Proposed Water Treatment Residuals Management Process

Engineering Feasibility Study

Prepared for

Washington Aqueduct Division
Baltimore District, U.S. Army Corps of Engineers

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Acronyms & Abbreviations

C&O	Chesapeake & Ohio
CSO	Combined Sewer Overflow
DC WASA	District of Columbia Water and Sewer Authority
DEIS	Draft Environmental Impact Statement
DOPAA	Description of Proposed Actions and Alternatives
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FCWA	Fairfax County Water Authority
FFCA	Federal Facilities Compliance Agreement
HDPE	high-density polyethylene
LTCP	Long-Term Control Plan
mgd	million gallons per day
MHW	mean high water
MLW	mean low water
NEPA	National Environmental Policy Act
nm	nautical mile
NPDES	National Pollution Discharge Elimination System
PI	Potomac Interceptor
TSS	total suspended solids
UPIRS	Upper Potomac Interceptor Relief Sewer
USGS	U.S. Geological Survey
WFP	water filtration plant
WR&A	Whitman Requardt & Associates
WSSC	Washington Suburban Sanitary Commission
WTP	water treatment plant
WWTP	wastewater treatment plant

SECTION 1

Introduction

1.1 Background and Project History

The U.S. Army Corps of Engineers, Baltimore District, Washington Aqueduct operates the Dalecarlia and McMillan Water Treatment Plants (WTPs) in Washington, D.C., serving over 1 million persons in the D.C. and northern Virginia area with potable water. The treatment process removes solid particles (e.g., river silt) from the Potomac River supply water, treats and disinfects the water, and distributes the finished water to the metropolitan service area. The solids removed during the treatment process have historically been returned to the Potomac River, but a recently reissued version of the Washington Aqueduct National Pollution Discharge Elimination System (NPDES) permit (Permit No. DC 0000019) effectively precludes the discharge of water treatment solids, or residuals, to the river.

Consequently, Washington Aqueduct is in the process of evaluating water treatment residuals management options that minimize or eliminate the discharge of residuals to the river. The residuals management option that is ultimately selected has a potential to affect the human environment, and thus development of the residuals management plan must comply with the National Environmental Policy Act (NEPA). This Engineering Feasibility Study was developed as background material for the Description of Proposed Actions and Alternatives (DOPAA) portion of the Draft Environmental Impact Statement (DEIS). The DOPAA partially fulfills the NEPA requirements to document the environmental implications of residuals management alternatives before a decision is made on the proposed action. NEPA requires federal agencies to integrate environmental considerations into their decision-making processes by evaluating the environmental impacts of their proposed actions and reasonable alternatives to those actions.

The current water treatment system consists of a series of reservoirs and treatment facilities (Figure 1-1). Raw water diverted from the Potomac River is collected in the Dalecarlia Reservoir. Natural sedimentation of river silt typically occurs in the Forebay of the Dalecarlia Reservoir (Figure 1-2). This silt (Forebay residuals) is periodically dredged, temporarily land applied on Washington Aqueduct property for drying, and then trucked off-site or utilized on-site. The part of this process that involves trucking of dried Forebay solids occurs approximately every seven years.

Washington Aqueduct water treatment operations then achieve an additional level of sediment removal by adding aluminum sulfate (alum) as a coagulant. Alum is added after the water has passed through the Dalecarlia Reservoir, but prior to reaching the four sedimentation basins at the Dalecarlia WTP (Figure 1-2) and the Georgetown Reservoir (Figure 1-3), where the coagulated sediment (i.e., water treatment residuals) is removed. The settled residuals are periodically flushed from the basins to the Potomac River. This process had been previously permitted through the U.S. Environmental Protection Agency’s (EPA’s) NPDES permitting process.

The reissued NPDES permit, which became effective on April 15, 2003, significantly reduced the allowable concentration of residuals that may be discharged by the Washington Aqueduct to the Potomac River. Washington Aqueduct and EPA Region III entered into a Federal Facilities Compliance Agreement (FFCA), on June 12, 2003, to allow the continued production of drinking water during the development of a new residuals management process to meet the requirements of the new permit. The FFCA includes a strict schedule for delivering documentation and achieving compliance with the NPDES permit, including completion of an alternatives evaluation and a disposal study, a DEIS, and final compliance with the numerical discharge limitations.

1.2 Purpose and Need for Action

The purpose and need for the project were defined in the Notice of Intent, published in the *Federal Register* on January 12, 2004, as restated below:

> The objectives of the proposed residuals management process are as follows, not necessarily in order of precedence (measurement indicators in parentheses):
>
> - To allow Washington Aqueduct to achieve complete compliance with NPDES Permit DC00000019 and all other federal and local regulations.
> - To design a process that will not impact current or future production of safe drinking water reliably for the Washington Aqueduct customers. (Peak design flow of drinking water).
> - To reduce, if possible, the quantities of solids generated by the water treatment process through optimized coagulation or other means. (Mass or volume of solids generated).
> - To minimize, if possible impacts on various local and regional stakeholders and minimize impacts on the environment. (Traffic, noise, pollutants, etc.).
> - To design a process that is cost-effective in design, implementation, and operation. (Capital, operations, and maintenance costs).

Washington Aqueduct developed these objectives with the intention of ensuring compliance with all permit and other legal mandates, and preserving or improving upon the safety, reliability, and efficiency of the current water treatment process. In addition, Washington Aqueduct incorporated into the objectives a concern for minimizing impacts to the human and natural environment.

Comments from the public, generated during the scoping process for the EIS, have been incorporated into the list of alternatives developed for Section 2 of this report. A detailed evaluation of all alternatives is presented in Section 3. Section 4 discusses various options for sedimentation and residuals collection, and Section 5 presents a summary of the alternatives that will be retained for further evaluation as part of the EIS.

Alternatives screening criteria, linked to the purpose and need statement as listed above, were developed subsequent to the issuance of the Notice of Intent. These screening criteria have been used to identify a reasonable range of alternatives for detailed analysis in the DEIS.

Washington Aqueduct will select an alternative among those presented in Section 2 for implementation. The final alternative selected may be contingent on authorization, approvals, or issuance of permits or easements by various public agencies or private entities including, but not limited to, the relevant State Historic Preservation Office, the National Capital Planning Commission, the Environmental Protection Agency, the National Park Service, and the Washington Aqueduct Wholesale Customers.

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FIGURE 1-1
Washington Aqueduct Supply and Treatment System

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Figure 1-2
Dalecarlia Reservoir and Forebay Facilities

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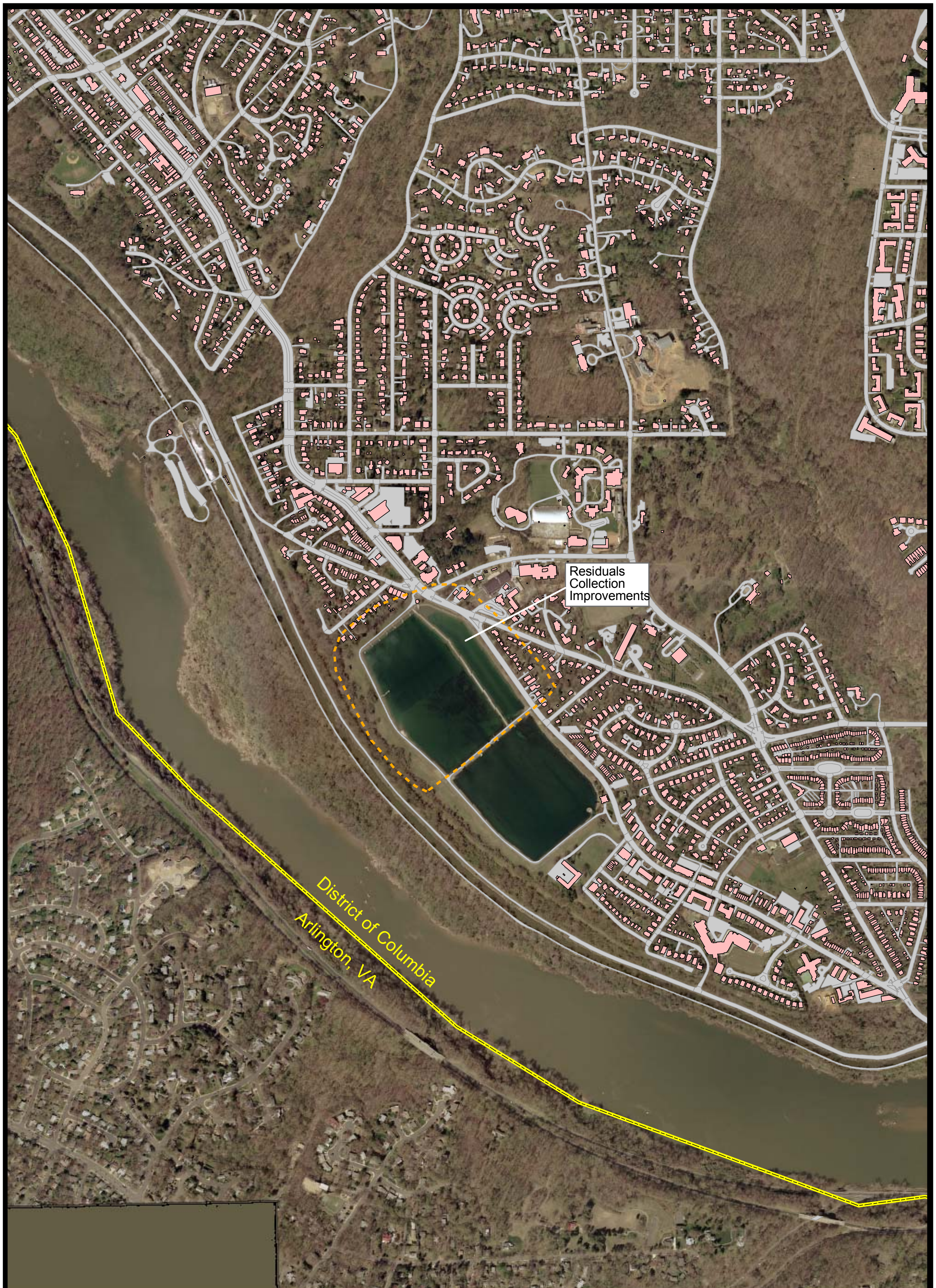

Legend

- Area of Potential Modifications
- County Boundary
- Existing Buildings
- Roads

The geographic information shown on this map is based on data from the District of Columbia Geographic Information System (DC GIS). The District Government makes no warranty, express or implied, and disclaims all implied warranties of suitability of the DC GIS product for a particular purpose.

0 375 750 1,500 Feet

Figure 1-3
Georgetown Reservoir

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SECTION 2

Description of Proposed Action and Alternatives

2.1 Proposed Action

The proposed action is to develop, design, and construct a permanent new residuals management process that will cost-effectively collect, treat, and dispose of the residuals in conformance with the purpose and need stated above. The selected action must meet the FFCA compliance deadlines. It must also address the management of projected residuals quantities for a period of at least 20 years. Table 2-1 lists the current and future volume of water treatment and Forebay residuals generated daily, as developed for the Engineering Feasibility Study. The table also lists the number of truck trips associated with the residuals quantities based on a 5-day week. Not all alternatives evaluated use trucking for the disposal of dewatered residuals. The larger residuals values listed in the design year columns reflect the larger quantity of water anticipated to require treatment approximately 20 years in the future.

TABLE 2-1
Washington Aqueduct Basis for Residuals Quantities

	Daily Generated Volume (Cubic Yards)[a]		Truck Trips/Day[b]			
			22 Cubic Yards/ Truck		11 Cubic Yards/ Truck	
Residuals	Current Average	Design Year Average	Current Average	Design Year Average	Current Average	Design Year Average
Water Treatment	94	120	7	8	13	16
Forebay	22	28	2	2	3	4

[a] Based on 7 days per week production.
[b] Based on hauling 5 days per week.

2.2 Development of Alternatives

Washington Aqueduct has been evaluating residuals management approaches for a number of years. During that time many options have been identified. However, there have also been shifts in emphasis for the residuals management goals and objectives. Thus, not all approaches considered within the history of the project achieve the current objectives equally.

The first step in the NEPA alternative identification process was to review the project history and compile a full range of possible alternatives that have the potential to meet the stated purpose and need. The following documents were reviewed to develop the historical list:

- Department of the Army Baltimore District, Corps of Engineers, Washington Aqueduct. "Dalecarlia Water Treatment Plant and Georgetown Reservoir Residuals Collection and Treatment Engineering Estimate (35% Design)." Whitman, Requardt, and Associates. November 1996
- Department of the Army Baltimore District, Corps of Engineers, Washington Aqueduct. "Dalecarlia Water Treatment Plant and Georgetown Reservoir Residuals Disposal Facilities Residuals Disposal Study." Whitman, Requardt, and Associates in association with Malcolm Pirnie, Inc. September 1995
- Department of the Army, Baltimore District, Corps of Engineers, Washington Aqueduct. "Draft NPDES Permit Review Memorandum on Residual Solids Evaluations." AH Environmental Consultants, Inc., and Greeley and Hansen LLC. May 30, 2003

To this list were added new alternatives and approaches with the potential to improve the historical alternatives. Suggestions made by the public during the scoping process, such as plasma heat treatment of residuals, were also considered.

2.3 Alternatives Description

The following 26 alternatives were initially evaluated for this project. Since many of the alternatives are similar, they have been grouped in categories based on similarity of critical components, such as the method of dewatering residuals, transport, or the location of processing facilities.

Alternative 1 is a "No-Action" alternative that provides no changes to the current practice of discharging residuals to the Potomac River as allowed by the previous NPDES permit. Although this alternative clearly does not meet the purpose and need for the project because it does not comply with the current NPDES permit, it must be examined under NEPA for comparison to other alternatives.

Alternatives 2 through 8 do not require continuous trucking of residuals from the Dalecarlia WTP:

- Alternative 2: Process water treatment residuals at Dalecarlia WTP and dispose of them in the Dalecarlia monofill. Process Forebay residuals by current methods and periodically haul offsite.
- Alternative 3: Coprocess water treatment and Forebay residuals at Dalecarlia WTP and codispose in Dalecarlia monofill.
- Alternative 4: Pump unthickened water treatment residuals via Potomac Interceptor to the District of Columbia Water and Sewer Authority (DC WASA) Blue Plains Wastewater Treatment Plant (WWTP). Process Forebay residuals by current methods and periodically haul.

- Alternative 5: Thicken water treatment residuals at Dalecarlia WTP, then pump via a new pipeline to DC WASA Blue Plains WWTP. Process Forebay residuals by current methods and periodically haul.
- Alternative 6: Thicken water treatment residuals at Dalecarlia WTP, then transport by barge to the Blue Plains WWTP. Process Forebay residuals by current methods and periodically haul.
- Alternative 7: Thicken water treatment residuals at Dalecarlia WTP, then pump via pipeline to neighboring water utility. Process Forebay residuals by current methods and periodically haul.
- Alternative 8: Thicken water treatment residuals at Dalecarlia WTP, then pump via pipeline to a new dewatering location. Process Forebay residuals by current methods and periodically haul.

Alternatives 9 through 11 anticipate discharging some portion of the residuals, or related process streams, back to the Potomac River:

- Alternative 9: Process most water treatment residuals at the Dalecarlia WTP and haul offsite, but dilute some residuals for discharge back to the Potomac River. Process Forebay residuals by current methods and periodically haul.
- Alternative 10: Renegotiate NPDES permit to allow discharge of all residuals to the Potomac River.
- Alternative 11: Process water treatment residuals at Dalecarlia WTP and haul offsite. Process Forebay residuals by current methods and periodically haul. Dilute side streams and discharge to the Potomac River.

Alternatives 12 through 15 would involve some construction of residuals facilities in the Dalecarlia Reservoir:

- Alternative 12: Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals. Dispose of residuals in Dalecarlia and McMillan monofills.
- Alternative 13: Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal.
- Alternative 14: Construct new sedimentation basins at the Dalecarlia Reservoir and process all residuals at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal.
- Alternate 15: Coagulate all flow in the Dalecarlia Reservoir and process all residuals at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal.

Alternatives 16 through 23 anticipate constructing residuals facilities at the McMillan WTP:

- Alternative 16: Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer's treatment facility. Contract haul dewatered residuals. Process Forebay residuals by current methods and periodically haul.
- Alternative 17: Coprocess Forebay and water treatment residuals at the McMillan WTP. Dispose of residuals via contract hauling from the McMillan WTP.
- Alternative 18: Process water treatment residuals at the McMillan WTP and haul offsite. Process Forebay residuals by current methods and periodically haul.
- Alternative 19: Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer's dewatering facility. Dispose of residuals via contract hauling from the existing facility. Discharge Forebay residuals to the Potomac River.
- Alternative 20: Thicken water treatment residuals at the Dalecarlia WTP and Georgetown Reservoir and dewater at the McMillan WTP. Dispose of water treatment residuals via contract hauling from the McMillan WTP. Process Forebay residuals via current methods and periodically haul.
- Alternative 21: Store residuals at lagoons at Forebay, Dalecarlia WTP, and McMillan WTP. Thicken and dewater residuals with portable equipment and dispose via contract hauling from all locations.
- Alternative 22: Store water treatment residuals in Dalecarlia and Georgetown Reservoirs prior to thickening and dewatering at Dalecarlia and McMillan WTPs. Dispose of water treatment residuals via contract hauling from the Dalecarlia and McMillan WTPs. Process Forebay residuals via current methods and periodically haul.
- Alternative 23: Store water treatment residuals in the McMillan Reservoir prior to dewatering at the McMillan WTP. Dispose of water treatment residuals via contract hauling from McMillan WTP. Process Forebay residuals via current methods and periodically haul.

Alternatives 24 through 26 involve the construction of residuals facilities at the Dalecarlia WTP, followed by offsite disposal:

- Alternative 24: Coprocess Forebay and water treatment residuals at the Dalecarlia WTP. Dispose of residuals via contract hauling from the Dalecarlia WTP.
- Alternative 25: Process water treatment residuals at the Dalecarlia WTP and dispose via contract hauling. Process Forebay residuals via current methods and periodically haul.
- Alternative 26: Use plasma oven technology to process Forebay and water treatment residuals at the Dalecarlia WTP. Dispose of residuals via contract hauling from the Dalecarlia WTP.

Appendix A briefly describes each alternative evaluated for this project; the locations where residuals are produced and processed; and how each type of residual will be collected, conveyed, processed, and disposed of.

This Engineering Feasibility Study was prepared for residuals management concurrent with the DEIS and provides detailed technical information on the identified alternatives. The

Engineering Feasibility Study also describes and evaluates the alternatives in much greater detail than will be done in the DEIS and can be consulted for more information. The Engineering Feasibility Study documents the evaluation of the alternative methods for the collection and disposal of Forebay residuals and water treatment residuals (produced at the Dalecarlia Water Treatment Plant and Georgetown Reservoir). The results of the study include a determination of feasible alternatives with consideration given to the most environmentally sound, economical, and practical methods. This document will be available for review in the Document Repository as part of the EIS Administrative Record.

2.4 Alternative Screening Process and Criteria

Screening of alternatives is an approach commonly used as part of the NEPA process to identify the feasible alternatives and ensure a reasonable range of alternatives for detailed evaluation in the DEIS. In this document, each previously or newly identified alternative (or individual component of a residuals management approach) was screened against predetermined criteria. The draft predetermined screening criteria were circulated for public review and comment during the Scoping Process before they were applied to the alternatives.

The screening criteria used to judge attainment of purpose and need are:

- Is able to meet the FFCA, including schedule.
- Preserves the quality, reliability, and redundancy of the existing water treatment and distribution system.
- Uses proven methods (i.e., proven design water treatment processes, construction equipment and techniques, and operating principles).
- Complies with NPDES permit to reduce or eliminate discharge to the Potomac River.
- Does not produce an undue economic hardship on Washington Aqueduct customers for additional facilities that cost more than 30 percent of the baseline budget of $50 million (to increase total project cost beyond $65 million) that are not needed for other feasible alternatives for the five basic project elements of residuals collection, conveyance, thickening, dewatering, and disposal.
- Complies with zoning and land use regulations, institutional constraints, and other Federal and local regulations.
- Reduces residual quantities, if possible.

SECTION 3

Screening of Alternatives

This section of the Engineering Feasibility Study evaluates the alternatives and describes the specific screening process for each alternative.

3.1 No Action (Alternative 1)

Alternative 1 is the "No Action" alternative. The alternative would maintain the existing practice of discharging water treatment residuals to the Potomac River. This approach cannot be implemented because an NPDES permit for Washington Aqueduct is now in effect that effectively prohibits the discharge of residuals to the river. In addition, the FFCA has been negotiated to identify the steps and time frame for Washington Aqueduct to put the needed facilities in place to come into compliance with the NPDES permit.

Although this alternative does not meet the purpose and need of the project, it represents the "base case" of current environmental conditions, by which other alternatives will be evaluated for their impacts as part of the DEIS, in accordance with the requirements of NEPA. Therefore, this alternative shall be retained for further evaluation in the DEIS.

3.2 Alternatives That Do Not Require Continuous Trucking from Dalecarlia WTP (Alternatives 2–8)

3.2.1 Alternative 2

Process water treatment residuals at Dalecarlia WTP and dispose in Dalecarlia monofill; process Forebay residuals by current methods and periodically haul

The requirements for Alternative 2 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill
Forebay	Collect Forebay residuals using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

To determine whether an onsite monofill is feasible, the amount of dewatered water treatment residuals that would be placed in the monofill over a 20-year period was calculated. The calculation assumed a linear increase in the average amount of water treated from 180 mgd in the first year to 230 mgd in the 20th year with the amount of water treatment residuals being based on 11-year-average concentrations. Using this assumption, the amount of dewatered water treatment residuals produced under average operating conditions during the 20-year period would be 781,964 cubic yards.

The monofill would require enough volume for the total quantity of residuals. Other components of the monofill are expected to include a liner, a leachate collection system, periodic cover material, and a landfill cap (to be installed at the end of the operating period). Dewatered Forebay residuals, if found to be suitable, could potentially be used as periodic cover material. A design summary is presented in Table 3-1.

