficient geologic and hydrogeological data to provide input data for groundwater modeling and therefore current estimates for time until impact of receptors is likely inaccurate.

e) Although we concur with the Remedy Optimization Team Report, that aggressive source removal is not likely to change downgradient plume expansion in the near term (<50 years) due to current downgradient concentrations; on-site areas of high contamination (both above and below the water table) are providing a significant source that will continue to contaminate this groundwater resource. Aggressive source removal would decrease future concentrations and overall plume longevity.

f) We concur with the Remedy Optimization Team that a comprehensive conceptual site model (CSM) be developed for the entire site incorporating all of the new information, OU-2 and OU-3. The CSM should be updated as new information becomes available. The decision for the remedial alternative should not be made until the plumes are delineated, geologic and hydrogeologic data is collected, the CSM updated, and a well structured, well calibrated model be set up to evaluate the capture zones of plume containment wells and public water supply wells. **However,** this does not preclude addressing the known contaminated areas in the "hot spot" from the OU-3 plume in the BWD Plants 4, 5, and 6 areas, as well as the identified deep contaminated zone below the ANY-SNR well field.

g) The increased pursuit of the hydrogeology characterization could identify target zones that could improve contaminant capture and limit the amount of groundwater pumped, thereby increasing the effectiveness of the remedial system(s) while reducing costs.

h) There is a consensus with both the "Remedy Optimization Team Report for the Bethpage Groundwater Plume Remedy" and the "Study of Alternatives for Management of Impacted Groundwater at Bethpage", and we also recommend that additional monitoring wells need to be installed to:

1. Further delineate the horizontal and vertical boundaries of the plume(s)
2. Identify stratigraphy and heterogeneity within the aquifer to increase our understanding of the plume migration pathways
3. Better define hydrogeologic parameters of the aquifer
4. Act as intercept/sentry wells for down-gradient public supply wells

2. Recommendations

a) At a minimum, new wells should be placed to define the leading edge and east/west boundaries of both the deep and shallow plumes. The deeper plume is not well defined and could very likely be migrating under the influence of the Bethpage well system. Also, intercept/sentry wells should be placed upgradient of each of the public wells that are determined to have a potential to be impacted. This should be initiated after the plume(s) have been delineated and the conceptual site model has been updated.

b) Given the complexity and depth of this aquifer and the inherent problems of accurate geological description of wells drilled with the mud-rotary method, it is recommended that any additional wells be installed using the Roto-Sonic® drilling method. A complete core should be collected at each well. The core sample will provide an accurate geologic description at that location and can be used to correlate other wells drilled with this method and to correlate with geophysical profile. The newly installed monitoring wells should be constructed using multi-level screens to not only give a vertical profile of contamination, but allow for repeat sampling, mass flux calculations, and aquifer testing from discrete zones.

c) A geophysical log should be run at each of the newly installed wells. Natural Gamma,Resistivity, and EM Conductivity have been shown to work in this area but the suite of logs should be selected by the contractor and tested for reliability before widespread use. These can then be used as a baseline for additional geophysical logs. A geophysical log should be run on select existing wells to determine if accurate geophysical logs can be generated from the existing wells. A geologic core with a geophysical log correlation will be very beneficial to identify stratigraphy and permeability zones within the aquifer as well as clay lenses/layers. Data can be compared to the baseline log(s) to determine an accurate geologic profile from each well. If successful, existing wells should be selected for plume transects and along the plume axis(s) to generate new geologic cross-sections. This can be used later to focus discrete sampling and ultimately a focused extraction system from impacted zones, especially the deeper zone that appears to be isolated in a permeability

channel. Ultimately, this information can be used to create a 3-D geologic profile for 3-D GIS mapping and will provide more accurate data to enhance any future modeling effort.

d) Any new vertical profile wells should be not be plugged, rather they should be completed and screened across impacted areas for future analytical using discrete sampling or a chain of passive diffusion samplers, (PDB's). This would offer reproducible data and greatly increase the information available for future decision making.

e) **Hybrid 2A/2B Alternative Description:**
While we agree with the recommendations in the Summary (3.3) of the "Study of Alternatives for Management of Impacted Groundwater in Bethpage", with improved characterization, it is possible that an alternative could be developed that could use a ***combination*** of Alternative 2A and 2B which would offer increased efficiency of contaminant reduction while reducing costs. These include:

1. All items from Alternative 1 (which are also included in both Alternative 2A, 2B),

2. Focused capture and treatment of the deep zone contamination in the western portion of the Bethpage Plume near the ANY-SNR well field. This could be accomplished by installing at least one and possibly two wells that are screened in this deep zone *(See Figure 1, and 2)*. Flow rates would be adjusted to focus the capture of water in this contaminated zone, without influencing the rest of the aquifer. The flowrate would likely be less than 200 GPM and be discharged into the local Public Water Supply System. While Alternative 2A recommends operating the ANY-SNR wells at maximum capacity, the focused capture of this deep zone would preclude continual pumping from these wells and the ANY-SNR wellfield would only be pumped to satisfy normal water supply demands.

3. We also recommend that the Bethpage wellfields BWD No. 4, BWD No. 5, and BWD No 6 pump at maximum capacity throughout the year. All wells have intercepted the eastern/OU-3 portion of the Bethpage plume and currently have treatment systems. The screened intervals of these wells appear to be located in an advantageous position for plume capture. This could result in the highest mass removal with a significant cost savings from Alternative 2B.

Table 1: Estimated Costs for Alternatives (30 Year basis and 50 Year basis)

Alternative	30 Year Basis Estimated Cost	30 Year Basis Present Value	50 Year (Current) Basis Estimated Cost	50 Year (Current) Basis Present Value
1	$ 161,000,000	$ 114,000,000	$ 254,000,000	$ 151,000,000
2A	$ 141,000,000	$ 95,000,000	$ 229,000,000	$ 130,000,000
2B	$ 308,000,000	$ 236,000,000	$ 458,000,000	$ 296,000,000
2C	$ 299,000,000	$ 235,000,000	$ 484,000,000	$ 309,000,000
3	$ 185,000,000	$ 141,000,000	$ 277,000,000	$ 177,000,000
2A/2B Hybrid*	$ 182,000,000	$ 129,000,000		

Updated Cost Tables and Cost Evaluation Notes:

1) The costs provided in this study were revised to reflect a **30 year basis**. These costs do not include continued cost of operation, maintenance, groundwater monitoring of existing water plants, and any source or plume control measures in non-OU-2 sources, as these costs are common across all alternatives.

2) * The proposed 2A/2B Hybrid Alternative cost estimate is pro-rated from existing cost estimates for Alternatives 2A and 2B from the "Study of Alternatives for Management of Impacted Groundwater at Bethpage" report.

3) The "Study of Alternatives for Management of Impacted Groundwater in Bethpage" was reviewed for reasonableness and we offer the following observations:

   a) The cost tables are challenging to follow due to the capitol cost being included in year one and at different future years as new treatment systems are required/installed.
   b) The above holds true for the annual cost. As new systems are turned on, increased Operations and Maintenance Costs are incurred. If a reviewer wants a comprehensive view of how the costs were developed, they should review the costs tables in Appendix 4 that show costs allocated per year. The summary Tables accurately reflect the detailed estimates in the Appendix.
   c) Based on historical experience with installing and managing pump and treat systems in New York and New Jersey (residential areas), the treatment system capitol and operations costs appear reasonable. The costs will change as the design gets finalized and construction details are defined; however, the presented costs fall within the expected historical range for construction and operation.
   d) The real estate costs and other complicating factors from being in a high population area cause these costs to be potentially more variable and pose the greatest project cost risks.