TABLE 3-1
Monofill Design Summary

Parameter	Description
Area Requirement	30 acres (minimum)
Height	50 to 80 ft
Total Volume (Minimum)	1,471,172 cubic yards
Liner	60 mil HDPE (typical)
Leachate Collection System	Assumed to be required
Periodic Cover Material	Assumed to be required
Landfill Cap	To be installed as it reaches the end of it's useful life

The Washington Aqueduct property was evaluated to determine whether enough land was available for the monofill. A review of zoning and waste disposal regulations, as well as property maps, was undertaken. To prevent regulatory problems in the future, it was decided that the monofill should not straddle the District of Columbia (D.C.)–Maryland border but should be completely within one of the two jurisdictions. Consequently, each jurisdiction was considered separately.

Monofills are permitted in Maryland, pursuant to Title 26, Subtitle 4, Chapter 7, Regulation 4. A review of the property map of the Dalecarlia WTP was conducted to locate a potential site Washington Aqueduct property within Maryland. The review indicated that the only available land for monofill use in Maryland would be a space bounded by Mill Creek, the Dalecarlia Reservoir, and the D.C.–Maryland border. The space was found to occupy approximately 377,121 ft^2 (8.7 acres). The rest of the land in Maryland owned by Washington Aqueduct either is already used or will be used by the existing plant, roads, the proposed thickening and dewatering facilities, Mill Creek, other Federal facilities, and the Dalecarlia Reservoir.

The available site was evaluated further to determine whether this area would be large enough to hold the volume of dewatered water treatment residuals that would be generated over a 20-year period. To approximate the maximum capacity of a proposed monofill area, a slope for the monofill's sides is assumed, and the volume was calculated as if the sides were to converge in an inverted-**V** shape. The actual volume will be slightly less than this estimate because monofills usually are relatively flat on top. The available subparcel of land suitable for siting the monofill in Maryland is asymmetrical in shape. It was assumed that the slope to the top of the monofill would be 4:1, which is the maximum slope that could be used to control erosion by conventional means. The base of the monofill would have an area of approximately 359,200 ft^2. The sides would be approximately 600 ft long. Using the 4:1 length-to-width ratio, the height would be about 75 ft. A monofill of this size could hold 498,889 cubic yards of material. The assumed monofill footprint does not include allowances for dikes, roads, or anything else needed to build the monofill, which could reduce the amount of material it could hold. Based on this evaluation, the onsite monofill option is not a viable alternative for the Maryland site because the required monofill volume could not be constructed on the available land.

D.C. regulations were also reviewed to determine whether a monofill could be built within the District. The study concluded that D.C. waste disposal regulations (Title 8, Subtitle B, Chapter 10) prohibit, in concept, the operation of a solid waste facility in §8-1052 by private parties or individuals. However, Washington Aqueduct may be excluded from these regulations because it is a governmental entity. No other regulations pertaining to the construction of a monofill in D.C. were found. For the purposes of this evaluation, therefore, it was assumed that D.C. regulations would not prohibit the construction of a monofill by the Washington Aqueduct. Further investigation, and additional interpretation of the regulations, would be needed to verify this conclusion.

The only available land on the D.C. side of the property that is large enough for a monofill is an area just north of East Creek and east of Dalecarlia Reservoir. Dalecarlia Parkway and the D.C.–Maryland line are the other two boundaries of the area. Based on a US Geological Survey (USGS) map of the site, the area is primarily underlain by fractured bedrock, which would be very expensive to excavate. Based on this concern, it was assumed that the monofill would begin at ground elevation.

A 20-acre monofill with a 3.5:1 slope that could hold approximately 1.6 million cubic yards of material could be constructed on this portion of the site. The monofill would be approximately 50 ft above grade on the side facing the Dalecarlia Parkway and 80 ft above grade on the side facing the Dalecarlia Reservoir. The calculated volume assumes 10 percent of the volume in the monofill will be used for the liner, a leachate collection system, and for the periodic placement of cover material.

3.2.1.1 Screening Evaluation

Existing Washington Aqueduct property was evaluated to determine whether enough space was available to construct a monofill that would hold the 20-year volume of dewatered water treatment residuals. A site on Washington Aqueduct property in Maryland was not large enough to accommodate the required volume of dewatered residuals. A site was located within the District of Columbia that would satisfy the volume requirement, and comply with pertinent regulations governing the construction of monofills within the District of Columbia. Figure 3-1 shows the location of the two sites investigated for this evaluation.

This alternative will be retained for further analysis in the DEIS.

3.2.2 Alternative 3

Coprocess water treatment and Forebay residuals at Dalecarlia WTP and codispose in Dalecarlia monofill

If the Forebay residuals were included in the quantity of solids going to an onsite monofill, the amount of residuals would increase from that considered in Alternative 2 to 961,845 cubic yards over a 20-year operating period. This amount of residuals would still fit in the identified monofill site. The monofill would be built in the same location and with the design criteria described previously.

The requirements for Alternative 3 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals Dalecarlia monofill
Forebay	Collect Forebay residuals using current methods	Pump residuals to Dalecarlia thickening facility along with water treatment residuals	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill

3.2.2.1 Screening Evaluation

This alternative involves the coprocessing of water treatment and Forebay residuals. With the exception of Alternative 26, all options involving coprocessing of Forebay residuals and water treatment residuals can be eliminated based on reliability and redundancy concerns. The Forebay residuals contain mostly grit and sand from the Potomac River, which would add a large volume of material to the amount of residuals the thickening and dewatering units that would need to be processed. The total volume of resulting dewatered residuals to be disposed of would also increase because the dewatered material would be limited to about 30 percent dry solids (with the exception of Alternative 26, which uses plasma treatment to reduce the volume of processed residuals). For the other alternatives, a much higher dry solids content (with an associated decrease in volume to disposed of) can be achieved by processing the Forebay residuals by the current methods.

The characteristics of the Forebay residuals would result in increased wear on pumping and dewatering equipment, resulting in more frequent repair and replacement needs than those of similar equipment used for the processing of water treatment residuals alone. Concern over increased equipment maintenance requirements may also limit choices for the type of dewatering technology to be used for this application. Centrifuges, for example, might not be the best choice for a coprocessing application due to the potential for more frequent equipment maintenance, since centrifuge maintenance is expensive and usually includes offsite for machine and balancing work.

For this application, coprocessing of Forebay residuals with water treatment residuals is not recommended, and can be eliminated due to reliability and redundancy concerns. Based on the discussion above, all alternatives that utilize coprocessing (with the exception of Alternative 26) will not be considered further as they are inconsistent with the "Reliability and Redundancy" screening criteria.

3.2.2.2 Summary

Alternatives utilizing an onsite monofill for the disposal of water treatment residuals alone and for the disposal of coprocessed water treatment and Forebay residuals have been described in the preceding paragraphs. Since the latter involves coprocessing Forebay residuals with water treatment residuals, it has been eliminated from further consideration.

3.2.3 Alternative 4

Pump unthickened water treatment residuals via the Potomac Interceptor to the District of Columbia Water and Sewer Authority (DC WASA) Blue Plains Wastewater Treatment Plant; process Forebay residuals by current methods and periodically haul

This alternative eliminates truck traffic associated with residuals on the roads surrounding the Washington Aqueduct facility by conveying water treatment residuals to the Blue Plains WWTP for further processing and disposal.

Residuals from the sedimentation basins at the Dalecarlia WTP and the Georgetown Reservoir would be collected at the Dalecarlia WTP before being pumped to the Potomac Interceptor (PI) and conveyed to Blue Plains. Residuals from the Forebay would be processed separately for onsite disposal and periodic hauling offsite, as is currently practiced.

The requirements for Alternative 4 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals into the Potomac Interceptor	Process residuals at Blue Plains with raw sewage	Transport dewatered residuals for disposal per current Blue Plains methods
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals from Dalecarlia to Potomac Interceptor	Process residuals at Blue Plains with raw sewage	Transport dewatered residuals for disposal per current Blue Plains methods
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

3.2.3.1 Screening Evaluation

For Alternative 4, the water treatment residuals would be discharged directly to the Potomac Interceptor for conveyance to Blue Plains. The residuals would be processed with the incoming sewage. The water treatment residuals could be conveyed in either the unthickened or thickened state. Alternative 4 specifically states that unthickened residuals would be conveyed (Alternative 5 considers the thickened residuals option). The unthickened residuals would be conveyed at a dry solids content of approximately 0.5 percent. Table 3-2 summarizes the residuals quantities used for the evaluation.

TABLE 3-2
Residuals Quantities for Alternative—Unthickened Water Treatment Residuals to Blue Plains (230 mgd)

	11-Year Annual Average			Wet Year		
	Annual Average	Max Month	Max Week	Annual Average	Max Month	Max Week
Dry lbs/day	65,220	106,524	191,935	86,179	144,335	336,078
Dry tons/day	33	53	96	43	72	168
Gallons/day (0.5% dry solids)	1,563,100	2,554,500	4,602,800	2,066,600	3,461,300	8,059,400

Note: Forebay residuals are not included above.

Potomac Interceptor. In the vicinity of the Washington Aqueduct, the PI is a 96-in. diameter pipeline. It conveys sewage from the suburbs in Virginia and Maryland to Blue Plains for treatment. There is only one pipeline (no redundancy). Average flow in the vicinity of the Washington Aqueduct is about 50 mgd. Unthickened Washington Aqueduct residuals would account for 3 to 16 percent of the average PI flow. Modeling of the interceptor conducted for other purposes has shown that the PI has the capacity to convey current and future sewage flows, along with their associated peaks. However, peak flows can increase dramatically in wet weather due to rainfall-induced inflow and infiltration. Modeling predicts that in 2025, the PI will have the capacity to handle peaks associated with the 5-year storm with an acceptable level of surcharging, but will not have the capacity to handle a 10-year storm. The discharge of residuals flows from the Washington Aqueduct to the Potomac Interceptor would need to be carefully managed in the future, especially in times of wet weather to minimize the impact on the interceptor.

At the District of Columbia line, the Potomac Interceptor becomes the Upper Potomac Interceptor Relief Sewer (UPIRS), which flows to the Potomac Pump Station. The pump station is located near the Kennedy Center and is a major DC WASA sewage-pumping station. It collects sewage from the UPIRS, and from several other sewers, and pumps all the collected flow to Blue Plains. The pump station cannot pump all of the flow it receives because much of the older part of the District of Columbia has a combined sewer system that conveys large volumes of rainwater runoff to the pump station. The pump station is the site of one of the most active combined sewer overflows (CSOs) in the District. There are also a number of CSOs in the Georgetown area on the UPIRS.

A study of CSOs conducted as part of the DC WASA Combined Sewer System Long-Term Control Plan predicted that 43 overflows into the Potomac River associated with the pump station occurred during a 3-year study period. The estimated total CSO overflow volume associated with these events was 763 million gallons per year.

Blue Plains WWTP. The Blue Plains WWTP is rated for about 370 mgd, and has a throughput capacity of 740 mgd. However, wet weather peaks can increase the incoming flow to 1.2 billion gallons per day. Walter Bailey, Director of Wastewater Operations at Blue Plains was interviewed for this evaluation, and much of the information below is based on his comments. While his comments do not represent an “official” or “written” response from DC WASA regarding this alternative, his comments are based on a high level of knowledge regarding the capabilities of the Blue Plains facility.

The average quantity of Washington Aqueduct water treatment residuals (32.6 dry tons/day) is about 10 percent of the amount of residuals generated at Blue Plains. In some respects, DC WASA might be able to absorb this load, if it was managed carefully within the confines of daily flow and loading peaks. However, the maximum weekly quantity of Washington Aqueduct residuals (168 tons/day) would represent 75 to 80 percent of the typical amount of residuals generated by Blue Plains. Blue Plains could not process this water treatment residual loading. As was noted with a discharge to the interceptor, a large volume of storage would need to provided (probably at Washington Aqueduct) to equalize the flow coming to Blue Plains.

Several issues would affect DC WASA’s capabilities and capacity to handle the water treatment residuals. Presumably, most of the residuals would be settled out in the primary clarifiers. However, performance of the primary clarifiers varies because the clarifiers are subjected to hydraulic shock loads resulting from variations in influent flow rates. Residuals that do not settle in the primary clarifiers would be passed on to the secondary treatment train. The residuals contain a high percentage of inert material that would not be beneficial to biological treatment operations. The inert material is not an energy source for the microorganisms used for biological treatment and would have to be settled out in the secondary clarifiers. Secondary clarification capacity is already a major treatment bottleneck at Blue Plains, so the higher loading associated with the water treatment residuals could further contribute to operational problems.

The residuals would ultimately be sent to the digesters for further processing, and then on to dewatering, irrespective of whether they are settled out in the primary or the secondary clarifiers. The inert content of the residuals would also be an issue for digester operation because anaerobic digestion is a biological process. Increased inert material would result in reduced volatile solids destruction—a key indicator of digester performance. DC WASA does not currently have digestion facilities for its own flow (the existing digesters have been taken out of service owing to age and performance problems). DC WASA is currently in the middle of a program to build eight new digesters that will be capable of producing a Class A digested product. However, the new digesters will not be online until about 2008.

Dewatering is the final step of the treatment process. DC WASA currently does not have any excess dewatering capacity that could be used for Washington Aqueduct residuals. However, it is possible that excess capacity will be available when the new digesters are completed in 2008. The schedule for confirming the availability of dewatering capacity at Blue Plains is no sooner than mid-2005.

Reliability and Redundancy. As mentioned above, the unthickened residuals would have a solids concentration of about 0.5 percent, on a dry solids basis. The resulting volume of residuals (in gallons) would be about four times greater than that of the same dry weight of residuals thickened to 2 percent. This volume could have an impact on the reliability and redundancy of the Potomac Interceptor, due to its limited capacity to carry peak flows. There would also be an impact on treatment facilities at both the Washington Aqueduct and the Blue Plains WWTP.

An onsite thickening facility would be of benefit to Washington Aqueduct as a means of providing control for the solids-collection processes to provide a more consistent residuals product for dewatering. The thickeners would also serve as an important location for temporarily holding solids should there be a downstream problem with the interceptor or at Blue Plains.

Based on the discussion above, it can be concluded that the DC WASA facilities at Blue Plains would have difficulty processing Washington Aqueduct's residuals with the incoming sewage due to the high solids loading of the residuals, the variability in the both Washington Aqueduct residuals and DC WASA raw sewage flows, and ongoing process and equipment issues at Blue Plains. These difficulties could impact the ability of the receiving facility to achieve its permit limits.

Economic Considerations. The economic impact of discharging Washington Aqueduct's residuals into the Potomac Interceptor was not calculated. However, the cost would likely be considerable. Additional flow into the Potomac Interceptor would exacerbate the existing DC WASA CSO problem. The Combined Sewer System Long Term Control Plan has identified $250 million in improvements to solve the existing problems in Potomac River portion of the conveyance system, including the rehabilitation of the Potomac Pumping Station, the consolidation of CSOs in the Georgetown waterfront area, and the construction of a 58-million-gallon Potomac Storage Tunnel. While DC WASA is actively working on this program, the Long Term Control Plan is so extensive that the implementation period has been identified as having a duration of 15 to 40 years.

At the Blue Plains facility, impacts were identified for most of the major treatment processes:

- Primary clarification
- Biological treatment and secondary clarification
- Anaerobic digestion
- Dewatering

Because of the number of processes impacted, and the complexities of the programs that are currently underway to address treatment and capacity issues at the plant, a detailed cost estimate for the impact of the discharge of residuals to Blue Plains through the Potomac Interceptor was not developed for this evaluation. Using a conservative estimate of $5 to $10 to construct a gallon of treatment capacity (assuming that biological treatment can be excluded), and assuming that treatment capacity for at least an additional 4 mgd would be required (the approximate difference between Washington Aqueduct average and peak flows), than it could be assumed that an impact of between $20 million to $40 million could be established. This impact would not include the cost of residuals collection and thickening facilities at the Washington Aqueduct. In addition, Washington Aqueduct would need to provide extensive storage and flow equalization facilities to help address minimize the impact of residual flows on the existing CSO situation and on treatment processes at Blue Plains. Since these costs are at least equal to the costs of providing processing facilities at the Washington Aqueduct, this option can be eliminated based on economic considerations.

Zoning, Land Use, Institutional Constraints, and other Federal and Local Regulations. The discharge of water treatment residuals to the Blue Plains WWTP via sewer would have major impacts on the treatment processes at the receiving facility. In many communities, the discharge of water treatment residuals to the sewer system is a common practice. However, the representative of DC WASA that was contacted for this evaluation indicated that operations staff already have difficulties adjusting treatment processes to accommodate the current highly variable flow and load conditions. Therefore, discharge to the sewer system is not feasible at this facility.

Previous work conducted by Whitman Requardt & Associates evaluated this option in detail. As part of the previous effort, the District of Columbia Department of Public Works (the entity that operated Blue Plains before the creation of DC WASA) stated that this alternative was not acceptable to their agency. In response to a more recent request by another jurisdiction for the discharge of biosolids into the Potomac Interceptor, DC WASA cited Section 4, Paragraph 3 of District of Columbia Order No 64-1680 (Regulations for use of the Potomac Interceptor), which prohibits “sludges or other materials from sewage or industrial waste treatment plants or from water treatment plants” from being discharged to the District of Columbia sewer system.

Therefore, Alternative 4 can be eliminated from further consideration as inconsistent with this screening criteria, based on discussions with DC WASA, and on past responses to requests of this nature.

3.2.3.2 Summary

Alternative 4 was described in detail in the preceding paragraphs. As noted above, this alternative was eliminated from further consideration because it is inconsistent with the screening criteria for “Reliability and Redundancy,” “Economic Considerations,” and “Zoning, Land Use, Institutional Constraints, and other Federal and Local Regulations.”

3.2.4 Alternative 5

Thicken water treatment residuals at Dalecarlia WTP, then pump via a new pipeline to DC WASA Blue Plains Wastewater Treatment Plant; process Forebay residuals by current methods and periodically haul

As Alternative 5 was originally envisioned, Washington Aqueduct residuals would be discharged directly to the Potomac Interceptor for conveyance to Blue Plains. The residuals would be coprocessed with the incoming sewage. Alternative 5 specifically states that thickened residuals would be conveyed to Blue Plains. Alternative 4 is similar, however, unthickened residuals would be sent to Blue Plains for that alternative. The thickened residuals would be conveyed at a dry solids content of approximately 2.0 percent, resulting in much less flow that the unthickened residuals in Alternative 4. Table 3-3 summarizes the residuals quantities used for the evaluation.

TABLE 3-3
Residuals Quantities for Alternative 5

	11-Year Annual Average			Wet Year		
	Annual Average	**Max Month**	**Max Week**	**Annual Average**	**Max Month**	**Max Week**
Dry lbs/day	65,220	106,524	191,935	86,179	144,335	336,078
Dry tons/day	33	53	96	43	72	168
Gallons/day (2.0% dry solids)	389,800	638,300	1,150,700	516,700	865,300	2,014,800

Note: Forebay residuals are not included above.

While a much reduced volume of residuals would be discharged to Blue Plains under Alternative 5, this alternative suffers from the same problems as Alternative 4 (impacts on the interceptor system and the Blue Plains WWTP, potential discharge to the Potomac River through CSOs, etc.). Therefore, this option would also need to be eliminated under the screening criteria used for this evaluation.

An alternative approach that might make conveyance of residuals to Blue Plains acceptable would be to provide a separate pipeline route to completely isolate the water treatment residuals from the sewage. The simplest approach would have a new, dual pipeline following the existing right-of-way for the Potomac Interceptor. This approach would eliminate the CSO concerns and allow the residuals to be bypassed around most of the treatment processes at Blue Plains (i.e., primary clarifiers, biological treatment and secondary clarifiers, digesters).

For this alternative, the residuals would be likely be blended into the Blue Plains biosolids flowstream after the anaerobic digestion process. Several options for processing the residuals could be envisioned:

- The residuals could be blended with the digested biosolids so that the two residuals streams could be dewatered together
- The residuals could be dewatered separately and then blended with the dewatered biosolids; an evaluation could be conducted to determine whether there was any benefit to blending the two residuals streams (i.e., a beneficial reuse residuals product could possibly be developed for a specialized purpose, such as mine reclamation, etc.)
- The residuals could be dewatered separately and disposed of separately

Because of the volume reduction and level of storage and control provided by thickeners, as well as the resulting decrease in required pipeline diameter, it is recommended that the residuals be thickened at the Dalecarlia WTP before being pumped to DC WASA for dewatering.

As modified per the above, Alternative 5 would now consist of the following major elements:

- Thicken water treatment residuals at the Dalecarlia WTP
- Pump via a new, dual pipeline (for redundancy) to Blue Plains
- Process Forebay residuals by current methods and periodically haul

The requirements for Alternative 5 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to Blue Plains via a new dual pipeline	Thicken collected residuals at Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to Blue Plains via a new dual pipeline	Thicken collected residuals at Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

3.2.4.1 Screening Evaluation

The most direct route to Blue Plains from the Washington Aqueduct would be to follow the existing right-of-way for the Potomac Interceptor. A second pipeline along this route would be feasible in concept. However, permitting and construction for this pipeline would be a major undertaking. Much of the route passes through government property administered by the National Park Service, and the route passes important monuments and through the Naval Research Laboratory and Bolling Air Force Base. The National Park Service does not allow unlimited access to the route and has very strict rules about activities on its property.

As noted above, the isolation of Washington Aqueduct's residuals flow stream from the incoming sewage would lessen the impact on treatment operations at Blue Plains, and would allow for greater flexibility and more options for the dewatering of the residuals. The impact of the residuals on dewatering operations at Blue Plains must still be evaluated.

DC WASA currently has seven centrifuges that are each capable of processing 50 dry tons/day. An ongoing project is underway to add seven more units for a total capacity of 500 dry tons/day (10 units in service and four units out of service). When the new digesters are completed in 2008, DC WASA may only need to operate half of it's installed dewatering capacity due to the greatly increased digester performance (i.e., volatile solids destruction) that is expected upon completion of this project.

To compensate for the current shortfall in biosolids processing capacity, DC WASA has contracted with an outside vendor (i.e., KF Environmental) to provide contract dewatering operations at a cost of $85/dry ton. Walt Bailey, of DC WASA, said that the firm is very reliable and cost effective because they are paid only according to the amount of biosolids they can process. They do not get paid if their equipment is out of service. Their operation is located outdoors, and they currently have seven belt filter presses (BFPs) and two centrifuges onsite. Walt Bailey mentioned that the Washington Aqueduct might want to consider a contract dewatering operation as part of an interim plan; particularly if it might help meet a regulatory deadline.