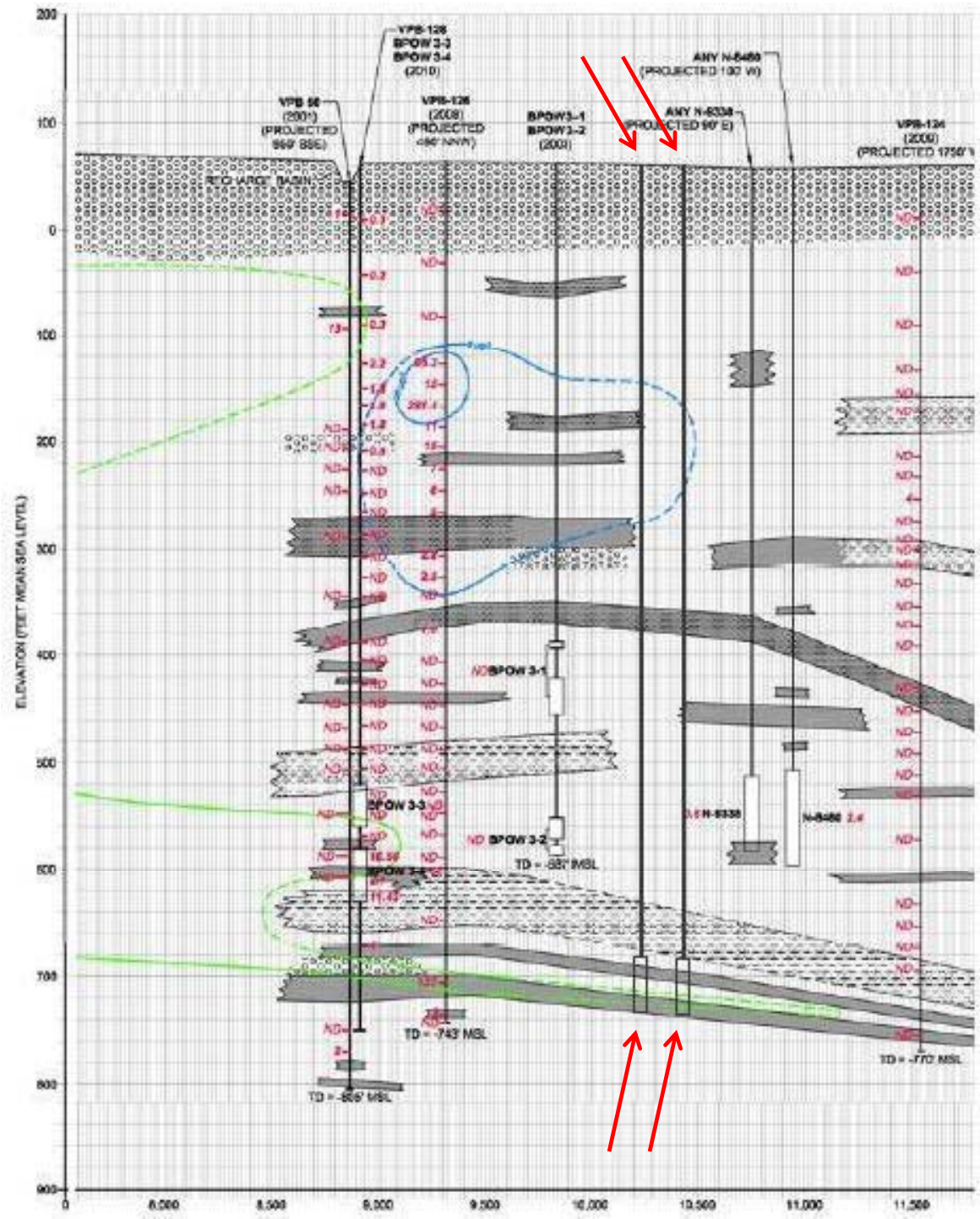


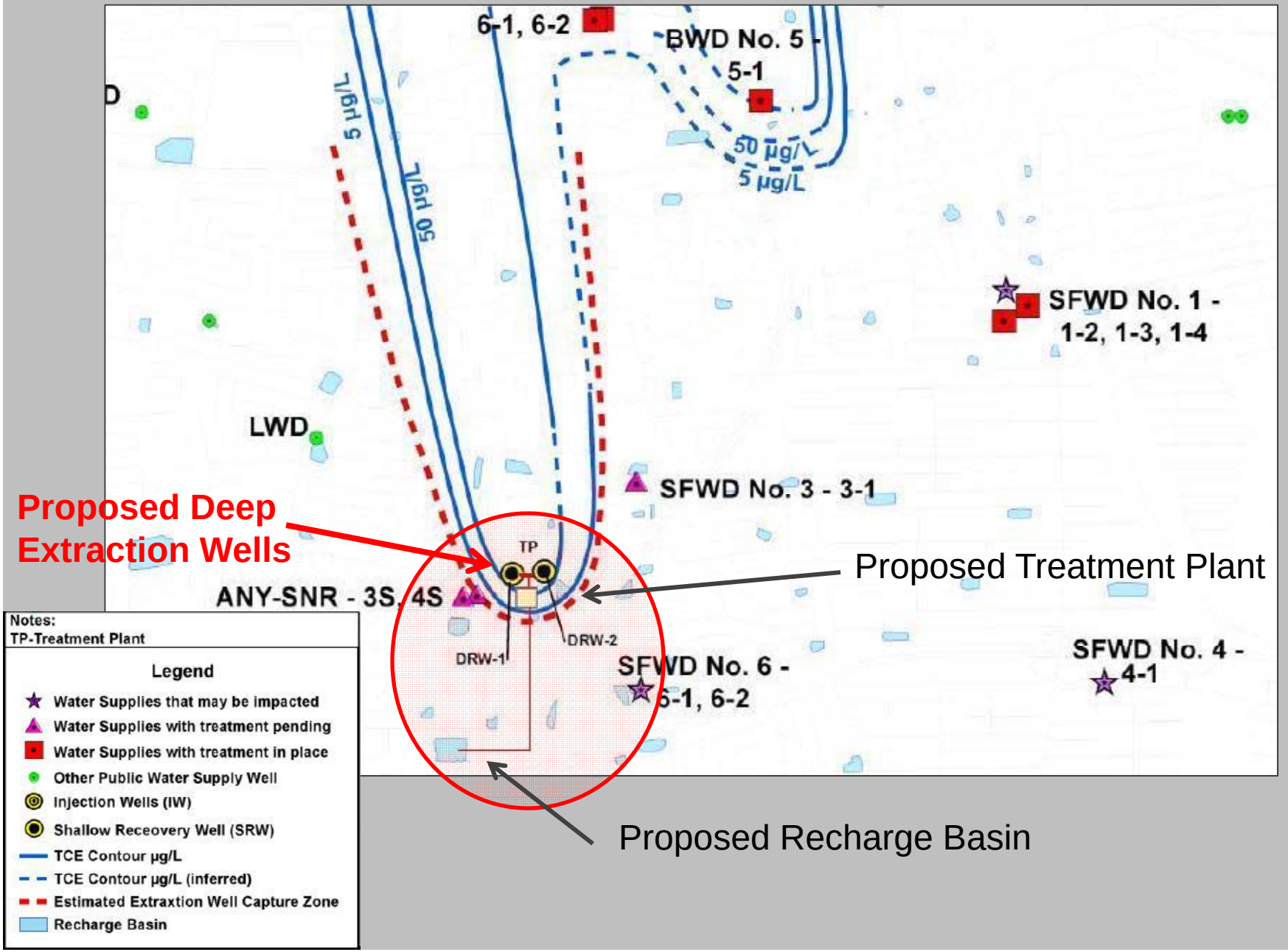
Figure 1: Bethpage Plume Cross-Section A-A'

Proposed Deep Extraction Wells

(DRW-1 & DRW-2) Shown in Red

(Figure is adapted from Figure 1-7 in Navy Report)

Figure 2: Alt. 2A/2B-Hybrid - Proposed Deep Extraction Wells



US Army Corps of Engineers:
Kansas City District

Bethpage Plume Containment Alternatives Analysis

Detailed Cost Estimate

With Excerpts From:

"STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE"
by Tetra Tech for the Naval Facilities Engineering Command Mid-Atlantic

Alternative 1A

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Plume Delineation/Monitoring**				
1.1	Vertical Profile Borings (24 Borings, sampling, oversight)	21600	feet	$ 200	$ 4,320,000
1.2	Monitoring Wells (44)	26400	feet	$ 100	$ 2,640,000
1.3	Reporting & Surveying	24	each	$ 12,500	$ 300,000
	Subtotal (Item 1)				***$ 7,260,000***
2	**Hotspot Treatment System (736 MG/Yr)**** ***Alternatives, so not included in subsequent Alternative Cost Estimates)***				***(Assumed for all***
2.1	Delineation (VPBs)	5400	feet	$ 200	$ 1,080,000
2.2	Monitoring Wells	4500	feet	$ 100	$ 450,000
2.3	Extraction Wells (2 to 750 feet)	1500	feet	$ 200	$ 300,000
2.4	Extraction Vault and Pumps	2	each	$ 150,000	$ 300,000
2.5	Conveyance Piping (trenching & piping - 8 inch)	1500	feet	$ 150	$ 225,000
2.5	Air Stripping System (with blower, sump and pumps	1	each	$ 900,000	$ 900,000
2.6	Liquid Phase GAC System	2	each	$ 400,000	$ 800,000
2.7	Vapor Phase GAC System	1	each	$ 400,000	$ 400,000
2.8	In plant piping	1	each	$ 400,000	$ 400,000
2.9	Discharge Piping & structure	2500	feet	$ 250	$ 625,000
2.10	Building	3600	SF	$ 400	$ 1,440,000
2.11	Power and controls	1	each	$ 2,100,000	$ 2,100,000
2.12	Property	2	acre	$ 2,000,000	$ 4,000,000
2.13	Construction Oversight & startup (3 people - 16 months)	48	months	$ 25,000	$ 1,200,000
2.14	Construction Facilities (trailer, utilities)	18	months	$ 5,000	$ 90,000
2.15	Contingency (20%)				$ 2,862,000
2.16	Design & Engineering (13%)				$ 1,860,300
	Subtotal (Item 2)				***$ 19,032,300***
3	**Public Water Supply GAC Unit (1,400 GPM, Cost per System)**				
3.1	Pump Upgrade	1	each	$ 150,000	$ 150,000
3.2	Liquid Phase GAC System	2	each	$ 400,000	$ 800,000
3.3	In plant Piping	1	each	$ 250,000	$ 250,000
3.4	Building	2400	SF	$ 400	$ 960,000
3.5	Power and Controls	1	each	$ 550,000	$ 550,000
3.6	Construction Oversight & startup (3 people - 6 months)	18	months	$ 25,000	$ 450,000
3.7	Construction Facilities (trailer, utilities)	8	months	$ 5,000	$ 40,000
3.8	Contingency (20%)				$ 640,000
3.9	Design & Engineering (13%)				$ 416,000
	Subtotal (Item 3)				***$ 4,256,000***
	15 GAC Units				***$ 63,840,000***
4	**Public Air Stripping Unit (1,400 GPM, Cost per System)**				
4.1	Pump Upgrade	1	each	$ 250,000.00	$ 250,000.00
4.2	Air Stripping Unit	1	each	$ 800,000.00	$ 800,000.00
4.3	In plant Piping	1	each	$ 450,000.00	$ 450,000.00
4.4	Building (60 x 60)	3600	SF	$ 400.00	$ 1,440,000.00
4.5	Sump and Booster Pumps	1	each	$ 500,000.00	$ 500,000.00
4.6	Power and Controls	1	each	$ 850,000.00	$ 850,000.00
4.7	Construction Oversight & startup (3 people - 8 months)	24	months	$ 25,000.00	$ 600,000.00
4.8	Construction Facilities (trailer, utilities)	10	months	$ 5,000.00	$ 50,000.00
4.9	Contingency (20%)				$ 988,000.00
4.10	Design & Engineering (13%)				$ 642,200.00
	Subtotal (Item 4)				*$ 6,570,200.00*
	2 Air Stripper Units				*$ 13,140,400.00*
	Total Construction Cost				**$ 103,272,700.00**

Note: This Page is an Excerpt from "STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE" prepared by Tetra Tech for the Naval Facilities Engineering Command Mid-Atlantic