DC WASA is considering construction of a drying facility as part of another major ongoing project—the digester gas utilization project. The drying facility would also be capable of producing a Class A product. This project will be structured, in some manner, as a privatization project (i.e., design-build-operate, etc.), although plans for the project are not yet finalized. Biosolids that would go to the dryer would possibly not be digested in order to preserve the organic solids content of the biosolids. Consequently, DC WASA might not have the excess dewatering capacity mentioned above if a drying facility were added at Blue Plains.

Since DC WASA is in the midst of implementing a major program to reliably produce a Class A biosolids product, a careful evaluation would need to be conducted to determine whether the blending of DC WASA biosolids with the water treatment residuals would cause the dewatered DC WASA biosolids to lose its Class A rating. The Class A rating will be based on the use of an EPA-approved process (Temperature Phased Anaerobic Digestion). If the process were changed by blending with dewatered water treatment residuals, DC WASA might need to implement an extensive testing program to prove that the blended product still meets the Class A standards.

The impact of the water treatment residuals on the rating of the dewatered DC WASA biosolids would depend on the biological activity of the residuals (presumed to be slight) and the metals content of the residuals. There might also be a potential to create a customized product (for mine reclamation, etc.) by blending the residuals and the biosolids.

3.2.4.2 Summary

Alternative 5, as originally envisioned, would discharge Washington Aqueduct residuals to the Potomac Interceptor for conveyance to Blue Plains. This alternative is similar to Alternative 4, which was determined to be not feasible. Consequently, Alternative 5, as originally described, is not feasible.

A modification to Alternative 5 that would convey Washington Aqueduct residuals to Blue Plains for processing via a separate pipeline was developed and described above. The advantage of this alternative is that it would have less impact on the treatment operations at Blue Plains. In addition, it would have no impact on operation of the existing conveyance facilities. In principle, this alternative appears to be feasible. However, implementation of this option would involve a major permitting effort, which may ultimately limit the feasibility of this alternative, and be difficult to complete within the FFCA milestone schedule.

In addition, DC WASA's biosolids operations are currently undergoing major change as part of an ongoing improvement program. While various possibilities can be envisioned for the processing of Washington Aqueduct's residuals at Blue Plains, there is an extremely high level of uncertainty associated with any of these ideas due to the complexity of the biosolids improvements program and the current level of uncertainty and change associated with the biosolids operations at Blue Plains. A more detailed evaluation would be required before any conclusion can be reached on the potential for using existing or future facilities at Blue Plains.

For the purposes of this evaluation, it can only be assumed that additional facilities would need to be provided at Blue Plains. These facilities would essentially be the same dewatering facilities that would be provided at the Dalecarlia WTP under several of the other alternatives. Washington Aqueduct would then either need to staff these facilities, or develop a contract operations arrangement with DC WASA or a private contractor.

In summary, Alternative 5 (as modified herein) appears to be feasible, based on the screening criteria used for this evaluation. A more detailed evaluation will be conducted as part of the Draft Environmental Impact Statement to determine whether this alternative can be implemented.

3.2.5 Alternative 6

Thicken water treatment residuals at Dalecarlia WTP, then transport by barge to DC WASA Blue Plains Wastewater Treatment Plant; process Forebay residuals by current methods and periodically haul

This alternative eliminates truck traffic associated with residuals on the roads surrounding the Washington Aqueduct treatment facility by transporting residuals via barge to the Blue Plains WWTP for further processing and disposal. The use of barges would allow the water treatment residuals to be handled separately from the incoming wastewater. The residuals could either be processed with the Blue Plains biosolids or be processed separately.

A Technical Memorandum that describes the nautical aspects of this alternative in detail is included in Appendix B. This description of the alternative draws heavily on the Technical Memorandum. Nautical maps from the National Oceanic and Atmospheric Administration (NOAA), the U.S. Coast Pilot for the Potomac River, and discussions with representatives of regulatory agencies and marine contractors were consulted to prepare the memorandum.

The approximate distance along the Potomac River from the Washington Aqueduct to Blue Plains is 9.7 nautical miles (nm). There is an existing dock at the Blue Plains WWTP. It is not currently in regular use, and may require dredging, the construction of unloading facilities, and other improvements before it could be used on a regular basis for this purpose. There are no dock or barge loading facilities near the Washington Aqueduct or at Georgetown. Tourist boats currently travel upriver as far as the Key Bridge (approximately 3.2 nm below the Washington Aqueduct) before returning downstream. Consequently, this alternative would likely require construction of barge facilities at Georgetown. An alternative site would be further upriver near the Washington Aqueduct. To load the barges, pipelines would have to be routed to either Georgetown (along the Capital Crescent Bike Path or the C&O Canal) or directly to the shoreline below the Georgetown Reservoir.

To implement this alternative, residuals from the Dalecarlia sedimentation basins and the Georgetown Reservoir would be collected and thickened at the Dalecarlia WTP before being loaded onto barges on the Potomac River for transport to Blue Plains. To minimize the volume requiring transport, the residuals would be thickened to about 2 percent solids using gravity thickeners (see Table 3-3). Residuals from the Forebay would be processed separately for onsite disposal, as is currently practiced.

Once the residuals arrive at Blue Plains, they could either be pumped to existing solids-handling processes, or they could be handled through a completely separate system. This aspect of the operation would have to be negotiated with DC WASA. The need for the construction of new facilities at Blue Plains has not been determined, but would depend on how Blue Plains wanted to process the materials.

The requirements for Alternative 6 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Transport thickened residuals to Blue Plains by barge	Thicken collected residuals at Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Transport thickened residuals from Dalecarlia to Blue Plains by barge	Thicken collected residuals at the Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

Two alternate approaches to barging the materials were investigated. The first involved the use to two single hopper barges. Each barge would have a hopper volume of approximately 1,150,700 gallons and would be about 328 ft long, 52 ft wide, and have a 9-ft draft. Each barge would be capable of holding the maximum weekly volume of thickened residuals. The approach would allow one barge to be filled each day while the second barge was being emptied, based on a 5-day-per-week operating schedule. Discussions with maritime contractors indicated that it was not safe to handle barges of this size and weight in areas such as those along the proposed route, which have limited water depth and bridge clearances.

An alternative approach could use approximately eight smaller barges to transport the material. Each barge would be about 150 ft long, 40 ft wide, and have a 7-ft draft. These barges could carry approximately 295,000 gallons each and a liquid load weight of approximately 2.48 million pounds (1,250 tons). Barges of this type could safely navigate the channel between Marbury Point at Blue Plains and the Key Bridge.

Other significant maritime-related issues that would affect the feasibility of this option include the following:

- Significant manpower and facility requirements would be required for loading, unloading, and transit of six barges in each 24-hour period, 5 days per week, along with the coordination and scheduling of the shipments.
- Locations in the river to safely stand-down one or more barges to allow opposing barge traffic to pass would have to be identified.
- Facilities at each end of the transit route would have to accommodate two to four barges for weekends and periods when environmental conditions or security issues make the river unnavigable for this operation.
- Alternate means of handling or storing the liquid residual would be required during periods when environmental conditions or security issues make the river unnavigable for this operation.

3.2.5.1 Screening Evaluation

As a result of this Feasibility Study, this alternative has been eliminated from further consideration based on the following screening factors:

- Reliability and redundancy
- Zoning, land use, institutional constraints, and other Federal and local regulations
- Proven methods

Reliability and Redundancy. The Potomac River is part of a large, but narrow watershed, which is subject to floods, swift currents caused by ice and snowmelts, tropical storms, and other phenomena associated with the weather. The channel above the Key Bridge is shallow, rocky, and particularly dangerous. It is currently negotiated only by small craft, such as canoes, kayaks, rowboats, and small fishing boats. Consequently, it would be impossible to bring barges beyond Georgetown without embarking on a significant dredging operation to widen and deepen the channel.

Barges traveling between Blue Plains and Georgetown would have to navigate eight individual bridges (the 14th Street Bridge Complex, the Memorial Bridge, and the Key Bridge). Detailed information on the bridges, as well as other navigational constraints are summarized below:

- Arlington Memorial Bridge: clear width of 80 ft with vertical clearance of 30 ft.
- The 14th St. Bridge Complex: clear width of 104 ft with vertical clearance of 18 ft above Mean High Water (MHW) resulting in maximum air draft of 14 to 16 ft for barge/pushboat operation.
- Obstructions (old stone bridge piers) at 10 ft below Mean Low Water (MLW) just north of Key Bridge.
- Minimum water depth of 10 ft below MLW resulting in maximum water draft of 7 ft for barge/pushboat operation.

- Transit distance of 6.5 nm with maximum speed of 5 knots for 4.1 nm from Key Bridge to Hains Point and 8 knots for 2.4 nm from Hains Point to the Blue Plains plant at Marbury Point.
- One-way transit time estimated to range from 1.5 to 2.5 hours for small barge/push boat operation making only 2.5 knots against the current.
- Average ebb and flood currents of approx. 0.6 knots from Key Bridge to Hains Pt. and up to 1 knot from Hains Point to Marbury Point.
- Transit above Key Bridge to the Washington Aqueduct facility, a distance of 3.2 nm, is currently unsafe for navigation for all but very limited recreational craft such as kayaks and canoes.

A barge operation to transport residuals between the Washington Aqueduct and the Blue Plains WWTP appears to pose a high and possibly unacceptable level of risk to reliability and redundancy due to navigational difficulties associated with the route. This risk is magnified by the number of barges per day, the volume of liquid that would be loaded on each barge, and the human element associated with operating, loading, unloading, and docking of the barges at two sites.

Zoning and Land Use. The Zoning Map for the District of Columbia (2003) shows all of the riverfront land above 37th Street as being government owned. Presumably, District of Columbia Zoning does not necessarily govern the use for this land. Most of this land is currently part of the Chesapeake & Ohio (C&O) Canal National Historic Park, which runs along the Potomac River for 184 miles from Cumberland, Maryland, to Georgetown. The park is administered by the National Park Service.

The park contains perpetual easements for utilities, and pipelines, conduit, tunnels, etc. However, the existing facilities are relatively unobtrusive in nature. Many, such as the Potomac Interceptor, were in existence before the park was created.

According to the General Plan for the park (1976), one of the purposes of the park is to "enjoy the recreational use of the canal, the parklands, and the Potomac River." The General Plan further states that two of the management objectives for the park are:

- Preserve the atmosphere of past times and enduring beauty and safeguard historic remains and features.
- Impart to visitors an understanding and appreciation of the historic way of life blended into the natural setting of the Potomac Valley.

With the exception of a small piece of land at Georgetown Harbour, which is designated to be for "Mixed Use," all of the land on the Potomac River waterfront is designated on the District of Columbia Generalized Land Use Map as "Parks, Recreation, and Open Space." These uses are fully compatible with the purposes and management objectives of the C&O National Historic Park described above.

More recently, the National Capital Planning Commission (NCPC) published a plan for the Georgetown Waterfront Park (1987). Some of the key features of the plan include the following:

- Create a passive public park along the river
- Create a shoreline promenade
- Maintain river views
- Provide limited docking for transient boats (east of Wisconsin Avenue)
- Establish boating area (nonmotorized)
- Acquire railroad right-of-way (Georgetown spur) for bike path
- Provide floating restaurant
- Preserve and interpret archeological resources
- Preserve the natural scenic values of the Palisades

The plan specifically states that development should end no further than 1,100 ft west of Key Bridge to preserve the natural appearance of the Palisades area of the shoreline.

The vision for the Georgetown Waterfront Park has been largely unrealized due to a lack of funding. However, the plan was recently affirmed by the NCPC in a report entitled *Washington's Waterfronts* (1999). Additional ideas discussed in this report include the establishment of a water taxi service to provide access to Georgetown and improvements to the Kennedy Center to provide a direct pedestrian connection to the river.

The industrial-scale barging operation that would be necessitated by this alternative is not compatible with current and proposed land uses or the purpose and objectives of the C&O National Historic Park, and the vision for future land uses in the area. If the route of the barging operation were to extend beyond the Key Bridge, the barging operation would have major impacts on the park and its operation.

Proven Methods. The barging operation would also violate the "Proven Methods" screening criterion. While there is commercial maritime traffic in Washington Harbor, there is no existing barging operation, per se, in the Georgetown Channel, or in the Washington Harbor. Washington does not have a "modern era" maritime tradition, such as that of other large cities where barging operations can be seen (e.g., Boston, New York, Baltimore, Pittsburgh, or Norfolk).

To initiate such an operation would involve a major commitment of planning, permitting, engineering, and financial resources. In addition, the risks associated with the reliability and redundancy of such an operation are clear. Consequently, the concept is "unproven."

3.2.5.2 Summary

Alternative 6 (barging residuals to the Blue Plains WWTP) was described in detail in the preceding paragraphs. As noted above, this alternative can be eliminated from further consideration because it is inconsistent with the screening criteria for "Reliability and Redundancy," "Zoning, Land Use, Institutional Constraints, and Other Federal and Local Regulations," and "Proven Methods."

3.2.6 Alternative 7

Thicken water treatment residuals at Dalecarlia WTP, then pump via pipeline to neighboring water utility; process Forebay residuals by current methods and periodically haul

Residuals from the Dalecarlia sedimentation basins and the Georgetown Reservoir would be collected and thickened at the Dalecarlia WTP before being conveyed to either the Washington Suburban Sanitary Commission's Potomac Water Filtration Plant (WFP) or to Fairfax County Water Authority's Corbalis WTP. As with most other alternatives, the residuals would be thickened to approximately 2 percent dry solids before being conveyed to the offsite facility. Forebay residuals would be processed onsite in accordance with to current methods, and periodically hauled offsite for disposal.

The requirements for Alternative 7 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to WSSC or FCWA facility	Thicken collected residuals at Dalecarlia Dewater thickened residuals at WSSC or FCWA	Dispose of dewatered residuals with residuals from host facility
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Pump thickened residuals from Dalecarlia to WSSC or FCWA facility	Thicken collected residuals at Dalecarlia Dewater thickened residuals at WSSC or FCWA	Dispose of dewatered residuals with residuals from host facility
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

Preliminary routes for pipelines to both the WSSC Potomac WFP and the FCWA Corbalis WTP were developed for the screening evaluation. The Potomac WFP is located on the Potomac River approximately 12.5 miles upstream from the Dalecarlia WTP. A pipeline could be routed between these two plants by using either (1) existing roadways, or (2) the C&O Canal. An alignment along existing roadways is not desirable due to the extensive number of easements that would be required along the pipeline route. In addition, the only reasonably direct route consists mostly of major roadways, such as River Road. Construction in major roadways can involve significant permitting issues, would be very expensive, and causes additional inconvenience to businesses and residents.

An alignment along the C&O Canal is also potentially challenging. The property is government owned, but an easement would be required from the National Park Service, which administers the park. Environmental permitting would likely be very complex. The route is not entirely direct, but overall this is expected to be the most feasible route.

The Corbalis WTP is in Herndon, Virginia. A review of pipeline routes leads to a similar conclusion as for the Potomac Plant. The route chosen follows the Canal as described above and crosses the Potomac near the location of the Corbalis Plant's intake. From there the new pipe would be built within the easement for the intake pipe. The route would be approximately 22.5 miles with a 0.6-mile river crossing.

3.2.6.1 Screening Evaluation

As a result of this Feasibility Study, this alternative has been eliminated from further consideration based on the following screening factors:

- Economic considerations
- Zoning, land use, institutional constraints, and other Federal and local regulations

Economic Considerations. Order-of-magnitude cost estimates for routing the pipelines according to the preliminary pipeline routes along the C&O Canal to each optional destination were developed. The pipelines would be sized for the maximum weekly flow (1.15 mgd). To provide an appropriate level of reliability and redundancy, it was assumed that two pipelines would be provided. High-density polyethylene (HDPE) was assumed for the pipeline material. In an attempt to provide an affordable project, two approaches to sizing the pipelines were evaluated. The first approach would provide 100 percent redundancy (i.e., each pipeline would be sized for the entire maximum weekly flow). An alternate approach would provide two pipelines that were each sized for 50 percent of the maximum weekly flow.

For the route to the WSSC Potomac WFP, two 12-in. pipelines and one booster pump station would be needed for the 100 percent redundancy alternative. The order-of-magnitude cost for this pipeline would be approximately $15.7 million. For the 50 percent redundancy alternative, two 8-in. pipelines and two booster pump stations would be required. The order-of-magnitude cost for this alternative would be approximately $8.5 million. For either design approach, the cost is less than the screening criteria requirement that would eliminate this option based on cost (i.e., 30 percent of the $50 million budget).

For the route to the FCWA Corbalis WTP, two 12-in. pipelines and one booster pump station were be needed for the 100 percent redundancy alternative. The order-of-magnitude cost estimate for this pipeline is $26.1 million. For the 50 percent redundancy option, two 10-in. pipelines and one booster pump station would be required. The order-of-magnitude cost estimate for this pipeline is $18 million. The cost estimates for both options are greater than the screening criteria for cost (i.e., 30 percent of the $50 million budget). Therefore, this option can be eliminated based on cost.

Land Use, Zoning, Institutional Constraints, and Other Federal and Local Regulations. Washington Aqueduct has contacted officials at both WSSC and FCWA. Washington Aqueduct was told that it's residuals could not be processed at either the WSSC Potomac WFP or at the FCWA Corbalis Plant. In general, it is not part of the "mission" for either facility to process residuals from another jurisdiction, or become a regional facility. Consequently, this alternative must be eliminated as inconsistent with the "Institutional Constraints" screening criteria.

3.2.6.2 Summary

Alternative 7 was eliminated from further study as inconsistent with the screening criteria for "Economic Considerations" (for the FCWA alternative) and "Land Use, Zoning, Institutional Constraints, and Other Federal and Local Regulations" (both locations).

3.2.7 Alternative 8

Thicken water treatment residuals at Dalecarlia WTP and pump via pipeline to new dewatering location; process Forebay residuals by current methods and periodically haul

Water treatment residuals from the Dalecarlia sedimentation basins and the Georgetown Reservoir would be collected and thickened at the Dalecarlia WTP before being conveyed by a pipeline to a new residuals treatment facility in the D.C. Metro area. To minimize the volume of residuals requiring conveyance, the residuals would be thickened to a concentration of about 2 percent dry solids before conveyance. Forebay residuals would continue to be processed according to current methods.

The requirements for Alternative 8 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from the existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to new offsite dewatering facility	Thicken the collected residuals at Dalecarlia Dewater the thickened residuals at offsite facility	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Pump thickened residuals from Dalecarlia to a new dewatering facility	Thicken collected residuals at Dalecarlia facility Dewater the thickened residuals at offsite facility	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

Approximately 10 acres will be required for the offsite facility, although it may be possible to configure the facility into a smaller space. The location for the new facility would attempt to minimize the distance of the pipeline as well as the need for hauling by truck on local roads. A location close to Dalecarlia would accomplish the former, and a location near a major highway would accomplish the latter.

One important factor in the development of this alternative is that a pipeline alignment within existing rights of way may not be desirable due to the extensive number of easements that would be required along the pipeline route. In addition, the only reasonably direct routes consist mostly of major roadways. Construction within major roadways requires significant additional permitting efforts, is more expensive, is an inconvenience to residents and businesses, and would take more time to permit, design, and construct.

Therefore, cross-country routes were considered. Two options include the C&O Canal and the Capital Crescent Trail. These alignments also pose difficulties. Easements would be required from the National Park Service and other entities. In the case of the C&O Canal, environmental permitting would likely be more complex. Despite these potential difficulties, these were considered to be two of the more feasible routes.

Available land suitable for construction of a new dewatering facility is extremely scarce in the area. A review of nonresidential (commercial and industrial) land values in the Bethesda and Silver Spring areas along the Capital Crescent Trail indicates current values of at least $1 million per acre. Industrial land is available in more distant locations, such as Chantilly, Springfield, or Woodbridge, Virginia. However, these communities are at least 20 miles from the Dalecarlia WTP, and the cost to construct a pipeline to these areas would be prohibitive, as was found in the evaluation of the cost for a pipeline to the Corbalis WTP, as described above for Alternative 7.

Alternatives to industrial land acquisition are also possibilities. The David Taylor Model Basin (U.S. Naval Reservation) is located approximately five miles upstream on the C&O Canal. However, due to ongoing projects at that site, acreage is likely not available for this project.

3.2.7.1 Screening Evaluation

As a result of this Feasibility Study, this alternative has been eliminated from further consideration based on the following screening factors:

- FFCA schedule requirements
- Economic considerations

FFCA. This alternative would violate the FFCA screening criteria because of the additional time required to identify and obtain a site for the new residuals treatment facility and a route for the pipeline to convey the residuals to the new facility. To initiate such an effort would involve a major commitment of planning, permitting, engineering, and financial resources. The project would be unable to meet the FFCA schedule, which is summarized below

- May 28, 2004: The Corps shall complete an alternatives evaluation and a disposal study. The purpose of the alternatives evaluation and disposal study shall be to identify a range of engineering and/or best management practices to achieve compliance with the numeric discharge limitations set forth in the NPDES permit.

- December 20, 2004: The Corps shall complete and submit to EPA an analysis of engineering and/or best management practices. This may be a draft EA or a draft EIS.

- June 3, 2005: The Corps shall identify in a notice to EPA the engineering/BMPs it will implement to achieve compliance with the NPDES Permit and a schedule for implementing the identified engineering/BMPs as expeditiously as practicable, consistent with best engineering judgement.

- March 1, 2008: The Corps shall exercise best efforts, consistent with best engineering judgement, to achieve compliance with the numeric discharge limitations set forth in the NPDES permit at one or more of the sedimentation basins.
- December 30, 2009: Achieve full compliance with the numeric discharge limitations at all basins.