Annual O&M Cost (1A)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Quarterly GW Sampling, analysis and reporting**	236	Samples	$ 600	$ 141,600
2	**Hot Spot Treatment System (736 MG/Yr)**				
2.1	Operator (2 days per week)	104	days	$ 650	$ 67,600
2.2	Electrical Cost for pumps and blowers - 150 kW	1314000	kW	$ 0.17	$ 223,380
2.3	Building heating and lighting costs	12	monthly	$ 1,000	$ 12,000
2.4	Maintenance (2% of capital minus real estate)	0.02	percent	$ 10,310,000	$ 206,200
2.5	O&M - cleaning (2 days per quarter, 8 hr day)	8	days	$ 650	$ 5,200
2.6	Performance monitoring (water and air - VOCs)	116	sample	$ 200	$ 23,200
2.7	Quarterly groundwater sampling, analysis and reporting	56.00	samples	$ 600	$ 33,600
2.8	Reporting and Management	12	monthly	$ 3,500	$ 42,000
2.9	GAC Changeout - Liquid	10000	pounds	$ 1.65	$ 16,500
2.10	GAC Changeout - Vapor	20000	pounds	$ 2.50	$ 50,000
2.11	Water Discharge (1000 gallons)	735840	1000 gallon	$ 0.03	$ 22,075
	Subtotal (Item 2)				***$ 701,755***
3	**Public Water Supply GAC Unit (220 MG/Yr, Cost per system)**				
3.1	Operator (1 day per week)	52	days	$ 650	$ 33,800
3.2	Electrical cost for pump (incremental) - 35 kW	306600	kW	$ 0.17	$ 52,122
3.3	Building heating and lighting costs, utilities	12	Monthly	$ 1,000	$ 12,000
3.4	Maintenance (1.5% of capitol)	0.015	percent	$ 3,200,000	$ 48,000
3.5	O&M - cleaning (2 day per quarter; 8-hr day)	8	days	$ 650	$ 5,200
3.6	Performance monitoring (water - VOCs)	58	sample	$ 200	$ 11,600
3.7	Reporting and Management	12	Monthly	$ 1,000	$ 12,000
3.8	GAC Changeout - Liquid	18000	pounds	$ 1.65	$ 29,700
	Subtotal (Item 3)				***$ 204,422***
4	**Public Air Stripping Unit (1,400 GPM, Cost per System)**				
4.1	Operator (1 day per week)	52	days	$ 650	$ 33,800
4.2	Electrical Cost for pumps and blowers (incremental) - 50Kw	438000	kw	$ 0.17	$ 74,460
4.3	Building heating and lighting costs, utilities	12	Monthly	$ 1,000	$ 12,000
4.4	Maintenance (2% of capitol)	0.02	percent	$ 4,940,000	$ 98,800
4.5	O&M - cleaning (2 day per quarter; 8-hr day)	8	days	$ 650	$ 5,200
4.6	Performance monitoring (water and air - VOCs)	116	sample	$ 200	$ 23,200
4.7	Reporting and Management	12	Monthly	$ 1,000	$ 12,000
4.8	AS Filter Changeout	12	Monthly	$ 1,000.00	$ 12,000
	Subtotal (Item 4)				***$ 271,460***

Note: This Page is an Excerpt from "STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE" prepared by Tetra Tech for the Naval Facilities Engineering Command Mid-Atlantic

Alternative 2A

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Plume Delineation/Monitoring**				
1.1	Vertical Profile Borings (24 Borings, sampling, oversight)	21600	feet	$ 200	$ 4,320,000
1.2	Monitoring Wells (44)	26400	feet	$ 100	$ 2,640,000
1.3	Reporting & Surveying	24	each	$ 12,500	$ 300,000
	Subtotal (Item 1)				***$ 7,260,000***
3	**Public Water Supply GAC Unit (1,400 GPM, Cost per System)**				
3.1	Pump Upgrade	1	each	$ 150,000	$ 150,000
3.2	Liquid Phase GAC System	2	each	$ 400,000	$ 800,000
3.3	In plant Piping	1	each	$ 250,000	$ 250,000
3.4	Building	2400	SF	$ 400	$ 960,000
3.5	Power and Controls	1	each	$ 550,000	$ 550,000
3.6	Construction Oversight & startup (3 people - 6 months)	18	months	$ 25,000	$ 450,000
3.7	Construction Facilities (trailer, utilities)	8	months	$ 5,000	$ 40,000
3.8	Contingency (20%)				$ 640,000
3.9	Design & Engineering (13%)				$ 416,000
	Subtotal (Item 3)				***$ 4,256,000***
	15 GAC Units				***$ 63,840,000***
4	**Public Water Supply Air Stripping Unit (ANY-Upgrade)**				
4.1	Pump Upgrade	2	each	$ 250,000	$ 500,000
4.2	Air Stripping Unit	1	each	$ 1,100,000	$ 1,100,000
4.3	In plant Piping	1	each	$ 600,000	$ 600,000
4.4	Building (60 x 60)	3600	SF	$ 400	$ 1,440,000
4.5	Sump and Booster Pumps	1	each	$ 750,000	$ 750,000
4.6	Power and Controls	1	each	$ 850,000	$ 850,000
4.7	Construction Oversight & startup (3 people - 8 months)	24	months	$ 25,000	$ 600,000
4.8	Construction Facilities (trailer, utilities)	10	months	$ 5,000	$ 50,000
4.9	Contingency (20%)				$ 1,178,000
4.10	Design & Engineering (13%)				$ 765,700
	Subtotal (Item 4)				*$ 7,833,700*
5	**Long Term Recharge Basin Tie Ins**				
5.1	Recharge Basin Tie-in & Permit	4	each	$ 75,000	$ 300,000
	Total Construction Cost				**$ 79,233,700**

Note: This Page is an Excerpt from "STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE" prepared by Tetra Tech for the Naval Facilities Engineering Command Mid-Atlantic