The elements of this alternative which jeopardize the ability to meet the FFCA schedule are identifying and obtaining a site for the new residuals treatment facility, as well as the pipeline route from Dalecarlia to the new facility. The evaluation process would involve the steps outlined in Table 3-4:

TABLE 3-4
Site and Route Evaluation for Alternative 8

Action	Time Required
1. Develop investigation process, including methods of public input	1 month
2. Determine site search area	1 month
3. Develop initial screening criteria for site selection, such as: – Size – Proximity to highways – Pipeline routes – Ownership issues – Permittability – Zoning	1 month
4. Collect baseline information on sites and routes within the site search area	2 months
5. Identify potential sites and routes	1 month
6. Develop detailed screening criteria	1 month
7. Screen potential sites based on detailed screening criteria to obtain a reasonable range of alternatives	1 month
8. Develop conceptual designs, impact evaluation, force main routing, and cost estimates for the alternatives.	2 months
9. Select site and force main route	1 month
10. Incorporate into overall alternatives evaluation and draft EIS	1 month
Total time required	**12 months**

Because of the nature and content of the EIS, it would not be possible to conduct the site and route evaluation process concurrently with the preparation of the EIS. Even if the offsite evaluation outlined in Table 3-4 were fast-tracked and completed in 8 months instead of 12, the impact on the overall EIS process would be dramatic. The current schedule calls for the overall alternatives analysis to be submitted to EPA in October 2004, while an 8-month offsite evaluation cannot be completed before the end of November. This would preclude the ability of the Corps to meet the December 20, 2004, deadline.

The implementation schedule for this alternative would also jeopardize the goal of reaching the March 1, 2008, deadline. Obtaining the selected site (whether by purchase or by lease) and confirming approvals and easements for the selected force main route could easily add three to twelve months to the implementation process, during which additional planning, permitting, and design work could be advanced only with increased risk.

Economic Considerations. Cost estimates for routing a pipeline to the offsite location were developed using the same approach as that used for Alternative 7. The pipeline would be sized for the maximum weekly flow (1.15 mgd). To provide an appropriate level of reliability and redundancy, it was assumed that two pipelines would be provided. HDPE was assumed to be the pipeline material. In an attempt to provide an affordable project, two approaches to sizing the pipelines were evaluated. The first approach would provide 100 percent redundancy (i.e., each pipeline would be sized for the entire maximum weekly flow). An alternate approach would provide two pipelines that were each sized for 50 percent of the maximum weekly flow.

For the route to the offsite location, a 10-mile distance was assumed. As mentioned above, this would allow the pipeline to be built either along the C&O Canal or along the Capital Crescent Trail. A particular location for the offsite dewatering facility was not identified for this evaluation, but these two routes would allow the pipeline to end near the beltway to the west and to the north. Two 12-in. pipelines and one booster pump station would be needed for the 100 percent redundancy alternative. The order-of-magnitude cost for this pipeline would be approximately $29.5 million, including $10 million for land purchase costs. For the 50 percent redundancy alternative, two 8-in. pipelines and two booster pump stations would be required. The order-of-magnitude cost for this alternative would be approximately $25.5 million, including the cost to purchase the land.

For either design approach, the cost is inconsistent with the screening criteria requirement that would eliminate this option based on cost (i.e., 30 percent of the $50 million budget for additional facilities beyond residuals collection, thickening, and dewatering).

3.2.7.2 Summary

Alternative 8 was described in the preceding paragraphs. As noted above, this alternative can be eliminated from further consideration because it is inconsistent with the screening criteria for the “FFCA” and “Economic Considerations.”

3.3 Alternatives with a Discharge to the Potomac River (Alternatives 9–11)

3.3.1 Alternative 9

Process most WTP residuals at Dalecarlia WTP and haul offsite, but dilute some residuals for discharge back to Potomac River; process Forebay residuals by current methods and periodically haul

In order to discharge in accordance with the NPDES permit, dilution water will need to be added to the water treatment residuals collected from the sedimentation basins since the water treatment residuals total suspended solids (TSS) concentration will be much greater than the 30 mg/L TSS concentration allowed in the permit. Only discharge water from the Dalecarlia Reservoir can be used for dilution water because the TSS concentration in the raw water from the river frequently exceeds the concentration of TSS allowed by the permit. The concentration of the Dalecarlia Reservoir discharge water ranges from about 16 mg/L to 316 mg/L, depending upon the weather conditions, with an annual concentration average of 16 to 25 mg/L. Thus, even the water from the reservoir cannot be used for dilution under many situations.

The requirements for Alternative 9 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump portion of residuals to Dalecarlia thickening facility Pump portion of residuals to Dalecarlia storage and dilution facility (10% assumed)	Thicken and dewater portion of collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location Discharge diluted residuals to Potomac River
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals from Dalecarlia to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia WTP thickening facility	Thicken and dewater collected residuals at Dalecarlia thickening facility	Haul dewatered residuals to offsite disposal facility every 7 years

To determine whether this alternative is feasible, the amount of dilution water potentially needed was calculated, assuming that the average concentration of TSS in water at the discharge end of Dalecarlia Reservoir was approximately 16 mg/L. It is important to note that the concentration is greater than 16 mg/L most of the time, and much greater during the maximum week, month, or day for the year.

For purposes of this calculation, it is assumed that only 10 percent of the total volume of residuals will be diluted and discharged to the Potomac River. The remainder of the residuals would be processed onsite and hauled offsite for disposal. With this assumption, the minimum amount of water that would need to be added to dilute 10 percent of the solids generated on an average day is 53 million gallons per day, or approximately 23 percent of the 230-mgd annual average design-year production capacity of the plant.

3.3.1.1 Screening Evaluation

As a result of this Feasibility Study, this alternative has been eliminated from further consideration as inconsistent with the following screening factors:

- Reliability and redundancy
- NPDES permit

Reliability and Redundancy. Because the TSS concentration of the reservoir discharge water is too high to use as dilution water for much of the time, this approach could not be used on a daily basis. A potentially significant volume of residuals storage (i.e., several days worth) would need to be provided to make this approach feasible.

Essentially, the use of Dalecarlia Reservoir water for the dilution of water treatment residuals reduces the potential production capacity of the facilities. Water that is used for dilution cannot be used to produce potable water. In addition, Washington Aqueduct would eventually need to remove the additional accumulation of silt that would occur in the Forebay and reservoir as a result of this operation.

NPDES Permit. The purpose of this project is to reduce or eliminate the discharge of water treatment residuals from Washington Aqueduct to the Potomac River, and that purpose will not be met by discharging residuals to the river, even if it is only a portion of the residuals and they are diluted.

3.3.1.2 Summary

Alternative 9, river discharge per permit, can be eliminated because the dilution approach is inconsistent with the reliability and redundancy screening criteria due to the variable water quality in the river and the reservoir. This approach is also not in accordance with the purpose and need of the project, as embodied in the NPDES permit.

3.3.2 Alternative 10

Renegotiate NPDES Permit to allow discharge of all residuals to Potomac River

Alternative 10 involves the renegotiation of the NPDES permit limits, to allow constituents such as TSS and aluminum to be discharged at higher discharge concentrations than are allowable by the current permit. The result could potentially reduce the amount of residuals Washington Aqueduct has to process. The permit, however, is final, and an agreement has been reached (the FFCA) defining an implementation period. Several years of negotiation were involved in finalizing the permit and developing the FFCA. It is not possible to negotiate the permit again. Thus, Alternative 10 is not viable. Even if Washington Aqueduct attempted to negotiate a new permit, the project would most likely not meet the agreed-upon FFCA schedule.

The requirements for Alternative 10 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Renegotiate NPDES Permit to discharge all water treatment residuals to the Potomac River			
Georgetown Reservoir	Renegotiate NPDES Permit to discharge all water treatment residuals to the Potomac River			
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia WTP thickening facility	Thicken and dewater collected residuals at Dalecarlia thickening facility	Haul dewatered residuals to offsite disposal facility every 7 years

3.3.3 Alternative 11

Process water treatment residuals at Dalecarlia WTP and haul offsite; process Forebay residuals by current methods and periodically haul; dilute treatment side streams and discharge to the Potomac River

This alternative includes the same residuals processing facilities that are included in many of the alternatives discussed in this Feasibility Study (i.e., thickening, dewatering, etc.), with the exception that the liquid waste stream from the dewatering processes would be discharged to the Potomac River.

As with Alternative 9, the TSS concentration of the discharge stream must be compared to the NPDES permit to determine whether the liquid waste can be directly discharged. Centrifuges or belt filter presses will likely be used to dewater the residuals. Based on a mass balance for the residuals flows, developed using typical solids capture design criteria, the TSS concentration in the liquid waste from the thickeners and centrifuges is predicted to be at or below approximately 260 mg/L and 860 mg/L, respectively. Both concentrations are well above the 30-mg/L limit allowed in the permit. Therefore, dilution is required to make this alternative feasible.

As with Alternative 9, only discharge water from the Dalecarlia Reservoir can be used as dilution water because the river water has a highly variable TSS concentration. If the residuals from the thickeners and centrifuges were combined into one waste stream, a minimum 40 mgd of reservoir water would need to be added as dilution water to allow the residuals to be discharged to the river under the best-case reservoir discharge conditions. This flow would be equivalent to 18 percent of the annual average design-year production capacity of the plant. Higher dilution water flow rates would be required during peak residual production periods. As with Alternative 9, clean reservoir water would need to be stored to provide dilution water during maximum-day, -month, or -week (i.e., high-TSS) events.

The requirements for Alternative 11 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump Thickener overflow and centrate to onsite storage and dilution facility	Thicken and dewater portion of collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location Discharge diluted thickener overflow and centrate to Potomac River
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals from Dalecarlia to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

3.3.3.1 Screening Evaluation

As a result of this Feasibility Study, this alternative has been eliminated from further consideration based on the following screening factors:

- Reliability and Redundancy
- NPDES Permit

Reliability and Redundancy. The TSS concentration of the reservoir is highly variable, and cannot be reliably used as dilution water. Consequently, this option is not feasible, and inconsistent with the reliability and redundancy criteria. The Washington Aqueduct would need to use a significant portion of its potential production capacity for the dilution operation, reducing the overall reliability of its drinking water production capability.

NPDES Permit. The purpose of this project is to reduce or eliminate the discharge of water treatment residuals from Washington Aqueduct to the Potomac River, and that purpose would not be met by discharging residuals to the river, even if it is only a portion of the residuals.

3.3.3.2 Summary

Alternative 11, processing of residuals at the Dalecarlia WTP with a liquid discharge of residuals sidestreams to the Potomac River is inconsistent with the "Reliability and Redundancy" and "NPDES Permit" screening criteria. This alternative can be eliminated as unreliable due to the variable quality of the river water. In addition, Dalecarlia Reservoir water that used for the dilution of residuals would reduce Washington Aqueduct's overall reliability by reducing its potential to produce water.

In addition, this approach would not meet the purpose and need of the project and the intent of the NPDES Permit, which is to eliminate discharges to the Potomac River.

3.4 Alternatives Involving the Dalecarlia Reservoir (Alternatives 12–15)

The four alternatives discussed in this section all use the Dalecarlia Reservoir in some manner, either as a location for the storage of WTP residuals, a location for treatment facilities, or as part of a treatment process.

3.4.1 Alternative 12

Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP; coprocess Forebay and water treatment residuals; dispose in Dalecarlia and McMillan monofills

This alternative converts Dalecarlia Reservoir into a storage basin for residuals. The stored residuals, including those from the Forebay, would then be thickened and dewatered at the Dalecarlia WTP, and disposed of at monofills on Washington Aqueduct property at the Dalecarlia and McMillan WTPs.

The requirements for Alternative 12 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia facility	Haul dewatered residuals to monofills on Dalecarlia and McMillan sites
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to monofills on Dalecarlia and McMillan sites
McMillan WTP				Haul dewatered residuals to monofill on the McMillan site
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia facility	Haul dewatered residuals to Dalecarlia and McMillan monofills

3.4.2 Alternative 13

Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP; coprocess Forebay and water treatment residuals and haul to offsite disposal

As with Alternative 12, Alternative 13 involves the storage of residuals in the Dalecarlia Reservoir and the coprocessing of Forebay and water treatment residuals at the Dalecarlia WTP. However, disposal of residuals in this alternative is done via contract hauling from Dalecarlia WTP. In Alternative 12, the processed residuals would be disposed of in monofills at both the Dalecarlia and McMillan WTPs.

The requirements for Alternative 13 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia facility	Haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location

3.4.3 Alternative 14

Construct new sedimentation basins at the Dalecarlia Reservoir and process all residuals at Dalecarlia WTP; coprocess Forebay and water treatment residuals and haul to offsite disposal

Alternative 14 involves the construction of new sedimentation basins within the Dalecarlia Reservoir and the coprocessing of Forebay and water treatment residuals at the Dalecarlia WTP. This would allow the Georgetown Reservoir to be abandoned, or used strictly as a backup facility. The residuals would then be disposed of via contract hauling.

The requirements for Alternative 14 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from new sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Abandon Georgetown Reservoir; all coagulation to occur at Dalecarlia			
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location

3.4.4 Alternative 15

Coagulate all flow in the Dalecarlia Reservoir and process all residuals at the Dalecarlia WTP; coprocess Forebay and water treatment residuals and haul to offsite disposal

For this alternative, coagulation chemicals would be added directly to the Dalecarlia Reservoir. The reservoir would be dredged on a regular basis and the residuals would be coprocessed with the Forebay residuals at the Dalecarlia WTP. The residuals would then be disposed of via contract hauling to an offsite location.

The requirements for Alternative 15 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Add Coagulant at Dalecarlia Booster Station; Coagulate in the Dalecarlia Reservoir Dredge the Dalecarlia Reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Abandon Georgetown Reservoir; all coagulation to occur at Dalecarlia			
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location

3.4.5 Screening Evaluation of Alternatives 12–15

Each of these alternatives includes the coprocessing of Forebay residuals with water treatment residuals. As discussed previously, this approach has been eliminated from further consideration as inconsistent with the “Reliability and Redundancy” screening criteria.

In addition, these alternatives all make some use of the Dalecarlia Reservoir, resulting in an additional loss of reliability in terms of storage volume and potentially in terms of water quality. The Dalecarlia Reservoir acts as a sedimentation basin to dampen the large swings in turbidity that occur in the Potomac River, stabilizing the quality of the water to be treated by the Dalecarlia and McMillan WTPs. Without the reservoir to serve this purpose, more sediment will need to be removed by the sedimentation basins within the plant. Chemical doses and treatment requirements will also be much more irregular, resulting in significant impacts to the operations and maintenance costs of the plant.

Alternative 15 will impact maintenance costs more than the other three alternatives as the addition of coagulant at the beginning of the reservoir will require additional dredging of the reservoir. This will stir up settled material in the reservoir, degrade water quality, and impact downstream treatment processes within the plant.

3.5 Alternatives with Facilities at the McMillan WTP (Alternatives 16–23)

Eight alternatives were identified with residuals processing facilities at the McMillan WTP. The specifics of the alternatives differ widely. However, they all share a common element—a residuals pipeline would need to be installed within the Washington City Tunnel to convey residuals from the Dalecarlia WTP and Georgetown Reservoir sites to the McMillan WTP.

Since the residuals pipeline would have a critical bearing on the feasibility of these alternatives, the feasibility evaluation was based primarily on the feasibility of the pipeline. Each alternative is described briefly in the paragraphs below. The feasibility evaluation for the pipeline follows.

3.5.1 Alternative 16

Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer's treatment facility; contract haul dewatered residuals; process Forebay residuals by current methods and periodically haul

This alternative eliminates truck traffic associated with residuals on the roads surrounding the Washington Aqueduct facility by conveying water treatment residuals by pipeline to an existing facility for further processing and disposal.

Residuals from the Dalecarlia Sedimentation Basins and the Georgetown Reservoir would be collected and thickened at the McMillan WTP before being conveyed to an existing facility for further processing. Presumably, the existing facility would be owned and operated by an existing wholesale customer, such as the Blue Plains WWTP (owned by DC WASA) or the Arlington County Water Pollution Control Plant. The City of Falls Church , another Washington Aqueduct customer, does not have any existing facilities. Residuals from the Forebay would be processed separately for onsite disposal followed by periodic hauling offsite, as is currently practiced.

The requirements for Alternative 16 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan thickening facility Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan facility Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan thickening facility Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan facility Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
McMillan WTP	Collect combined Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan thickening facility Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul the dewatered residuals from host facility to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Contract haul dewatered residuals to offsite disposal facility every 7 years.

3.5.2 Alternative 17

Coprocess Forebay and water treatment residuals at the McMillan WTP and dispose of residuals via contract hauling from McMillan WTP

This alternative eliminates truck traffic associated with residuals on the roads surrounding the Washington Aqueduct facility by conveying all residuals by pipeline to an existing facility for further processing and disposal. Residuals from the Dalecarlia Sedimentation Basins, Georgetown Reservoir, and Forebay would be collected and conveyed to the McMillan WTP for thickening and dewatering. The dewatered residuals would then be hauled to an offsite location for disposal.

As described previously, coprocessing of Forebay residuals with water treatment residuals is not consistent with the screening criteria for reliability and redundancy and is not recommended. Therefore, Alternative 17 can be removed from further consideration.

The requirements for Alternative 17 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
McMillan WTP	N/A	Pump water treatment residuals from Dalecarlia WTP and Georgetown Reservoir to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect water treatment residuals from reservoir using current methods	Pump Forebay residuals to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location

Note: Alternative 17 is the same as Alternative 18 with coprocessing.

3.5.3 Alternative 18

Process water treatment residuals at the McMillan WTP and haul offsite; process Forebay residuals by current methods and periodically haul

This alternative eliminates truck traffic associated with residuals on the roads surrounding the Washington Aqueduct facility by conveying water treatment residuals by pipeline to the McMillan WTP thickening, dewatering, and disposal. Residuals from the Dalecarlia Sedimentation Basins and the Georgetown Reservoir would be collected and thickened and dewatered at the McMillan WTP. Residuals from the Forebay would be processed separately for onsite disposal and periodic hauling to an offsite location, as is currently practiced.

The requirements for Alternative 18 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
McMillan WTP	Collect Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years.

3.5.4 Alternative 19

Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer’s treatment facility; dispose of residuals via contract hauling from the existing facility; discharge Forebay residuals to the Potomac River

This option is similar to Alternative 16 because water treatment residuals would be conveyed to the McMillan WTP for thickening. The thickened residuals would then be conveyed to an existing wholesale customer’s facility (i.e., Blue Plains, Arlington, or Falls Church) for further processing. This alternative differs from Alternative 16 in the way by which the Forebay residuals are handled. Residuals from the Forebay would be discharged to the Potomac River for this alternative.

Because of the discharge to the Potomac River, this alternative can be eliminated from further consideration because it is inconsistent with the screening criteria for the “NPDES Permit,” which does not authorize residuals discharges to the river.

The requirements for Alternative 19 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
McMillan WTP	Collect Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Potomac River	None	None

3.5.5 Alternative 20

Thicken water treatment residuals at the Dalecarlia WTP and the Georgetown Reservoir and dewater at the McMillan WTP; dispose of water treatment residuals via contract hauling from McMillan WTP; process Forebay residuals by current methods and periodically haul

This alternative would provide thickening facilities at both the Dalecarlia WTP and the Georgetown Reservoir. The thickened residuals would then be pumped to the McMillan WTP for additional processing. Compared to the previously discussed McMillan alternatives, this alternative has the advantage of providing a "wide spot" to equalize residuals flow in the thickeners. It also reduces the volume of flow that would need to be pumped to the McMillan WTP, resulting in a corresponding decrease in pipeline diameter and cost.

The requirements for Alternative 20 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to McMillan dewatering facility	Thicken collected residuals at Dalecarlia facility Dewater thickened residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Georgetown thickening facility Pump thickened residuals to McMillan	Thicken collected residuals at Georgetown Dewater thickened residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
McMillan WTP	Collect thickened Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan	Dewater residuals at McMillan	Contract haul dewatered residuals to offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

3.5.6 Alternative 21

Store residuals in lagoons at the Forebay, Dalecarlia WTP, and McMillan WTP; thicken and dewater residuals with portable equipment and dispose via contract hauling from all locations

The requirements for Alternative 21 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia storage lagoon	Thicken and dewater collected residuals at Dalecarlia with portable equipment	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan storage lagoon	Thicken and dewater collected residuals at McMillan with portable equipment	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia storage lagoon	Thicken and dewater collected residuals at Dalecarlia with portable equipment	Contract haul dewatered residuals to a permitted offsite location

3.5.7 Alternative 22

Store water treatment residuals in Dalecarlia and Georgetown Reservoirs, prior to thickening and dewatering at the Dalecarlia and McMillan WTPs; dispose of water treatment residuals via contract hauling from the Dalecarlia and McMillan WTPs; process Forebay residuals by current methods and periodically haul

The requirements for Alternative 22 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Add coagulant at Dalecarlia Lift Station Collect water treatment residuals from existing sedimentation basins Dredge Dalecarlia Reservoir	Pump collected residuals to the Dalecarlia Reservoir Pump dredged residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan Reservoir	Thicken and dewater dredged residuals at McMillan facility	Contract haul dewatered residuals to a permitted offsite location
McMillan WTP	Dredge the McMillan Reservoir	Pump dredged residuals to the McMillan thickening facility	Thicken and dewater dredged residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years.

3.5.8 Alternative 23

Store water treatment residuals in McMillan Reservoir prior to dewatering at the McMillan WTP; dispose of water treatment residuals via contract hauling from the McMillan WTP; process Forebay residuals by current methods and periodically haul

The requirements for Alternative 23 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan Reservoir	Thicken and dewater dredged residuals at McMillan facility	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan Reservoir	Thicken and dewater dredged residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location

Location	Collection	Conveyance	Processing	Disposal
McMillan WTP	Dredge the McMillan Reservoir	Pump dredged residuals to the McMillan thickening facility	Thicken and dewater dredged residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

3.5.9 Washington City Tunnel and Alternatives 16–23

All of the alternatives that would locate thickening and/or dewatering facilities to be constructed at the McMillan WTP would require a pipeline to be installed within the Washington City Tunnel. The installation of this pipeline would be a major project, and as such, warrants some serious consideration. The feasibility of each of the McMillan WTP alternatives depends, in part, on the feasibility of the residuals pipeline installation. As with other alternatives involving the construction of offsite pipelines, surface construction is not feasible due to the cost and time needed to obtain easements and the cost and difficulty of construction in major urban streets.

The Washington City Tunnel conveys water from the Georgetown Reservoir to the McMillan WTP. The tunnel is approximately 21,000 ft long, and was built between the years of 1883 and 1901. The 12-ft-diameter entrance shaft at the west end is 65 ft deep, and the 12-ft-diameter shaft at the McMillan end is 165 ft deep. A booster pump is installed at the McMillan end of the tunnel. The pump propeller is located at a depth of about 100 ft.

The lowest elevation of the tunnel is 29.45 ft below the Washington Aqueduct datum, at the point where the tunnel passes below Rock Creek. A 48-in.-diameter tunnel blow off is installed at Rock Creek at Elevation 14.0.

At the center, the tunnel is approximately 9 ft tall. The tunnel is 9 ft, 10.5 in. wide. The volume of the tunnel, not considering the shafts, is approximately 11.4 million gallons. There are several airshafts along the length of the tunnel. Four of the airshafts have pipe diameters of about 6 in. However, the shafts at Rock Creek and Champlain Avenue are about 6 ft in diameter.

Generally, the tunnel is built in an inverted-**U** shape and is lined with three rings of brick on the sides and top, backed by rubble masonry fill. Some of the lower walls have rock lining. The section under Rock Creek is lined with iron. In 1908, cracks and bulges were found in one section of the tunnel that had been constructed with a lowered bottom invert. About 1,600 ft of this section were reinforced with steel jacks, placed from side to side in the tunnel. The jacks were later replaced with concrete jacks in 1928. Other sections may have been lined with concrete in the years following completion of the tunnel. According to Mays (1992), the tunnel was dewatered in 1910, 1927, 1945, and 1967. It may not have been dewatered for at least 25 years, according to Washington Aqueduct staff. The tunnel is dewatered infrequently due to the difficulty of dewatering the tunnel and the desire to keep the McMillan plant in operation.

Figure 3-2 provides an overview of the construction details for the tunnel.

3.5.9.1 Installation of a Residuals Pipeline within the City Tunnel

As noted above, the installation of a pipeline within the City Tunnel to convey WTP residuals to the McMillan WTP for processing would be a major project. The specifics of the pipeline installation are described in the paragraphs below.

To minimize the risk of pipe failure and the resulting negative outcomes, dual double-walled pipelines, consisting of a carrier pipe within a containment pipe are recommended for this installation. The dual pipelines would provide redundancy, and the containment piping would provide an additional measure of reliability. Several pre-engineered dual containment piping systems are available in the marketplace. HDPE dual-containment piping would likely be recommended for this application due to its durability, reliability, flexibility, and chemical resistance. Pipe joints are connected by butt fusion welding techniques. Welded joints are inherently more reliable than mechanical joints because the joints are as strong as the pipe itself. Mechanical joints have a higher probability of leaking due to installation failures, or pipe settlement.

To determine the feasibility of this application, representatives from two major HDPE piping manufacturers were contacted. The information provided below is largely based on discussions with these manufacturer's representatives. Both the internal pressure of the fluid being conveyed and the outside pressure of the material surrounding the pipe must be taken into consideration to properly design the pipeline. For the purposes of this evaluation, it was assumed that a carrier pipe dimensional ratio of 11 would be sufficient. This piping would be rated for a working pressure of approximately 160 psi.

Two advantages of HDPE piping are that it is relatively flexible and that it has a high tensile strength. To install HDPE piping in the field, individual sections of piping are often welded together in a staging area, or on the ground above a trench. The connected sections can then be pulled into place using a cable and winch assembly. This installation approach is generally much faster than installation by conventional methods. The approach could be adapted to install the pipelines in the tunnel, as described below.

Staging areas would likely be installed at each end of the tunnel. Individual sections of piping, in 20-, 40-, or 50-ft lengths would be lowered to the bottom of the shafts, where they would be butt-fusion welded to each other and pulled into the tunnel. If 20-ft lengths were used, approximately 1,050 welds would be needed for each pipeline over the 21,000-ft length of the tunnel. For piping of this size, approximately 2,000 to 3,000 ft of piping could be welded together and dragged as one unit. The butt-fusion-welding equipment would then have to be moved into the tunnel to connect the long sections into one continuous pipeline.

Self-propelled, gasoline powered fusion welding machines are normally used to connect the individual sections of HDPE piping. Because the tunnel would be a confined space, with little natural ventilation, the machines would need to be converted to electric power. Generators (located at the surface of the shafts and electric cabling would then be used to power the machines). The machines are relatively compact, and could be partially disassembled to move around obstructions, such as the concrete braces that were installed within the tunnel, if required.

Once the pipeline is installed, it will have to be held down to prevent flotation in the tunnel. Three methods are typically used: **U**-bolt pipe brackets, concrete collars or weights, and continuous concrete encasement of the piping. Due to the age and unknown condition of the tunnel, concrete collars or encasements would probably be recommended to fix the pipelines to the bottom of the tunnel.

Careful planning and logistics are the keys to success on projects of this sort. Specialty contractors who have experience with tunnels and the installation of HDPE piping have the highest probability of completing a project of this sort successfully. The exact schedule for completing the work would depend on the type, quality, and quantity of equipment and the methods used by the contractor. Contractor preselection, performance specifications, or design-build might be appropriate approaches to consider for this type of project.

One manufacturer's representative estimated that the entire project might take 9 to 12 months, depending factors such as the setup time required, the difficulty and amount of dewatering required, the logistics of working onsite and gaining access to the tunnel, the condition of the tunnel, the environmental conditions within the tunnel, and the time needed to complete the concrete work. A conservative estimate for the duration of the project is 24 months, about twice as long as the maximum duration estimated by the vendor. The actual duration is dependent on the factors described above and the number of resources (i.e., crews and shifts) that can be put to work at any one time.

3.5.9.2 Screening Evaluation

As a result of this Feasibility Study, all alternatives involving the installation of a pipeline in the City Tunnel have been eliminated from further consideration as inconsistent with the following screening factors:

- FFCA
- Reliability and Redundancy
- Economic Considerations
- Proven Methods

FFCA. The FFCA requires that one or more sedimentation basins must be in compliance with NPDES permit No. DC 0000019 by March 1, 2008, and full compliance must be achieved by December 30, 2009. The compliance schedule associated with the FFCA anticipates that a 3-year construction period will be needed to build the facilities required to fully comply with the NPDES permit, commencing in January, 2007.

Construction in the Washington City Tunnel would add a significant level of complexity, and a number of interdependencies, to the overall construction project because it would require that the Georgetown Reservoir and the McMillan WTP be out of service for the entire period of time that construction was occurring in the City Tunnel. During this time, all production would need to occur at the Dalecarlia WTP, and work on the four Dalecarlia sedimentation basins would likely need to be deferred (or be completed before the work in the tunnel could be started).

With a maximum total finished water capacity of 320 mgd (220 mgd for the Dalecarlia WTP and 100 mgd for the McMillan WTP), and a peak historical demand of 260 mgd during the summer months, capacity reduction during the peak season must be limited to 60 mgd to ensure that demand for finished water can be met. Since the estimated duration of construction for the pipeline in the tunnel is 12 to 24 months, then all production needs for the Washington Aqueduct system would need to be met at the Dalecarlia WTP for one to two thirds of the total 3-year construction schedule, and for one or two periods of heavy seasonal demand.

There may also be impacts on the distribution system from taking the McMillan WTP out of service for such a long period of time.

Reliability and Redundancy. Since the City Tunnel carries coagulated water to the McMillan WTP for filtration and disinfection, reliability and redundancy of the residuals pipeline installation are important considerations. Washington Aqueduct operations and maintenance staff place a high priority on ensuring that the tunnel remains in operation. The tunnel is the only means of providing the McMillan WTP with coagulated water. As the only such conduit, it is already somewhat of a risk to reliability. A failure of the residuals pipeline could result in both the contamination of a major portion of the water supply (i.e., 100 mgd of the system's filtration capacity is located at the McMillan WTP) and the inability to operate the residuals processing facilities located at the McMillan WTP.

While the use of double-walled pipe minimizes the potential for pipeline failure, and the installation of dual pipelines would allow one pipeline to be taken out of service, neither measure would minimize the impact of a pipeline (or tunnel) failure. Since the tunnel is rarely taken out of service, it would be extremely difficult to regularly inspect the residuals pipeline. Both manufacturers noted that instrumentation to monitor the annular space in the containment piping was notoriously unreliable.

Economic Considerations. As described above, the installation of a pipeline within the City Tunnel would be a major undertaking. Eight alternatives were identified that would convey residuals to the McMillan WTP for processing. The pipe diameter of the pipeline would vary, depending on the materials to be conveyed under each alternative. The most conservative approach would be to provide a completely redundant pipeline, so that one line could be taken out of service without also taking the residuals processing facilities out of service. This approach would result in somewhat larger pipeline diameter requirements and corresponding higher costs. Because residuals flows can vary significantly, pipelines sized for peak flow could suffer from problems due to low velocity during times of low flow.

A less conservative, but still acceptable approach, would be to size the pipelines for 50 percent redundancy. That is, two pipelines would be provided, but each would be optimally sized for only 50 percent of the peak flow. This approach will result in some cost savings and will minimize the potential problem of low velocity at low flows. Because of the 21,000-ft length of the tunnel, an aboveground installation would likely include a booster pump station to minimize the pumping pressure requirements. A booster pump station cannot be provided for this installation because of the inaccessibility of the pipeline.

Table 3-5 summarizes the estimated pipeline diameter for each of the McMillan alternatives and for each of the two design approaches.

TABLE 3-5
Preliminary Pipe Diameters for Carrier Pipe to Convey Water Treatment Residuals to the McMillan WTP

No.	Material Pumped	Max Flow (gpm)	100% Redundancy Diameter (in.)	50% Redundancy Diameter (in.)
16, 18, 19, 23	Unthickened Water Treatment Residuals Only	5,600	16	14
17	Water Treatment Residuals plus Forebay Residuals	NA	NA	NA
20	Thickened Water Treatment Residuals Only	1,400	12	10
21, 22	Unthickened Water Treatment Residuals from Georgetown Reservoir Only	700	8	6

Notes: Alternative 17 was eliminated from consideration as inconsistent with reliability and redundancy screening criteria. The coprocessing of Forebay residuals with water treatment residuals is not recommended.

For the purposes of this evaluation, cost estimates were developed for the two pipeline options for Alternative 20, which appears to be the most practical alternative of all those involving the McMillan WTP . For Alternative 20, the water treatment residuals would be thickened at the Dalecarlia WTP and Georgetown Reservoir sites before being pumped to the McMillan WTP for dewatering. The estimated carrier pipe diameters were 12 in. for the 100 percent redundant installation and 10 in. for the 50 percent redundant installation. The estimated cost for the dual containment pipelines were $22,208,000 and $18,761,000, respectively. These amounts represent 44 percent and 38 percent, respectively, of the total project budget of $50 million. The cost for both options is greater than 30 percent of the estimated project budget used in this evaluation as the economic screening criteria.

Due to the large financial investment that would be required to build a residuals pipeline in the City Tunnel, all alternatives involving the McMillan WTP can be eliminated based on economic considerations.

Proven Methods. The two HDPE piping manufacturers contacted felt that construction of a residuals pipeline within the City Tunnel was feasible. Given the fact, however, that the tunnel has not been dewatered for inspection in many years, the actual condition of the tunnel is currently unknown. Consequently, the feasibility of building such a pipeline is in question.

For this reason, and until a thorough inspection and evaluation of the condition of the tunnel is undertaken, all alternatives involving the construction of a pipeline within the City Tunnel should also be eliminated as inconsistent with the “proven methods” criteria. The risks associated with the reliability and redundancy of such an operation are clear, and the concept is “unproven.”

3.5.10 Summary

Alternatives 16 to 23 (Alternatives Involving the Construction of Facilities at the McMillan WTP) were described in detail in the preceding paragraphs. As noted above, each of these alternatives can be eliminated from further consideration because construction of a residuals pipeline within the City Tunnel are inconsistent with the screening criteria for Reliability and Redundancy, the FFCA, Economic Considerations, and Proven Methods.

In addition, Alternative 12 can be eliminated because there is no available space at the McMillan WTP to build a residuals monofill. Alternative 17 can also be eliminated because it involves the coprocessing of Forebay residuals with the water treatment residuals. This approach is not recommended due to reliability and redundancy concerns. Alternative 19 is also inconsistent with the screening criteria for the NPDES Permit.

3.6 Alternatives with Facilities at the Dalecarlia WTP (Alternatives 24–26)

3.6.1 Alternative 24

Coprocess Forebay and water treatment residuals at Dalecarlia WTP; dispose of residuals via contract hauling from the Dalecarlia WTP

For this alternative, water treatment residuals would be collected from the Dalecarlia sedimentation basins and the Georgetown Reservoir. The residuals would be coprocessed with Forebay residuals at the Dalecarlia WTP. Residuals processing would consist of thickening and dewatering. The dewatered residuals would be hauled offsite for disposal.

The requirements for Alternative 24 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location

Note: Alternative 24 is the same as Alternative 25 with coprocessing.

3.6.1.1 Screening Evaluation

As noted for all other alternatives involving the coprocessing of Forebay residuals with water treatment residuals, this approach is not consistent with the screening criteria for reliability and redundancy. Coprocessing would greatly increase the residuals flow that would need to be processed, and would increase wear on residuals processing equipment due to the high concentration of grit and granular material that is characteristic of the Forebay residuals.

This approach is not recommended and will not be considered for further evaluation.

3.6.2 Alternative 25

Process water treatment residuals at the Dalecarlia WTP and dispose via contract hauling; process Forebay residuals by current methods and periodically haul

Residuals processing would consist of residuals collection from the Dalecarlia sedimentation basins and the Georgetown Reservoir, followed by thickening and dewatering. Contract hauling would be used to remove the dewatered residuals from the site for offsite disposal. Forebay residuals would be processed by current methods and periodically hauled from the site.

The requirements for Alternative 25 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

Table 3-6 summarizes the dewatered residuals quantities and the resulting number of trucks required to remove the residuals from the site for this alternative.

TABLE 3-6
Residuals Quantities for Alternative 25

	11-Year Annual Average		Wet Year	
	Annual Average	**Max Week**	**Annual Average**	**Max Week**
Dry lbs/day	65,220	191,935	86,179	336,078
Dry tons/day	33	96	43	168
Wet tons/day[a]	152.6	372	201	655
Number of trucks/day[b]	8 trucks/day or 0.5 trucks/hr	19 trucks/day or 1.2 trucks/hr	10 trucks/day or 0.6 trucks/hr	33 trucks/day or 1.4 trucks/hr

[a]30 percent dry solids at 67 lbs/ft^3; 5 days/week; 16 hours/day operation).

[b]One-way trips.

Note: Forebay residuals are not included above. Processing of Forebay residuals would result in approximately 2 trucks per day (5 days/week) on an average annual basis or 0.13 trucks/hr for a 16-hour day and 0.833 trucks/hr for a 24-hour day. Number of trucks is based upon 20-ton trucks transporting 22 cubic yards/truck; if smaller, 11-cubic-yard trucks are used, then number of trucks per day should be doubled.

3.6.2.1 Screening Evaluation

Alternative 25 is consistent with the screening criteria and will be retained for further evaluation in the DEIS.

3.6.3 Alternative 26

Use plasma oven technology to process Forebay and water treatment residuals at the Dalecarlia WTP; dispose of residuals via contract hauling from the Dalecarlia WTP

This alternative was added in response to a public comment received at the Scoping Meeting held by Washington Aqueduct on January 28, 2004. A suggestion was made to consider plasma arc technologies as a means of reducing the amount of material that needs to be disposed of. The feasibility of using this process was evaluated as a result of those comments.

The requirements for Alternative 26 are summarized below (see Appendix A for a summary of all alternatives):

Location	Collection	Conveyance	Processing	Disposal
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening/dewatering/ plasma oven facility	Use plasma oven process following thickening and dewatering on collected residuals at Dalecarlia	Contract haul processed residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening/dewatering/ plasma oven facility	Use plasma oven process following thickening and dewatering on collected residuals at Dalecarlia	Contract haul processed residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia thickening/dewatering/ plasma oven facility	Use plasma oven process following thickening and dewatering on collected residuals at Dalecarlia	Contract haul processed residuals to a permitted offsite location

Plasma arc technologies are also referred to as “plasma treatment,” “plasma-assisted sludge oxidation,” and “plasma gasification and vitrification.” These technologies have been used for selected waste applications for the past 20 years and collectively are still considered a relatively new and unproven method for waste treatment. Thickening and dewatering facilities would still need to be built for this alternative because plasma arc technology must be used with a material that is fairly dry to work effectively.

A plasma arc system generally consists of a plasma reactor, environmental controls, and a power generation unit or power supply. Dried waste is fed to the plasma reactor, an enclosed chamber where organic material is converted to a combustible gas and inorganic material is converted to a glasslike slag or very fine ash at temperatures ranging from 600°C to 15,000°C, depending upon the type of plasma system. The combustible gas must be cleaned of contaminants, and may either be burned off as waste or used for power generation.

The glasslike slag may be reused as road fill, bricks, etc., or be disposed of at a waste disposal facility. Uses for the fly ash are still being researched, but some that are being studied include agricultural fertilizer, cement aggregate, and geotechnical construction material. The potential usage, though, depends on the waste source since different sources have different chemical components in their waste. Like the slag, the ash can also be sent to a waste disposal facility.

Plasma arc technologies require environmental controls to prevent pollution of water, air, and/or soil. Emission control devices used to treat the combustible gas produced in the plasma arc processes include scrubbers, filter, and sorbent systems. Regular air monitoring and EPA Toxicity Characteristic Leaching Procedure (TCLP) testing of waste materials will be required for permitting and disposal. For the systems that produce fly ash, measures need to be taken to prevent the dust from blowing into the air.

3.6.3.1 Screening Evaluation

As a result of this Feasibility Study, this alternative has been eliminated from further consideration since it is inconsistent with the following screening factors:

- Reliability and redundancy
- Economic considerations
- Proven methods

Reliability and Redundancy. The process embodies a high degree of technology. It is still considered to be an innovative approach to residuals disposal, even though it has been used in select waste industries for several years. It can only be concluded that the use of this technology involves some degree of risk to reliability and redundancy for Washington Aqueduct, simply because it has not been adopted by the water and wastewater industry.

Economic Considerations. A cost for installing this technology cannot be precisely determined because the application has not been used with drinking water treatment residuals. Costs are very dependent on the type and characteristics of the material to be processed. Because the plasma arc system would be in addition to all of the previously identified components of the residuals processing system (i.e., thickening, dewatering, etc.), it would represent a large additional expense that would not be incurred by the other alternatives. Through discussions with various vendors, it is estimated that it would cost a minimum of $20 million to install a plasma arc system for the Washington Aqueduct (in addition to all other costs for residuals collection, conveyance, and processing). Therefore, this alternative can be eliminated as inconsistent with the screening criteria for economic considerations because these additional costs are greater than 30 percent of the budget of $50 million for the baseline project.

Proven Methods. Fabgroups, a company that is testing plasma-assisted sludge oxidation on wastewater sludge, requires the waste to have 20 percent organic content. If solids do not have that amount of organic matter, the energy input required to sustain the system is very high and the process becomes more costly. Since Washington Aqueduct's water treatment residuals have very little organic content, the process would likely require large amounts of energy (i.e., approximately 100 MW/ton) and be very expensive to operate.

Our research findings indicate that, to date, plasma arc technology has been used with materials such as municipal solid waste, hazardous waste, medical waste, and incinerator ash. This process has not been used on water treatment residuals. Thus, this technology does not meet the proven methods criterion.

3.6.3.2 Summary

Alternative 26 was described in the preceding paragraphs. This alternative is not a viable option for Washington Aqueduct because the technology is new and unproven, particularly with regards to its use with water treatment residuals, and the process is not reliable. Other disposal options offer more established, reliable, cost-effective processing of water treatment residuals. Thus, Alternative 26 will not be studied in the DEIS.

3.7 Alternative Screening Summary

Table 3-7 concisely describes each of the 26 alternatives considered in this analysis and summarizes the results of the screening process. Three of the alternatives were found to be feasible based upon the screening analysis. In addition, the no-action alternative will be carried forward into the EIS, as required by the NEPA process. The three feasible alternatives are described in more detail in Section 5.

The remaining 22 alternatives did not meet one or more of the screening criteria. Table 3-7 provides a brief list of the screening criteria that were not satisfied for each of these 22 alternatives.