Annual O&M Cost (2A)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Quarterly GW Sampling, analysis and reporting**	236	Samples	$ 600	$ 141,600
3	**Public Water Supply GAC Unit (220 MG/Yr, Cost per system)**				
3.1	Operator (1 day per week)	52	days	$ 650	$ 33,800
3.2	Electrical cost for pump (incremental) - 35 kW	306600	kW	$ 0.17	$ 52,122
3.3	Building heating and lighting costs, utilities	12	Monthly	$ 1,000	$ 12,000
3.4	Maintenance (1.5% of capitol)	0.015	percent	$ 3,200,000	$ 48,000
3.5	O&M - cleaning (2 day per quarter; 8-hr day)	8	days	$ 650	$ 5,200
3.6	Performance monitoring (water - VOCs)	58	sample	$ 200	$ 11,600
3.7	Reporting and Management	12	Monthly	$ 1,000	$ 12,000
3.8	GAC Changeout - Liquid	18000	pounds	$ 1.65	$ 29,700
	Subtotal (Item 3)				***$ 204,422***
4	**Public Air Stripping Unit (ANY -630 MG/Yr)**				
4.1	Operator (1 day per week)	52	days	$ 650	$ 33,800
4.2	Electrical cost for pump (incremental) - 50 kW	1314000	kW	$ 0.17	$ 223,380
4.3	Building heating and lighting costs, utilities	12	Monthly	$ 1,000	$ 12,000
4.4	Maintenance (2% of capitol)	0.02	percent	$ 5,890,000	$ 117,800
4.5	O&M - cleaning (2 day per quarter; 8-hr day)	8	days	$ 650	$ 5,200
4.6	Performance monitoring (water and air - VOCs)	116	sample	$ 200	$ 23,200
4.7	Reporting and Management	12	Monthly	$ 1,000	$ 12,000
4.8	AS Filter Changeout	12	Monthly	$ 1,000.00	$ 12,000
	Subtotal (Item 4)				***$ 439,380***
5	**Long Term Recharge Basin Tie Ins (800 MG/Yr)**				
5.1	Discharge per 1000	798912	1000 gal	$ 0.03	$ 23,967
5.2	Purchase per 1000 gallons (See App. Table A-4)	798912	1001 gal	$ 0.91	$ 727,010
	Subtotal (Item 5)				***$ 750,977***

Note: This Page is an Excerpt from "STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE" prepared by Tetra Tech for the Naval Facilities Engineering Command Mid-Atlantic

Alternative 2B

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Plume Delineation/Monitoring**				
1.1	Vertical Profile Borings (24 Borings, sampling, oversight)	21600	feet	$ 200	$ 4,320,000
1.2	Monitoring Wells (44)	26400	feet	$ 100	$ 2,640,000
1.3	Reporting & Surveying	24	each	$ 12,500	$ 300,000
	Subtotal (Item 1)				***$ 7,260,000***
2	**Groundwater Treatment System (5,700 MG/Yr)**				
2.1	Delineation (15 VPBs)	13500	feet	$ 200	$ 2,700,000
2.2	Monitoring Wells (36)	21600	feet	$ 100	$ 2,160,000
2.3	Extraction Wells (9 to 400 and 4 to 750 feet)	6600	feet	$ 200	$ 1,320,000
2.4	Extraction Vault and Pumps	13	each	$ 350,000	$ 4,550,000
2.5	Conveyance Piping (trenching & piping - 8 to 32 inch)	12500	feet	$ 275	$ 3,437,500
2.5	Air Stripping System (with blower, sump and pumps	2	each	$ 1,200,000	$ 2,400,000
2.6	Liquid Phase GAC System (16 units)	16	each	$ 300,000	$ 4,800,000
2.7	Vapor Phase GAC System	0	each	$ 500,000	$ -
2.8	In plant piping	3	each	$ 600,000	$ 1,800,000
2.9	Discharge Piping & (8 basins structure)	23000	feet	$ 275	$ 6,325,000
2.10	Basin Structures	8	each	$ 25,000	$ 200,000
2.11	Injection Wells (15 @ 300 feet)	4500	feet	$ 200	$ 900,000
2.12	Building (3 buildings)	16800	SF	$ 400	$ 6,720,000
2.13	Power and controls	3	each	$ 3,200,000	$ 9,600,000
2.14	Property	6	acre	$ 2,000,000	$ 12,000,000
2.15	Construction Oversight & startup (6 people - 48 months)	288	months	$ 25,000	$ 7,200,000
2.16	Construction Facilities (trailer, utilities)	144	months	$ 5,000	$ 720,000
2.17	Contingency (20%)				$ 13,366,500
2.18	Design & Engineering (13%)				$ 8,688,225
	Subtotal (Item 2)				***$ 88,887,225***
3	**Public Water Supply GAC Unit (1,400 GPM, Cost per System)**				
3.1	Pump Upgrade	1	each	$ 150,000	$ 150,000
3.2	Liquid Phase GAC System	2	each	$ 400,000	$ 800,000
3.3	In plant Piping	1	each	$ 250,000	$ 250,000
3.4	Building	2400	SF	$ 400	$ 960,000
3.5	Power and Controls	1	each	$ 550,000	$ 550,000
3.6	Construction Oversight & startup (3 people - 6 months)	18	months	$ 25,000	$ 450,000
3.7	Construction Facilities (trailer, utilities)	8	months	$ 5,000	$ 40,000
3.8	Contingency (20%)				$ 640,000
3.9	Design & Engineering (13%)				$ 415,999
	Subtotal (Item 3)				***$ 4,255,999***
	15 GAC Units				***$ 63,839,985***
	Total Construction Cost				**$ 159,987,210**