TABLE 3-7
Screening Results Summary

No.	Description	Screening Result (Consistent/ Inconsistent with Screening Criteria)	Unsatisfied Screening Criteria
1	No Action	Analyzed in detail in the EIS per NEPA requirements	• N/A
Alternatives 2–8: Alternatives That Do Not Include Continuous Trucking from the Dalecarlia WTP			
2	Process water treatment residuals at Dalecarlia WTP and dispose in Dalecarlia monofill. Process Forebay residuals by current methods and periodically haul.	Consistent	• None
3	Coprocess water treatment and Forebay residuals at Dalecarlia WTP and codispose in Dalecarlia monofill.	Inconsistent	• Reliability and redundancy

TABLE 3-7
Screening Results Summary

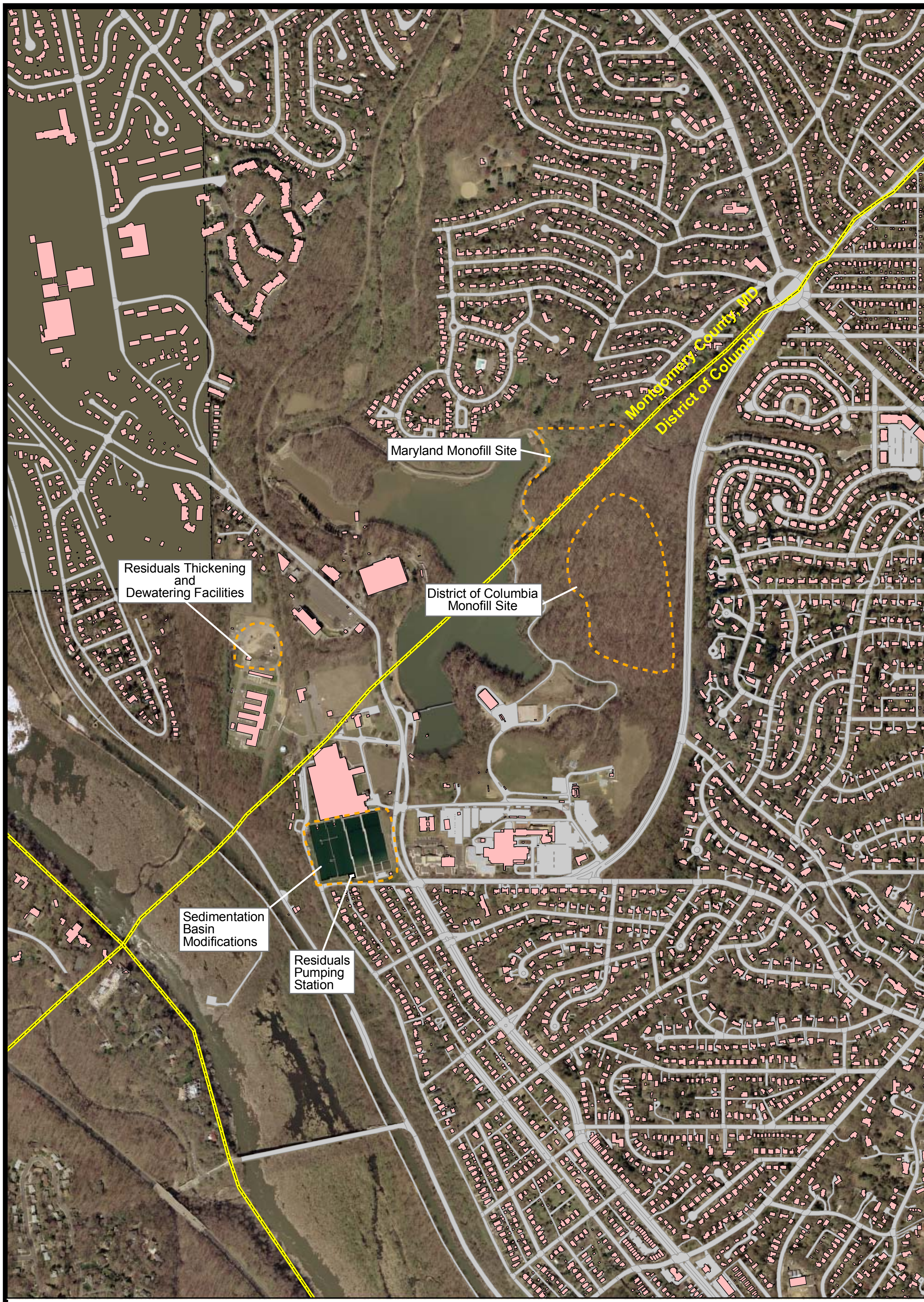
No.	Description	Screening Result (Consistent/ Inconsistent with Screening Criteria)	Unsatisfied Screening Criteria
4	Pump unthickened water treatment residuals via Potomac Interceptor to DC WASA Blue Plains WWTP. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• Reliability and redundancy • Economic • Zoning, land use, and Federal and local regulations
5	Thicken water treatment residuals at Dalecarlia WTP, then pump via a new pipeline to DC WASA Blue Plains WWTP. Process Forebay residuals by current methods and periodically haul.	Consistent	• None
6	Thicken water treatment residuals at Dalecarlia WTP, then transport by barge to DC WASA Blue Plains WWTP. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• Reliability and redundancy • Zoning, land use, and local regulations • Proven methods
7	Thicken water treatment residuals at Dalecarlia WTP, then pump via pipeline to neighboring water utility. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• Economic (FCWA) • Institutional constraints (FCWA, WSSC)
8	Thicken water treatment residuals at Dalecarlia WTP and pump via pipeline to new dewatering location. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• FFCA • Economic
Alternatives 9–11: Alternatives with a Discharge to the Potomac River			
9	Process most water treatment residuals at Dalecarlia WTP and haul offsite, but dilute some residuals for discharge back to Potomac River. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• Reliability and redundancy • NPDES
10	Renegotiate NPDES Permit to allow discharge of all residuals to Potomac River.	Inconsistent	• NPDES
11	Process water treatment residuals at Dalecarlia WTP and haul offsite. Process Forebay residuals by current methods and periodically haul. Dilute treatment side streams and discharge to the Potomac River.	Inconsistent	• Reliability and redundancy • NPDES
Alternatives 12–15: Alternatives Involving the Dalecarlia Reservoir			
12	Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals. Dispose in Dalecarlia & McMillan monofills.	Inconsistent	• Reliability and redundancy

TABLE 3-7
Screening Results Summary

No.	Description	Screening Result (Consistent/ Inconsistent with Screening Criteria)	Unsatisfied Screening Criteria
13	Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal.	Inconsistent	• Reliability and redundancy
14	Construct new sedimentation basins at the Dalecarlia Reservoir and process all residuals at Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal.	Inconsistent	• Reliability and redundancy
15	Coagulate all flow in the Dalecarlia Reservoir and process all residuals at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal.	Inconsistent	• Reliability and redundancy
Alternatives 16–23: Alternatives with Facilities at the McMillan WTP			
16	Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer's treatment facility. Contract haul dewatered residuals. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• FFCA • Reliability and redundancy • Economic • Proven methods
17	Coprocess Forebay and water treatment residuals at the McMillan WTP. Disposal of residuals via contract hauling from McMillan WTP. *(Same as Alternative 18 w/ coprocessing)*	Inconsistent	• Reliability and redundancy • FFCA • Economic and proven methods
18	Process water treatment residuals at the McMillan WTP and haul offsite. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• FFCA • Reliability and redundancy • Economic • Proven methods
19	Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer's treatment facility. Dispose of residuals via contract hauling from the existing facility. Discharge Forebay residuals to the Potomac River.	Inconsistent	• FFCA • Reliability and redundancy • Economic • Proven methods • NPDES

TABLE 3-7
Screening Results Summary

No.	Description	Screening Result (Consistent/ Inconsistent with Screening Criteria)	Unsatisfied Screening Criteria
20	Thicken water treatment residuals at the Dalecarlia WTP and the Georgetown Reservoir and dewater at the McMillan WTP. Dispose of water treatment residuals via contract hauling from McMillan WTP. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• FFCA • Reliability and redundancy • Economic • Proven methods
21	Store residuals in lagoons at Forebay, Dalecarlia WTP, and McMillan WTP. Thicken and dewater residuals with portable equipment and dispose via contract hauling from all locations.	Inconsistent	• FFCA • Reliability and redundancy • Economic • Proven methods
22	Store water treatment residuals in Dalecarlia and Georgetown Reservoirs, prior to thickening and dewatering at the Dalecarlia and McMillan WTPs. Dispose of water treatment residuals via contract hauling from the Dalecarlia and McMillan WTPs. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• FFCA • Reliability and redundancy • Economic • Proven methods
23	Store water treatment residuals in McMillan Reservoir prior to dewatering at the McMillan WTP. Dispose of water treatment residuals via contract hauling from the McMillan WTP. Process Forebay residuals by current methods and periodically haul.	Inconsistent	• FFCA • Reliability and redundancy • Economic • Proven methods
Alternatives 24–26: Alternatives with Facilities at the Dalecarlia WTP			
24	Coprocess Forebay and water treatment residuals at Dalecarlia WTP. Dispose of residuals via contract hauling from the Dalecarlia WTP. *(Same as Alternative 25 w/ coprocessing)*	Inconsistent	• Reliability and redundancy
25	Process water treatment residuals at the Dalecarlia WTP; and dispose via contract hauling. Process Forebay residuals by current methods and periodically haul.	Consistent	• None
26	Use plasma oven technology to process Forebay and water treatment residuals at the Dalecarlia WTP. Dispose of residuals via contract hauling from the Dalecarlia WTP. *(Same as Alternative 25 with coprocessing and plasma oven step)*	Inconsistent	• Reliability and redundancy • Economic • Proven methods



Legend

- Approximate Location of New/Modified Facilities
- County Boundary
- Existing Buildings
- Roads

The geographic information shown on this map is based on data from the District of Columbia Geographic Information System (DC GIS). The District Government makes no warranty, express or implied, and disclaims all implied warranties of suitability of the DC GIS product for a particular purpose.

0 375 750 Feet

Figure 3-1
Site Plan - Potential Monofill Sites

CH2MHILL

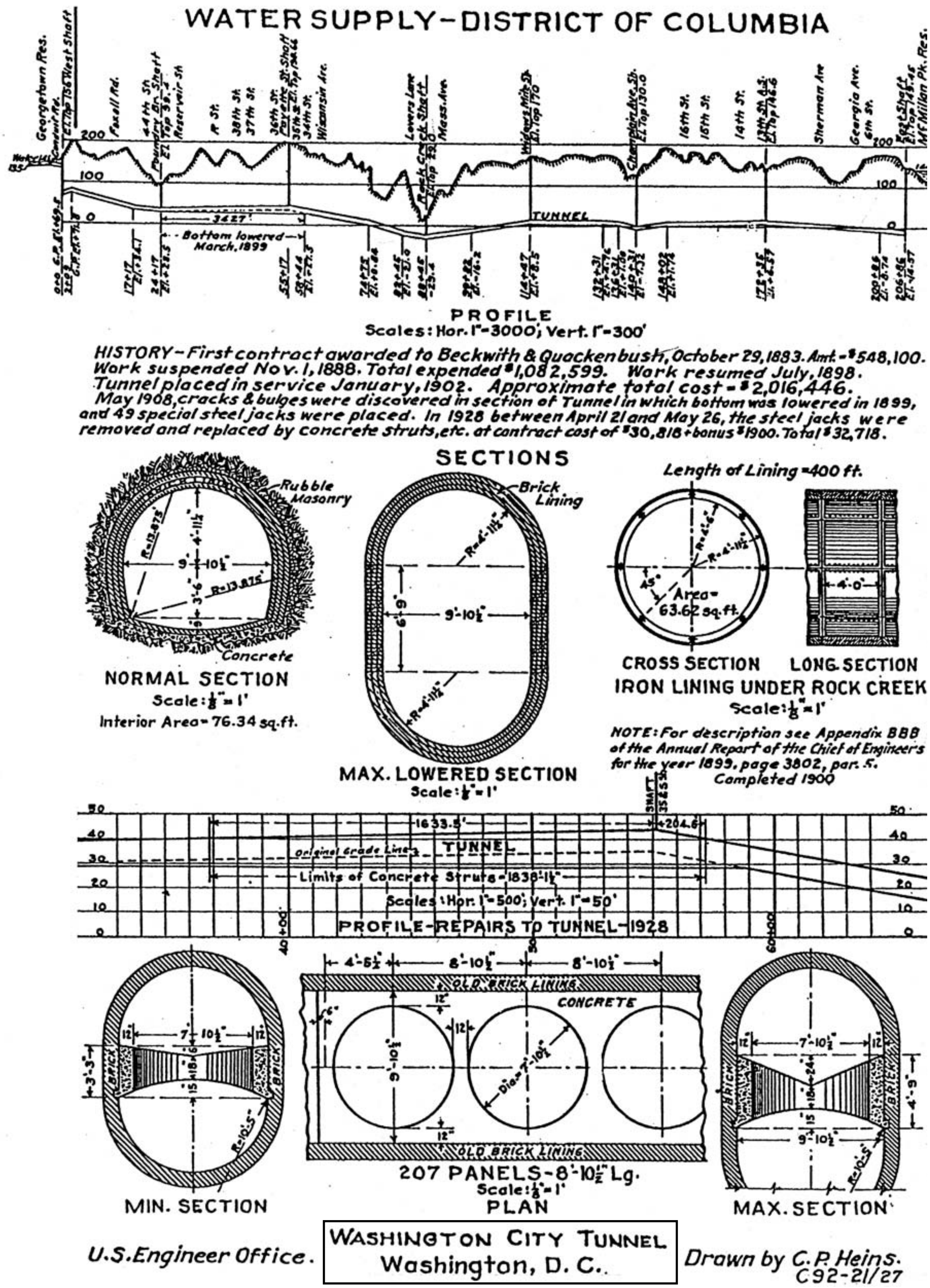


FIGURE 3-2
Profile and Sections of the Washington City Tunnel from "Washington Aqueduct Cultural Resource Management Plan" June 1998

SECTION 4

Residuals Processing Options

Previous sections of this Engineering Feasibility Study discussed several alternatives for the collection, conveyance, and processing of water treatment and Forebay residuals generated by the Washington Aqueduct treatment operations at the Dalecarlia WTP and the Georgetown Reservoir. The alternatives were evaluated with respect to a number of screening criteria to determine whether they were consistent with the purpose and need of the Washington Aqueduct Water Treatment Residuals Management Project.

For the purposes of this evaluation, it was assumed that residuals from the Forebay would be processed onsite by current methods and periodically hauled to an offsite location. Coprocessing of the Forebay residuals is not recommended. All alternatives that were based on this approach were eliminated as inconsistent with screening criteria for reliability and redundancy. Other options for the processing of Forebay residuals exist, and will be considered as part of a future plant improvement project. One promising technology for the processing of Forebay residuals is discussed in this section.

Three alternatives for the processing of water treatment residuals were selected as being consistent with the purpose and need of the project. These alternatives can be briefly described as:

- Monofill disposal of dewatered water treatment residuals
- Conveyance of thickened water treatment residuals to Blue Plains via a dedicated pipeline for further processing
- Onsite thickening and dewatering of water treatment residuals with contract hauling for off-site disposal

The selected alternatives each represent a generalized approach for residuals collection, conveyance, processing, and disposal. Within the context of each alternative, a number of options are available for implementing that alternative. The options might involve the choice of a particular technology, the manner in which a particular technology is used, or the location of a particular treatment process.

This section of the Engineering Feasibility Report discusses several specific options that are under consideration for the processing and treatment of Washington Aqueduct's water treatment residuals. The options have been developed in response to the particular configuration of Washington Aqueduct's current sedimentation processes and the location of its treatment units at the Dalecarlia WTP and the Georgetown Reservoir.

4.1 Sedimentation Alternatives at the Dalecarlia WTP

The existing sedimentation basins at the Dalecarlia WTP consist of two conventional units and two double-decker units. The conventional units (Basins 1 and 2) were constructed in 1992 to replace to older units. Each basin is approximately 407 ft long and 135 ft wide. The side water depth is approximately 16 ft deep. They have a maximum treatment capacity of 75 mgd, each. The two double-decker units (Basins 3 and 4) were constructed in 1947 and 1964. The settling area of each lower level is approximately 316 ft long and 138 ft wide. The lower and upper level depths are approximately 16 and 14 ft deep, respectively. Each of these basins has a maximum rated capacity of 90 mgd.

Residuals from the basins are currently discharged to the Potomac River. The purpose and need of the project is install the required facilities to eliminate this practice. The following alternatives were developed to address the need to collect the residuals from these basins and perform the sedimentation function at the Dalecarlia WTP:

- Install continuous residuals collection equipment in all four basins
- Install plate settling equipment and residuals collection equipment in Basins 1 and 2. This would enable Basins 1 and 2 to process 320 mgd. No modifications would then be needed for Basins 3 and 4, or for the Georgetown Reservoir, unless there was a desire to keep these facilities in service
- Provide a new, double-decker flocculation/sedimentation basin (using plate-settling technology) at the Dalecarlia WTP for the Georgetown flow. No modifications would then be required for the Georgetown Reservoir, unless there was a desire to keep this facility in service

4.1.1 Continuous Residuals Collection Equipment

The most “straightforward” approach to collecting the residuals in the existing sedimentation basins would be to simply install equipment in the existing four basins to allow the water treatment residuals to be collected on a continuous basis. Several technologies and systems could be used for this purpose. Options for the continuous collection of residuals include chain and flight collection systems and vacuum-type, or suction header-type collection systems.

A previous evaluation of residuals collection for the sedimentation basins at the Dalecarlia WTP resulted in a recommendation for a suction header-type system. This type of technology is commonly used in the industry. Typical manufacturers for suction header-type collection systems include Leopold (CT2 and Clari-Trac) and General Filter (Sludge Sucker). The pressure differential between the water in the tank and the discharge trough is used to withdraw the residuals from the basin. The withdrawal principle can be used with submerged, floating, or traveling bridge collection units. For submerged systems, operational problems can sometimes result if the sludge blanket is heavy, if thickening occurs in the basins, or if the residuals contain a high grit content. This concern is relevant because approximately half of the grit load contained in the raw water passes through the Dalecarlia Reservoir to the plant, historically.

Chain and flight-type collector mechanisms are also suitable for this application. These systems are also widely used in the industry. They are subject to wear and require regular maintenance. Basins 1 and 2 were designed for a future chain and flight retrofit, which would provide an additional reason to investigate this approach. Chain and flight collection system manufacturers include USFilter, Polychem, and Walker Process Equipment.

Collection equipment will be researched further during the detailed evaluation phase of the EIS project. The proposed equipment type will be selected before the issuance of the final EIS. The choice of equipment should have little impact on the EIS (i.e., the basins will generally look the same regardless of the type of equipment installed).

A pump station to transfer the collected residuals to the thickeners will also be required. It may be necessary to locate the pump station adjacent to the sedimentation basins. Consequently, this new facility will have some impact to the site. The final configuration will depend on the type of residuals collection equipment to be provided. Appendix C includes manufacturer's information on typical residuals collection equipment.

4.1.2 Plate Settlers

Sedimentation capacity is currently distributed between the Dalecarlia WTP and the Georgetown Reservoir. This approach requires water treatment residuals to be collected at both locations and transported to a central location for processing. An alternative approach would be to centralize all sedimentation capacity at the Dalecarlia WTP to simplify the logistics of residuals collection. The Georgetown Reservoir could then be removed from production completely or be used strictly as a backup facility. Residuals collection equipment would still need to be provided if the Georgetown Reservoir were to be used as a backup facility.

Sedimentation capacity could be centralized at the Dalecarlia WTP through either of two mechanisms:

- Maximize the production capacity of the existing sedimentation basins
- Provide additional sedimentation capacity at Dalecarlia through the construction of additional sedimentation basins

To produce 320 mgd, the Dalecarlia WTP would typically process 220 mgd and the Georgetown Reservoir would process 100 mgd. Through the use of inclined plate sedimentation, all 320 mgd of sedimentation capacity could be provided at the Dalecarlia WTP. The main advantage of inclined plate sedimentation is that increased surface loading rates can be used to provide settling using a smaller basin.

Plates (provided in pre-engineered modules, or "plate packs") can be retrofitted into existing basins to increase their sedimentation capacity. The plates are designed to be vertically inclined at an angle of 55 to 60 degrees from the horizontal. The distance between the plates (usually from 2 to 4 in.) is designed to provide an uplift velocity lower than the settling velocity of the particles, allowing them to settle to the surface of the plates to be directed to the collection area below. Most plate settlers use a combination of cross- and counter-current flow by introducing water into the plate packs at the side of the plates, near the bottom. Water flows across the plates as it rises to effluent troughs, or overflow weirs, at the top of the plates. Residuals are collected from the area below the plates.

Both chain and flight and suction header–type residual collection systems can be used with plate settlers. One objection to plate settlers is the perception that access to the residuals collection equipment is reduced because the equipment is located beneath the plate packs. In reality, access to residuals collection equipment is about equal for both conventional and plate settler sedimentation basin, provided that sufficient headroom is provided beneath the plate packs.

Manufacturers for plate settling equipment include Parkson, EIMCO, Meurer, and USFilter (i.e., Zimpro). While all plate settlers are based on the same principles, the equipment provided by each manufacturer differs considerably, especially with regard to influent flow distribution, equipment proportions and dimensions, effluent collection, etc. Consequently, the designer must work with the manufacturers to establish an appropriate design for any particular installation. Appendix C contains manufacturer's information for typical plate settlers.

The main design criterion for plate settlers is the projected surface loading for each plate, where the projected surface area is calculated as the active surface area of the plate (usually 80 percent of the actual plate area), multiplied by the cosine of the inclination angle. Typical loading rates range from 0.30 to 0.50 gpm/ft^2, depending on the settling characteristics of the residuals, the water temperature, and the desired effluent quality. The hydraulic loading rate for a basin equipped with plate settlers is 4 to 7 gpm/ft^2, compared to 0.25 to 0.38 gpm/ft^2 for conventional sedimentation processes.

4.1.3 Modifications to Basins 1 and 2

A preliminary analysis of the existing sedimentation basins has indicated that the entire required treatment capacity of 320 mgd could be supplied by Basins 1 and 2. This would potentially eliminate or defer the need to retrofit Basins 3 and 4 for residuals collection (if desired), and would potentially eliminate the need to retrofit the Georgetown Reservoir for residuals collection and for conveying residuals from the Georgetown Reservoir site to a centralized location for processing.

For this option, flocculation would occur in Basin 2 (the basin would be divided into seven parallel flocculation channels for redundancy purposes), and Basin 1 would hold the plate packs. Basin 1 would be divided into seven trains for redundancy. Each train would hold five modular plate packs of nine plates each, for a total of 315 plates. In addition to the compartmentalization of the basins, the influent and effluent channel arrangement would need to be extensively modified as part of the retrofit arrangement.

As part of the effluent channel modifications, a portion of the flow would need to be diverted to the McMillan WTP for filtration and disinfection via the existing Georgetown Tunnel. This would require the construction of a large diameter pipeline between the basins and the tunnel, since such a connection does not currently exist.

Chain and flight or suction header residuals collection mechanisms could be used with this approach. Residuals collection pumps could possibly be installed in the existing gallery between the two basins. Alternately, an external pump station could be provided adjacent to the existing basins.

Figure 4-1 is a plan view showing the modifications to Basins 1 and 2. Figure 4-2 is a sectional view of the basins.

4.1.4 New Georgetown Flocculation/Sedimentation at the Dalecarlia WTP

A new flocculation/sedimentation basin for the flow currently processed by the Georgetown Reservoir could be provided as an alternate means of centralizing sedimentation capacity at the Dalecarlia WTP. To conserve space, a double-decker basin, equipped with plate settlers was considered. Residuals collection equipment would still need to be retrofitted into Basins 1 through 4 to take advantage of the existing sedimentation capacity at the Dalecarlia WTP.

The double-decker basin would be configured with flocculation section on the lower level and the sedimentation section on the upper level. Three flocculation trains and five sedimentation trains are recommended. The basin would have a peak flow capacity of 120 mgd at a flocculation detention time of 20 minutes and a sedimentation rate of 0.38 gpm/ft^2.

Issues that would need to be addressed as part of the design of this facility include the depth of the basin (extensive rock excavation would likely be required), the routing of effluent flow to the Georgetown Tunnel, and the location of the residuals pump station.

Figure 4-3 depicts a plan view of the Georgetown Sedimentation Basin at Dalecarlia. Figure 4-4 is a sectional view of the basin.

4.2 Sedimentation at the Georgetown Reservoir

The Georgetown Reservoir consists of three large basins. The basins are irregular in shape, and were originally of bermed, earthen construction. They have been lined with concrete in recent years. Because of the large surface area of the basins (Basin 1 is 5.8 acres and Basin 2 is 19.5 acres) and the basin configuration, previous studies have concluded that it would be difficult to retrofit the basins with conventional residuals collection equipment. At least two previous studies recommended a dredging operation for the collection of water treatment residuals from the Georgetown Reservoir. Basin 3 is mainly used for the storage of clarified water. Therefore, residuals collection is not required for this basin.

Figure 4-5 is a dredging plan for the Georgetown Reservoir, as developed for a previous preliminary design. If dredging for the reservoir were provided, it would be similar to the plan shown in Figure 4-5. The plan includes an equalization basin and pump station that would be used to store the collected residuals and convey them to a processing facility at the Dalecarlia WTP via a pipeline through the existing Georgetown Tunnel. In addition, it was recommended that the bottom of Basin 2 be modified extensively to replace the current “hill and valley” design with a sloped bottom to facilitate the dredging operation.

4.2.1 New Sedimentation Basin within the Georgetown Reservoir

An alternative to dredging would be to construct a new, compact sedimentation basin within a portion of the Georgetown Reservoir. Due to the limited available space at the Georgetown Reservoir site, the basin could actually be constructed within one of the existing reservoir basins. The existing reservoir basins could taken out of service, be used as backup facilities, or be used strictly as a community “water feature.” A new basin, equipped with plate settlers, would need only a small fraction of the area currently used by the reservoir basins. A flocculation section would not be required because flocculation occurs as the water flows to the reservoir through the Georgetown Tunnel.

Issues to be resolved during the design of this facility include the details of the interface between the new basin and Basin 2 (i.e., influent flow routing, coordination of the basin foundation design with the existing facility, etc.).

Figure 4-6 is a plan view for a new sedimentation basin for the Georgetown Reservoir site. The basin would potentially be located within Basin 2. This location was chosen because it is well within the interior of the Georgetown Reservoir site. It is also a good distance from MacArthur Boulevard to limit the visual impact of the basin. Figure 4-7 is a section view of the basin.

4.3 Thickening and Dewatering

A site for the proposed thickening and dewatering complex was identified in previous work. The site is located to the north of the existing Maintenance Yard, and is bordered by a fence-line to the west and the Capital Crescent Trail to the east. A total of about 5 acres is available at this location.

Figures 4-8 through 4-16 provide some preliminary views of the thickening and dewatering complex. Figure 4-8 is a site plan of the complex on the proposed site and Figure 4-9 is an overall plan for the residuals processing complex. The design concept was based on the idea of combining the thickeners and the thickened residuals pump station with the dewatering building into a single complex. This concept will minimize the percentage of site area devoted to the processing facilities, making them appear smaller and allowing more site area to be preserved as buffer space.

Four 105-ft-diameter thickeners are proposed. Figure 4-10 is a section of a typical gravity thickener. The thickeners would be raised out of the ground to the maximum extent possible to minimize excavation depth and eliminate the need for a deep, thickened residuals pump station. A three-story dewatering building is envisioned. Preliminary sizing indicates that the building would be approximately 128 ft long and 76 ft wide. The space between the thickeners and the building would be enclosed to provide a location for the thickened residuals pumps.

Figures 4-11 and 4-12 are preliminary elevations of the dewatering building. To the greatest extent possible, the building will be designed to honor the architecture of the existing site buildings. Likely features of the building will include brick construction, multipane windows, slate (or slate-look) roof, etc. Figure 4-12 also shows the space provided for the thickened residuals pump station.

Figures 4-13, 4-14, and 4-15 show the preliminary layout of the first, second, and third floors of dewatering building portion of the residuals processing complex. The third floor would house the dewatering equipment and the polymer feed equipment, the second floor would house the dewatering bins and polymer storage tanks, and the first floor would include three drive-through bays for loading trucks.

A total of six dewatering devices will be required. The dewatering devices would be arranged in pairs, so that each pair would discharge into one of three storage and discharge bins. For the purposes of this evaluation, it was assumed that centrifuge dewatering equipment would be provided. However, belt filter press dewatering equipment would also fit in the same space and be appropriate for this application. Both technologies are expected to produce dewatered cake with a dry solids content of approximately 30 percent. Plate-and-frame dewatering equipment could also be used. However, the capital and operations and maintenance cost for this equipment would be significantly higher than that of either centrifuges or belt filter presses. A larger dewatering building might also be required. A more detailed evaluation of dewatering equipment will be conducted as part of the EIS to finalize the decision on dewatering equipment type.

Figure 4-16 is a section view of the residuals processing complex, which shows the vertical relationship of the equipment to the building structure.

4.4 Evaluation of Mechanical Processing for Forebay Residuals

The concept of coprocessing Forebay residuals with water treatment residuals was discussed in detail in Section 2 of this Engineering Feasibility Study. All alternatives involving the coprocessing of Forebay residuals with water treatment residuals were eliminated as inconsistent with the reliability and redundancy screening criterion because the Forebay residuals have a high grit content, which will result in excessive wear on pumps, centrifuges, pipes, and other mechanical equipment.

For the purposes of this evaluation, it was assumed that Forebay residuals would continue to be processed by current methods. They are currently dredged from the Forebay, allowed to dry in a holding area, loaded onto trucks and placed in a pile for additional drying, and then are finally hauled offsite for disposal every 7 or 8 years.

While this approach is acceptable for the present, new grit removal technologies are available that might simplify the processing effort, increase dryness of the processed residuals (resulting in fewer truck loads), and result in much better reservoir water quality. For example, one manufacturer (i.e., Eutec) provides a grit removal system that effectively removes grit particles as small as 50 microns in diameter. Conventional grit removal systems, by comparison, are designed to remove particles in the 300 micron diameter range.

The Eutec system, known by the trade name HEADCELL™, uses a modular multiple-tray solids concentrator. A high efficiency flow distribution header is used to divide the flow evenly between the trays. Tangential feed is used to establish a vortex flow pattern within the unit to force particles to settle into a boundary layer on each tray, from which they are swept through the center of vortex to a collection chamber. From the collection point, the solids are continuously pumped to a grit separation and classification devices (known by the trade names SLURRYCUP™ and GRIT SNAIL™) for further processing. Figure 4-17 is a cutaway view of a HEADCELL™ solids separator unit.

This new technology could be used for Forebay residuals processing by installing a grit collection facility at the entrance to the Forebay (i.e., a headworks facility). Incoming water from the Potomac River would pass through the grit removal system before entering the Forebay portion of the Dalecarlia Reservoir. The collected grit flow would be pumped from the new headworks facility to the residuals processing complex for separation and classification. Trucks could be loaded from the same location.

By removing grit and other settleable solids before the water enters the Forebay, incoming total suspended solids and turbidity would be greatly reduced, resulting in higher quality raw water. The current quality of incoming raw water varies tremendously, depending on conditions in the river, and the residuals processing facility would dampen these fluctuations in water quality.

A conceptual design for the new headworks facility was not developed for this Engineering Feasibility Study because the primary focus of this work is the elimination of the current discharges of water treatment residuals to the Potomac River (which do not include the Forebay residuals). However, Forebay residuals do need to be considered as part of the overall residuals management plan for the Washington Aqueduct. Therefore, the mechanical processing of Forebay residuals should be evaluated further as part of the EIS. If the evaluation is favorable, a future phase of work involving the construction of a headworks facility for the processing of Forebay residuals should be considered.

4.5 Treatment Options—Summary and Conclusions

Several options for the collection and processing of water treatment residuals were discussed in the paragraphs above. Not including the mechanical processing of Forebay residuals, which may be more appropriately considered as part of a second phase project, the processing options can be organized into the following residuals-processing options:

4.5.1 Option 1

Option 1 is the "base case," and consists of residuals collection from the Dalecarlia sedimentation basins and the Georgetown Reservoir (using dredging), followed by thickening and dewatering. Figure 4-18 is a general site plan, which shows the locations of the main facilities required for this option.

4.5.2 Option 2

Option 2 would centralize all sedimentation capacity at the Dalecarlia WTP through the modifications of Basins 1 and 2, followed by thickening and dewatering. Figure 4-19 is a site plan showing the location of the facilities required for this option.

4.5.3 Option 3

Option 3 would also centralize all sedimentation capacity at the Dalecarlia WTP through the addition of a new sedimentation basin, dedicated to treating the Georgetown flow. The new basin would be located adjacent to the existing Dalecarlia basins. Figure 4-20 is a site plan showing the location of the facilities for this option.

4.5.4 Option 4

Option 4 would involve the construction of a new sedimentation basin at the Georgetown Reservoir site. The new basin would likely be located within existing Basin 2. Figure 4-21 is a site plan showing the location of the facilities for this option.

4.5.5 Summary

The four residuals sedimentation and residuals collection options, as described above, would be relevant to all three of the previously identified residuals-management alternatives:

Alternative 2—Monofill disposal of dewatered water treatment residuals

Alternative 5—Conveyance of thickened water treatment residuals to Blue Plains via a dedicated dual pipeline for dewatering

Alternative 25—Onsite thickening and dewatering of water treatment residuals with contract hauling for offsite disposal

For Alternative 5 (the Blue Plains alternative), however, the dewatering facility would be located at Blue Plains. Therefore, a stand-alone thickening and thickened residuals pumping facility would need to be provided at the Dalecarlia WTP. Additional evaluation is needed to determine whether a separate dewatering facility would need to be constructed at Blue Plains. It is currently assumed that such facilities will be required because of the uncertainties regarding the long-term residuals processing capabilities at Blue Plains.

4.6 Cost Summary

“Order of magnitude” or “Class 4” costs, as defined by the Association for the Advancement of Cost Engineering, were developed to compare the four sedimentation and residuals collection processing options discussed above. Actual construction costs can be expected to range from 50 percent above to 30 percent below the estimate presented. This level of accuracy is consistent with costs prepared to compare the relative merits of several alternatives using sketches, general assumptions, and historical costs from similar projects before an exact project definition and specific preliminary design drawings are available. Because of the accuracy of this type of estimate and the variable nature of a number of factors, including the final scope of the project, this level of estimate is not a prediction of final construction costs. Final construction costs are expected to vary from those presented.

As part of a previous study and preliminary design, Whitman Requardt & Associates (WR&A) developed a 35 percent-complete design and cost estimate for a project that would be similar in scope to the “base case” described above. This estimate was completed in 1995. Because of the similarities between the two projects, and the early state of design associated with this Engineering Feasibility Study, the costs developed for the WR&A estimate for several facilities were updated to 2004 and used as the basis for the development of costs presented here. Adjustments to the costs were made for known differences in scope and design details.

Specifically, elements of the WR&A costs for the dredging system for the Georgetown Reservoir, the gravity thickeners, the dewatering building, and for ancillary facilities were used to develop the cost estimates presented in this document. In addition, the WR&A costs were used to develop unit costs for the estimates presented here. Entirely new cost estimates (based on quantity takeoffs from preliminary sketches and using appropriate unit costs from the WR&A estimate) were developed for the three new sedimentation basin options.

Table 4-1 summarizes the order-of-magnitude cost estimates for the four sedimentation and residuals collection options described above. Construction costs on Table 4-1 are presented in 2004 dollars, and have not been escalated to the midpoint of construction.

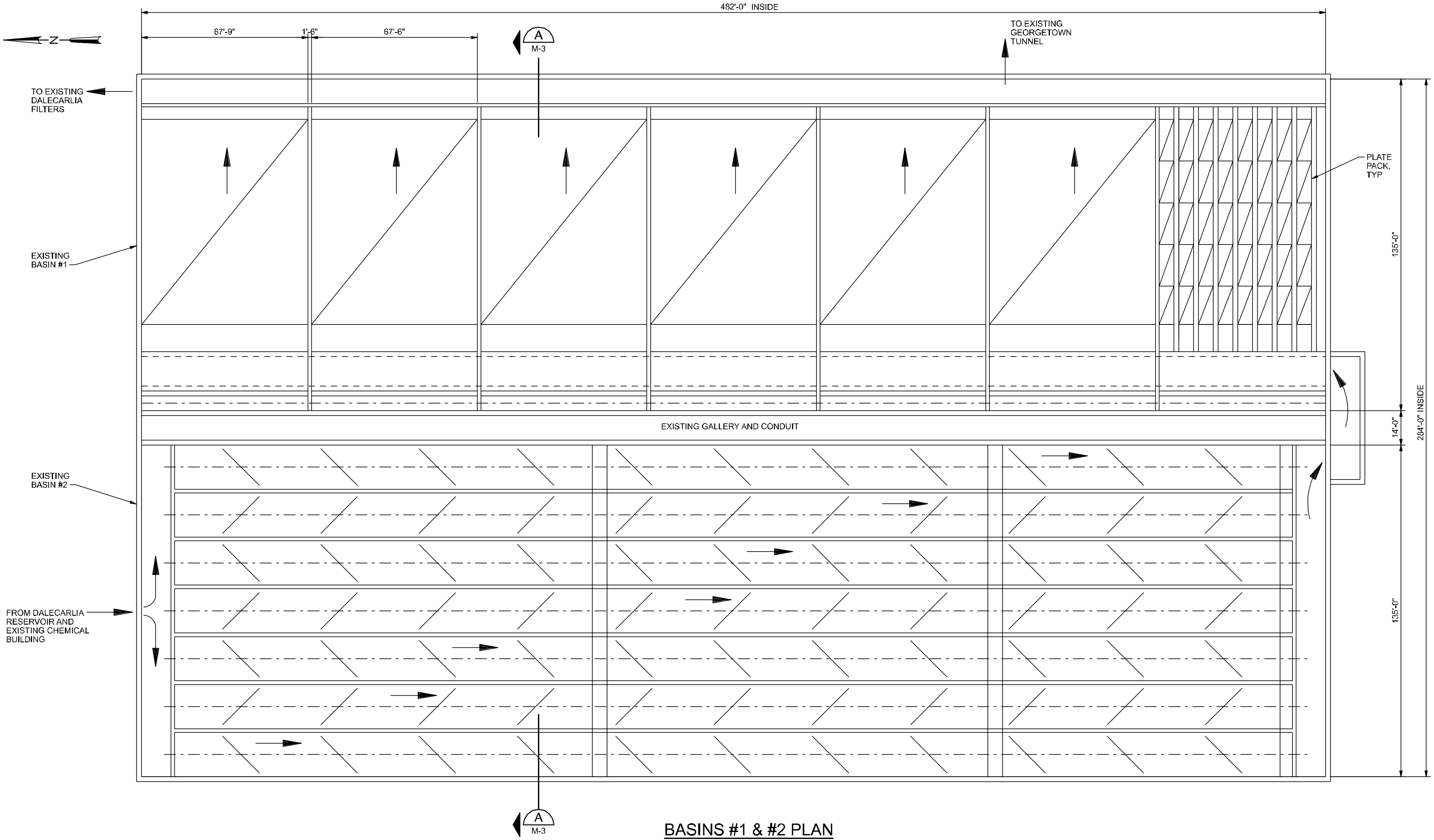
As with the WR&A estimate, the costs also include contractor's overhead and profit and a "design contingency" allowance of 25 percent. The costs do not include allowances for engineering, legal, permitting, or other costs. Other contingencies included in the WR&A estimate (a 7.5 percent funding contingency and a 6 percent allowance for site inspection and overhead associated with construction management) are not included in the totals on Table 4-1, but should be included as part of the overall capital cost of the project.

The "base case" has the lowest estimated construction cost, followed by Option 4 (new sedimentation basin at the Georgetown Reservoir). Options 2 and 3 (centralized sedimentation capacity at the Dalecarlia WTP) are approximately equal in cost. However, Options 2 and 3 are significantly higher in cost than Options 1 and 4.

Options 1 and 4 appear to be most promising options, and will continue to be evaluated as part of the EIS. Options 2 and 3 will continue to be evaluated, but will likely be eliminated from further consideration, unless a means of significantly reducing their cost is developed.

TABLE 4-1
Order-of-Magnitude Cost Summary for Sedimentation and Residuals Collection Alternatives

Residuals Process	Option 1 "Base Case"	Option 2 Modifications to Basins 1 & 2	Option 3 New Sedimentation Basin at Dalecarlia WTP	Option 4 New Sedimentation Basin at Georgetown
Sedimentation Alternatives at the Dalecarlia WTP				
Retrofit of Existing Basins with Residuals Collection Equipment	$12,592,000		$12,592,000	$12,592,000
Modifications to Basins 1 & 2 Only		$36,676,000		
New Basin Sedimentation Basin at Dalecarlia WTP (for Georgetown Flow)			$23,746,000	
Sedimentation Alternatives for the Georgetown Reservoir				
Dredging System	$7,441,000			
New Sedimentation Basin at the Georgetown Reservoir				$14,613,000
Total ($2004)	**$20,033,000**	**$36,676,000**	**$36,338,000**	**$27,205,000**



BASINS #1 & #2 PLAN
1"=20'-0"

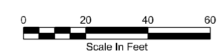


FIGURE 4-1
MODIFICATIONS TO
BASINS 1 & 2 PLAN

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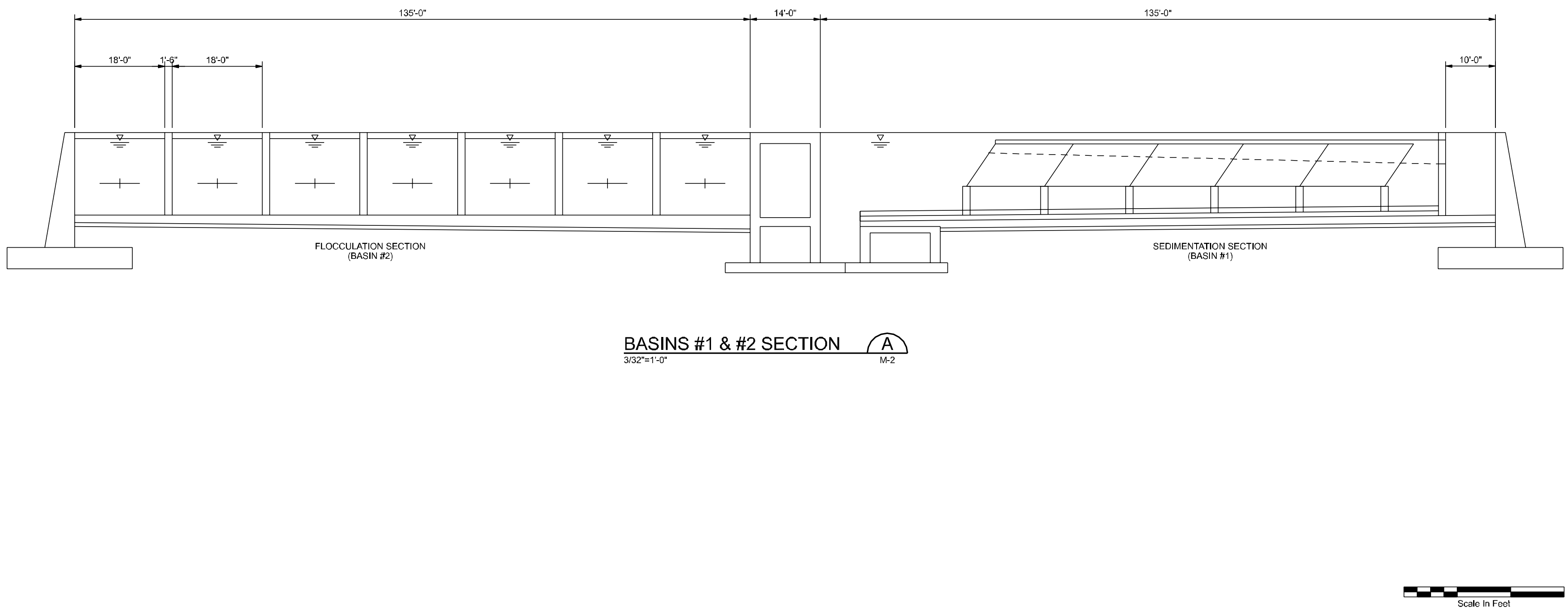