Note: This Page is an Excerpt from "STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE" prepared by Tetra Tech for the Naval Facilities Engineering Command Mid-Atlantic

Annual O&M Cost (2B)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Quarterly GW Sampling, analysis and reporting**	236	Samples	$ 600	$ 141,600
2	**Groundwater Treatment System (5,700 MG/Yr)**				
2.1	Operator (21 Shifts per week)	1092	shift	$ 650	$ 709,800
2.2	Electrical Cost for pumps and blowers - 862 kW	7551120	kW	$ 0.17	$ 1,283,690
2.3	Building heating and lighting costs	36	monthly	$ 1,000	$ 36,000
2.4	Maintenance (2% of capital minus real estate)	0.02	percent	$ 54,832,500	$ 1,096,650
2.5	O&M - cleaning (14 days per quarter, 8 hr day)	56	days	$ 650	$ 36,400
2.6	Performance monitoring (water and air - VOCs)	480	sample	$ 200	$ 96,000
2.7	Quarterly groundwater sampling, analysis and reporting	0.00	samples	$ 600	$ -
2.8	Reporting and Management	12	monthly	$ 10,000	$ 120,000
2.9	GAC Changeout - Liquid	470000	pounds	$ 1.65	$ 775,500
2.10	GAC Changeout - Vapor	0	pounds	$ 3	$ -
2.11	Water Discharge (1000 gallons)	5676480	1000 gallon	$ 0.03	$ 170,294
	Subtotal (Item 2)				***$ 4,324,335***
3	**Public Water Supply GAC Unit (220 MG/Yr, Cost per system)**				
3.1	Operator (1 day per week)	52	days	$ 650	$ 33,800
3.2	Electrical cost for pump (incremental) - 35 kW	306600	kW	$ 0.17	$ 52,122
3.3	Building heating and lighting costs, utilities	12	Monthly	$ 1,000	$ 12,000
3.4	Maintenance (1.5% of capitol)	0.02	percent	$ 3,200,000	$ 48,000
3.5	O&M - cleaning (2 day per quarter; 8-hr day)	8	days	$ 650	$ 5,200
3.6	Performance monitoring (water - VOCs)	58	sample	$ 200	$ 11,600
3.7	Reporting and Management	12	Monthly	$ 1,000	$ 12,000
3.8	GAC Changeout - Liquid	18000	pounds	$ 1.65	$ 29,700
	Subtotal (Item 3)				***$ 204,422***

Note: This Page is an Excerpt from "STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE" prepared by Tetra Tech for the Naval Facilities Engineering Command Mid-Atlantic

USACE Proposed: Alternative 2A/2B Hybrid Cost Estimate

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Plume Delineation/Monitoring**				
1.1	Vertical Profile Borings (24 Borings, sampling, oversight)	21600	feet	$ 200	$ 4,320,000
1.2	Monitoring Wells (44)	26400	feet	$ 100	$ 2,640,000
1.3	Reporting & Surveying	24	each	$ 12,500	$ 300,000
	Subtotal (Item 1)				***$ 7,260,000***
2	**Groundwater Treatment System (Focused Extraction) (105 MG/Yr)**				
2.1	Delineation (15 VPBs)	13500	feet	$ 200	$ 2,700,000
2.2	Monitoring Wells (4)	2400	feet	$ 100	$ 240,000
2.3	Extraction Wells (2 to 750 feet)	1500	feet	$ 200	$ 300,000
2.4	Extraction Vault and Pumps	2	each	$ 350,000	$ 700,000
2.5	Conveyance Piping (trenching & piping - 8 to 32 inch)	6250	feet	$ 275	$ 1,718,750
2.5	Air Stripping System (with blower, sump and pumps)	1	each	$ 1,200,000	$ 1,200,000
2.6	Liquid Phase GAC System (2 LGAC units)	2	each	$ 300,000	$ 600,000
2.7	Vapor Phase GAC System (1 VGAC unit)	1	each	$ 500,000	$ 500,000
2.8	In plant piping	1	each	$ 600,000	$ 600,000
2.9	Discharge Piping (1 basin structure)	2500	feet	$ 275	$ 687,500
2.10	Basin Structures	0	each	$ 25,000	$ -
2.11	Injection Wells	0	feet	$ 200	$ -
2.12	Building (1 building)	3600	SF	$ 400	$ 1,440,000
2.13	Power and controls	1	each	$ 3,200,000	$ 3,200,000
2.14	Property	1	acre	$ 2,000,000	$ 2,000,000
2.15	Construction Oversight & startup	18	months	$ 25,000	$ 450,000
2.16	Construction Facilities (trailer, utilities)	18	months	$ 5,000	$ 90,000
2.17	Contingency (20%)				$ 3,285,250
2.18	Design & Engineering (13%)				$ 2,135,413
	Subtotal (Item 2)				***$ 21,846,913***
3	**Public Water Supply GAC Unit (1,400 GPM, Cost per System)**				
3.1	Pump Upgrade	1	each	$ 150,000	$ 150,000
3.2	Liquid Phase GAC System	2	each	$ 400,000	$ 800,000
3.3	In plant Piping	1	each	$ 250,000	$ 250,000
3.4	Building	2400	SF	$ 400	$ 960,000
3.5	Power and Controls	1	each	$ 550,000	$ 550,000
3.6	Construction Oversight & startup (3 people - 6 months)	18	months	$ 25,000	$ 450,000
3.7	Construction Facilities (trailer, utilities)	8	months	$ 5,000	$ 40,000
3.8	Contingency (20%)				$ 640,000
3.9	Design & Engineering (13%)				$ 416,000
	Subtotal (Item 3)				***$ 4,256,000***
	15 GAC Units				***$ 63,840,000***
5	**Long Term Recharge Basin Tie Ins**				
5.1	Recharge Basin Tie-in & Permit	0	each	$ 75,000	***$*** -
	Total Construction Cost				**$ 92,946,913**

Annual O&M Cost (2A/2B-Hybrid)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1	**Quarterly GW Sampling, analysis and reporting**	236	Samples	$ 600	***$ 141,600***
2	**Groundwater Treatment System (105 MG/Yr)**				
2.1	Operator (21 Shifts per week)	364	shift	$ 650	$ 236,600
2.2	Electrical Cost for pumps and blowers - 67 kW	586920	kW	$ 0.17	$ 99,776
2.3	Building heating and lighting costs	12	monthly	$ 1,000	$ 12,000
2.4	Maintenance (2% of capital minus real estate)	0.02	percent	$ 14,426,250	$ 288,525
2.5	O&M - cleaning (14 days per quarter, 8 hr day)	56	days	$ 650	$ 36,400
2.6	Performance monitoring (water and air - VOCs)	160	sample	$ 200	$ 32,000
2.7	Quarterly groundwater sampling, analysis and reporting	0	samples	$ 600	$ -
2.8	Reporting and Management	12	monthly	$ 10,000	$ 120,000
2.9	GAC Changeout - Liquid	20000	pounds	$ 1.65	$ 33,000
2.10	GAC Changeout - Vapor	20000	pounds	$ 2.50	$ 50,000
2.11	Water Discharge (1000 gallons)	105120	1000 gallon	$ 0.03	$ 3,154
	Subtotal (Item 2)				***$ 911,455***
3	**Public Water Supply GAC Unit (220 MG/Yr, Cost per system)**				
3.1	Operator (1 day per week)	52	days	$ 650	$ 33,800
3.2	Electrical cost for pump (incremental) - 35 kW	306600	kW	$ 0.17	$ 52,122
3.3	Building heating and lighting costs, utilities	12	Monthly	$ 1,000	$ 12,000
3.4	Maintenance (1.5% of capitol)	0.02	percent	$ 3,200,000	$ 48,000
3.5	O&M - cleaning (2 day per quarter; 8-hr day)	8	days	$ 650	$ 5,200
3.6	Performance monitoring (water - VOCs)	58	sample	$ 200	$ 11,600
3.7	Reporting and Management	12	Monthly	$ 1,000	$ 12,000
3.8	GAC Changeout - Liquid	18000	pounds	$ 1.65	$ 29,700
	Subtotal (Item 3)				***$ 204,422***
5	**Long Term Recharge Basin Tie Ins (1,200 MG/Yr)**				
5.1	Discharge per 1000	1200000	1000 gal	$ 0.03	$ 36,000
5.2	Purchase per 1000 gallons (See App. Table A-4)	1200000	1000 gal	$ 0.91	$ 1,092,000
	Subtotal (Item 5)				***$ 1,128,000***

Hybrid 2A/2B Alternative Description:

While we agree with the recommendations in the Summary (3.3) of the "Study of Alternatives for Management of Impacted Groundwater in Bethpage", with improved characterization, it is possible that an alternative could be developed that could use a **combination** of Alternative 2A and 2B which would offer increased efficiency of contaminant reduction while reducing costs. These include:

1. All items from Alternative 1 (which are also included in both Alternative 2A, 2B),

2. Focused capture and treatment of the deep zone contamination in the western portion of the Bethpage Plume near the ANY-SNR well field. This could be accomplished by installing at least one and possibly two wells that are screened in this deep zone (See Figure 1, and 2). Flow rates would be adjusted to focus the capture of water in this contaminated zone, without influencing the rest of the aquifer. The flowrate would likely be less than 200 GPM and be discharged into the local Public Water Supply System. While Alternative 2A recommends operating the ANY-SNR wells at maximum capacity, the focused capture of this deep zone would preclude continual pumping from these wells and the ANY-SNR wellfield would only be pumped to satisfy normal water supply demands.

3. We also recommend that the Bethpage wellfields BWD No. 4, BWD No. 5, and BWD No 6 pump at maximum capacity throughout the year. All wells have intercepted the eastern/OU-3 portion of the Bethpage plume and currently have treatment systems. The screened intervals of these wells appear to be located in an advantageous position for plume capture. This could result in the highest mass removal with a significant cost savings from Alternative 2B.