FIGURE 4-2
MODIFICATIONS TO
BASINS 1 & 2 SECTION

CH2MHILL

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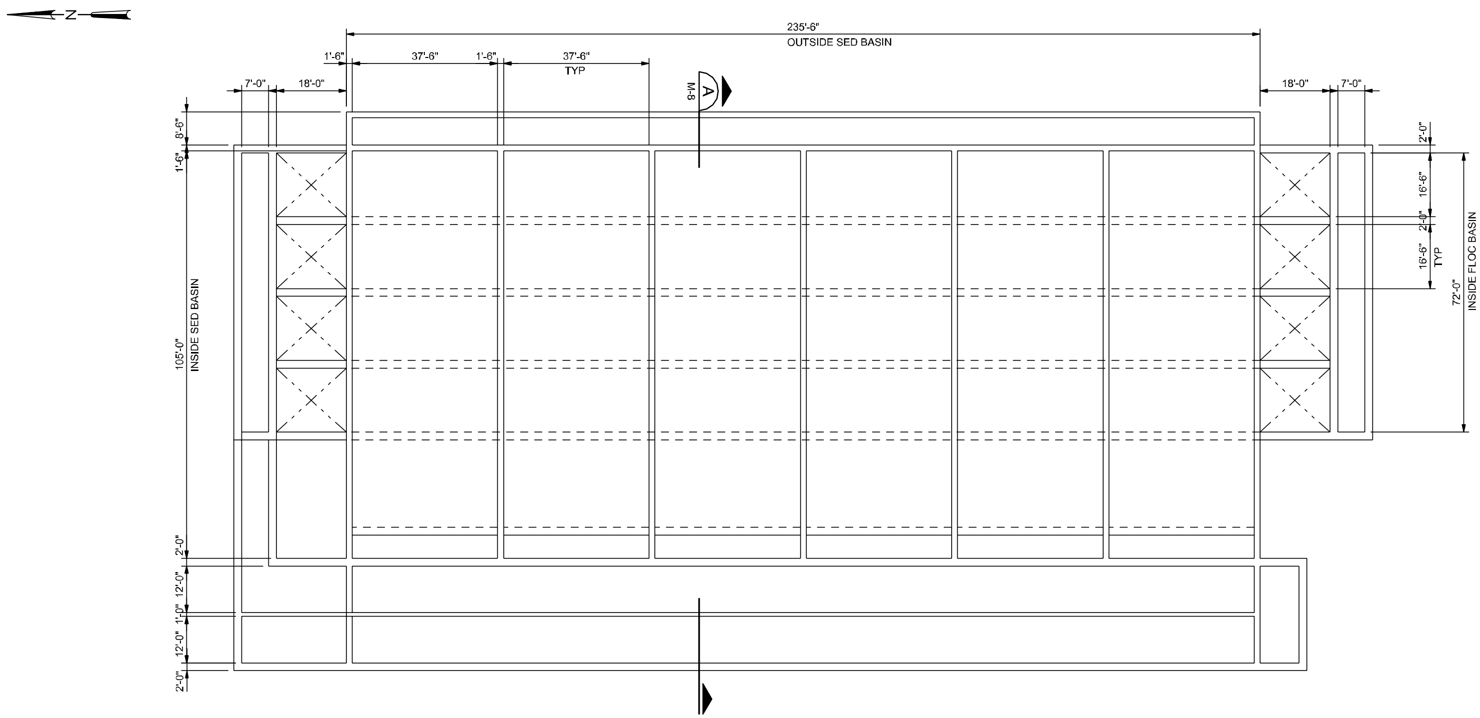

SEDIMENTATION BASIN PLAN
1/16"=1'-0"

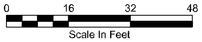

FIGURE 4-3
GEORGETOWN SEDIMENTATION
BASIN AT DALECARLIA
PLAN

CH2MHILL

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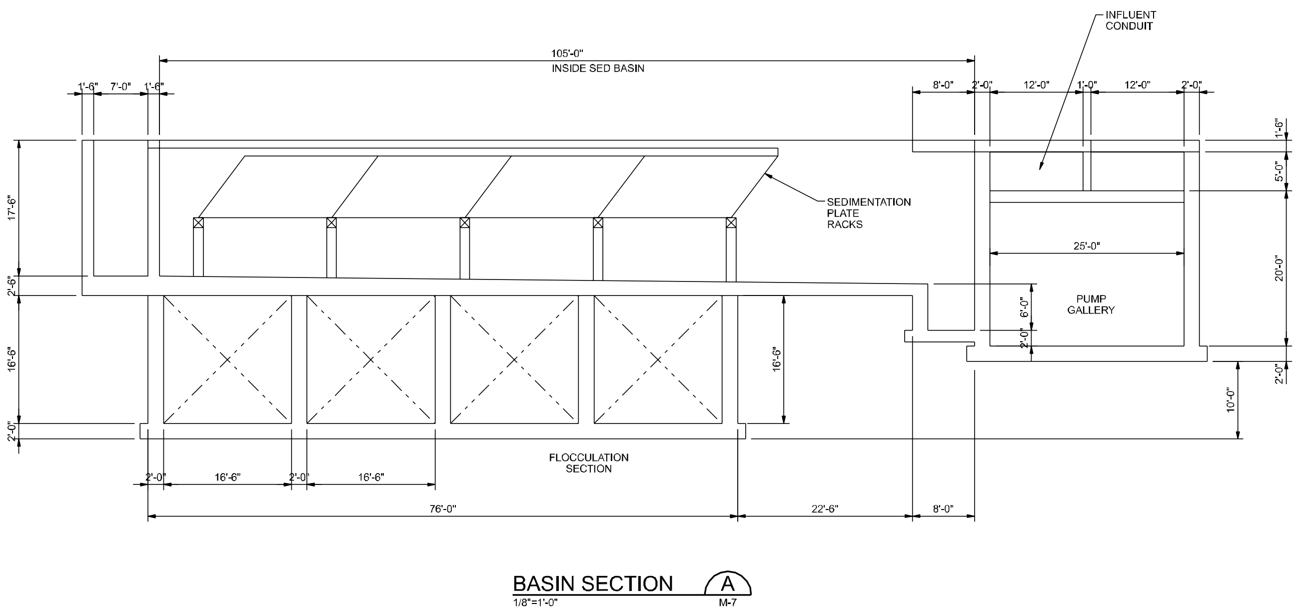

FIGURE 4-4
GEORGETOWN SEDIMENTATION
BASIN AT DALECARLIA
SECTION

CH2MHILL

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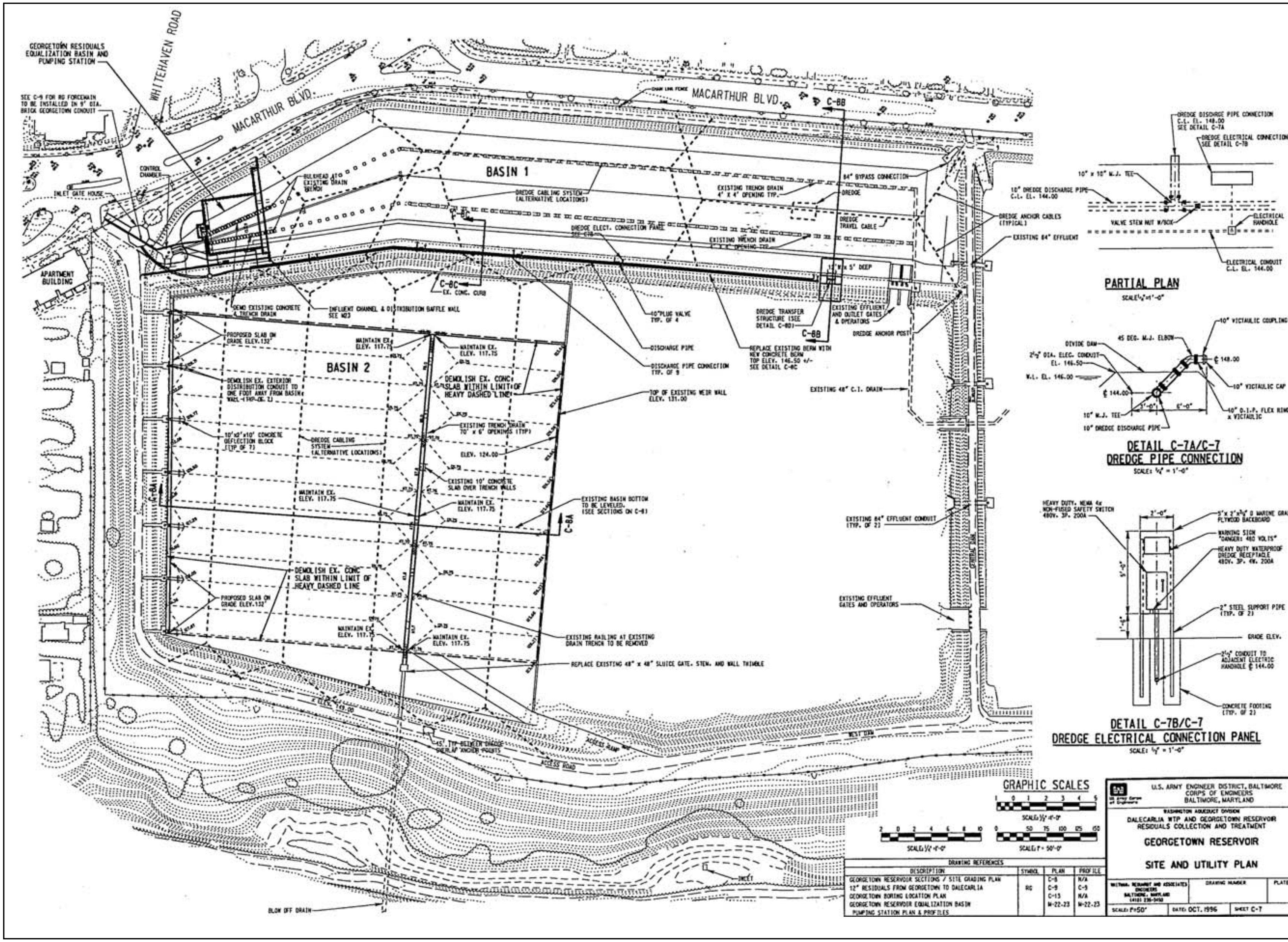
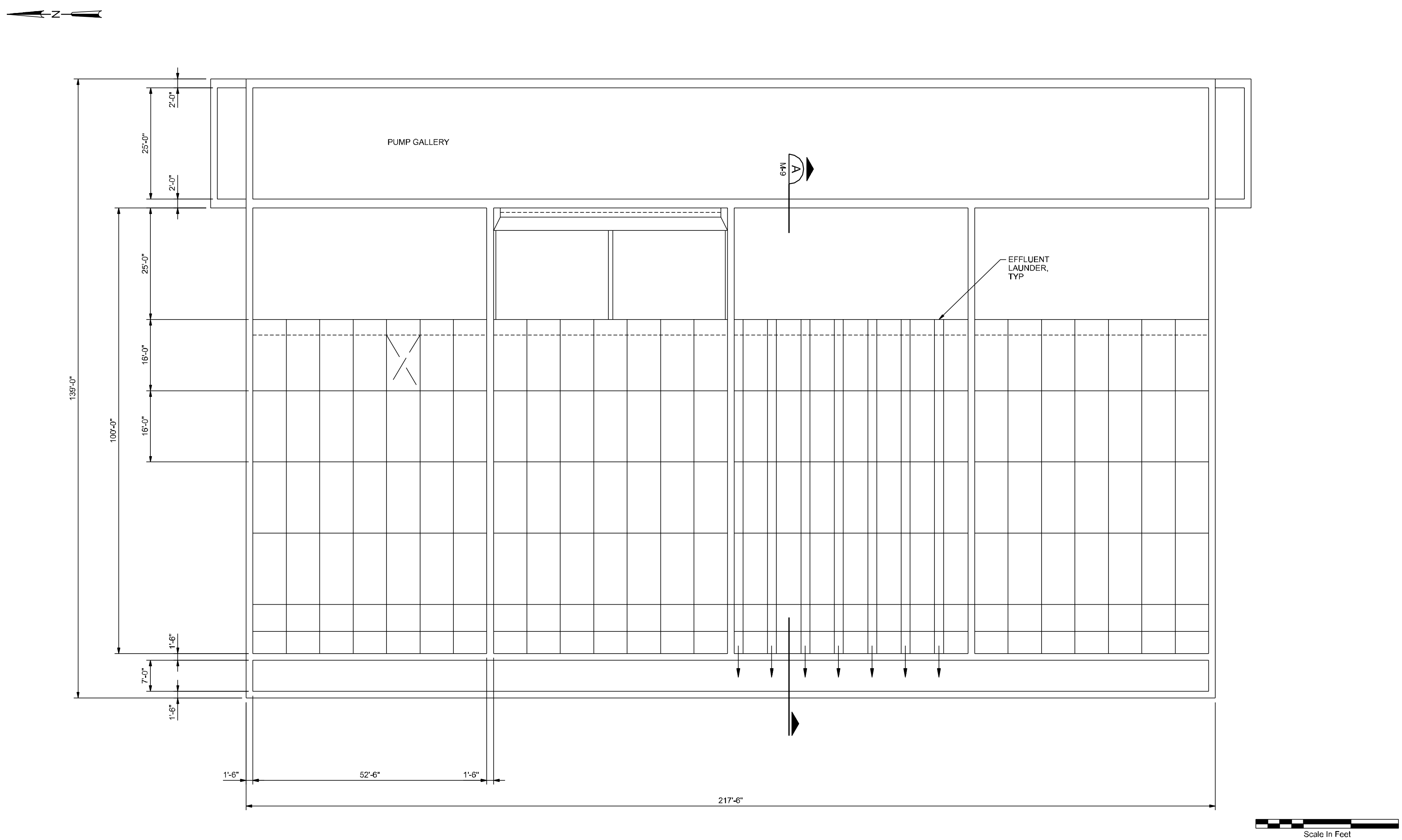


FIGURE 4-5
Dredging Plan for Georgetown Reservoir—Plan

CH2MHILL



BASIN PLAN
3/32"=1'-0"

FIGURE 4-6
GEORGETOWN SEDIMENTATION BASIN
PLAN

CH2MHILL

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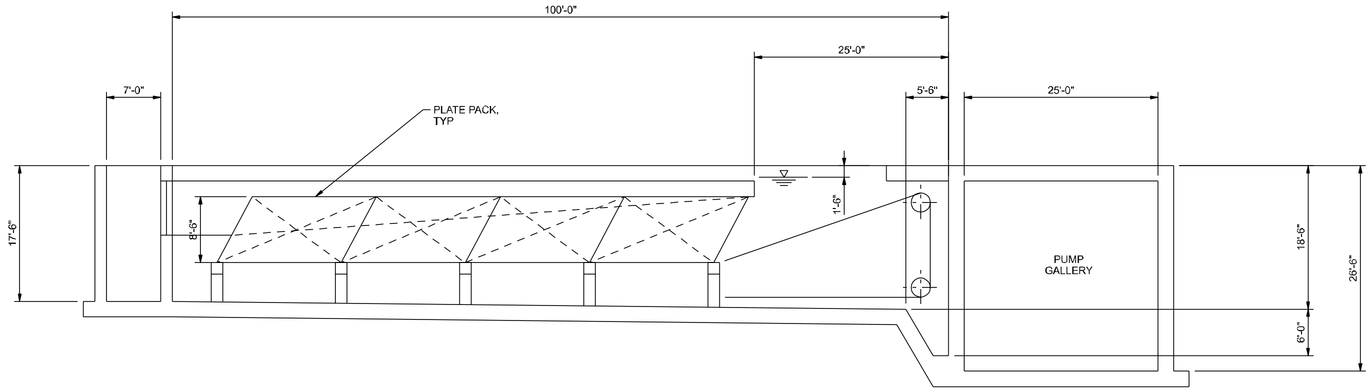

BASIN SECTION A
1/8"=1'-0" M-6

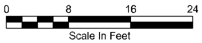

FIGURE 4-7
GEORGETOWN SEDIMENTATION BASIN
SECTION

CH2MHILL

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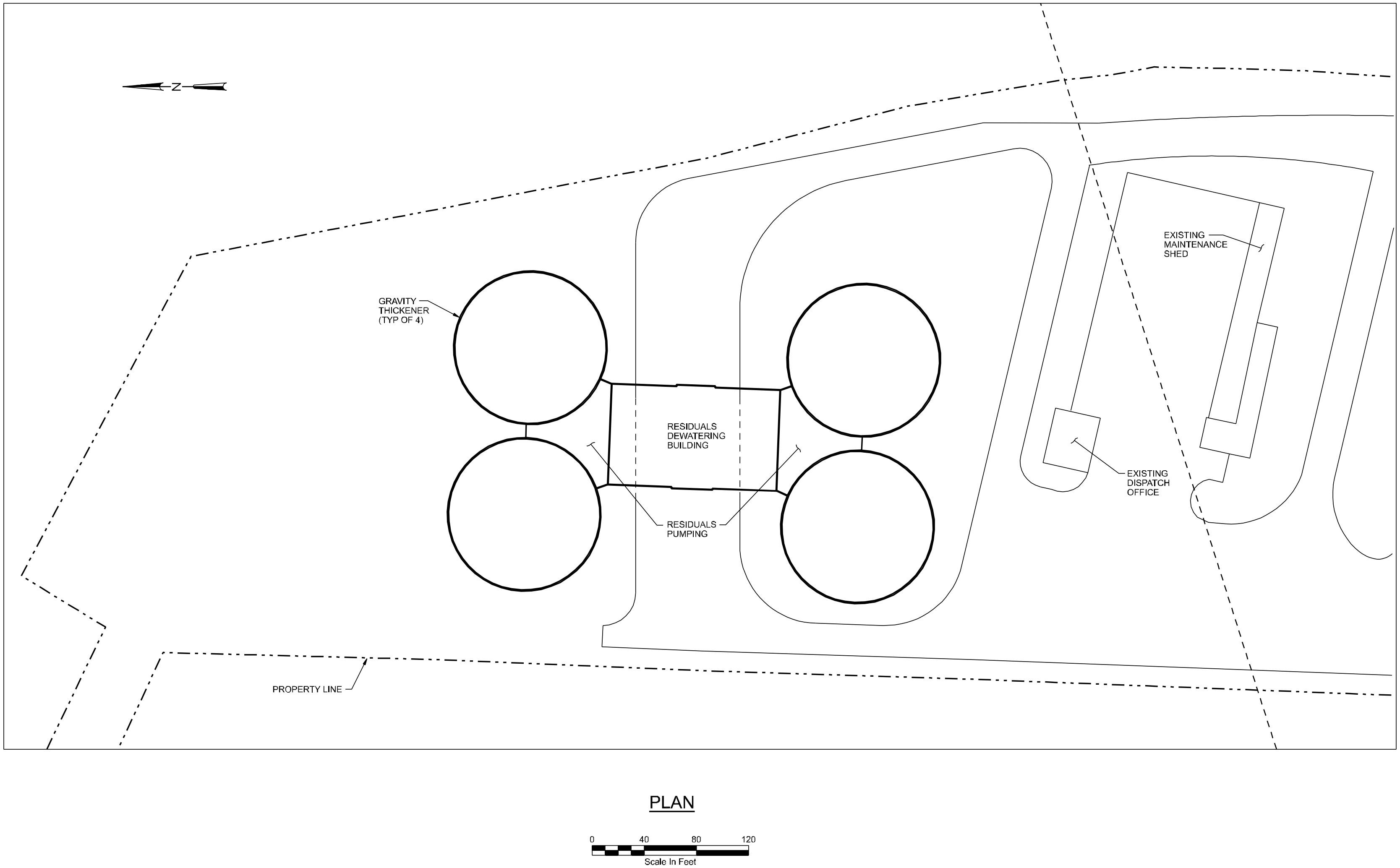


Figure 4-8
RESIDUALS PROCESSING COMPLEX
SITE PLAN

CH2MHILL

Not Modified 00nc05f_186970.dgn

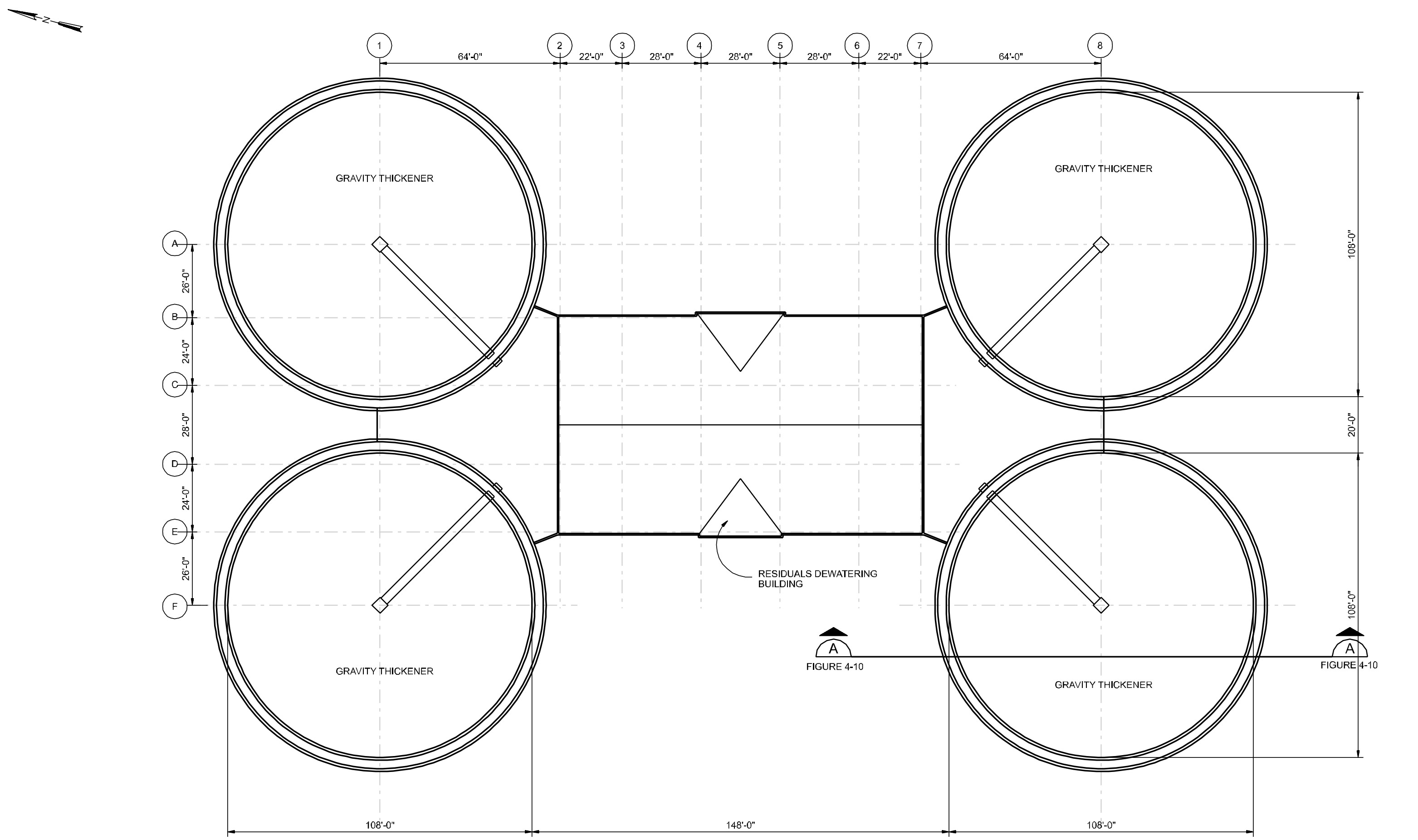
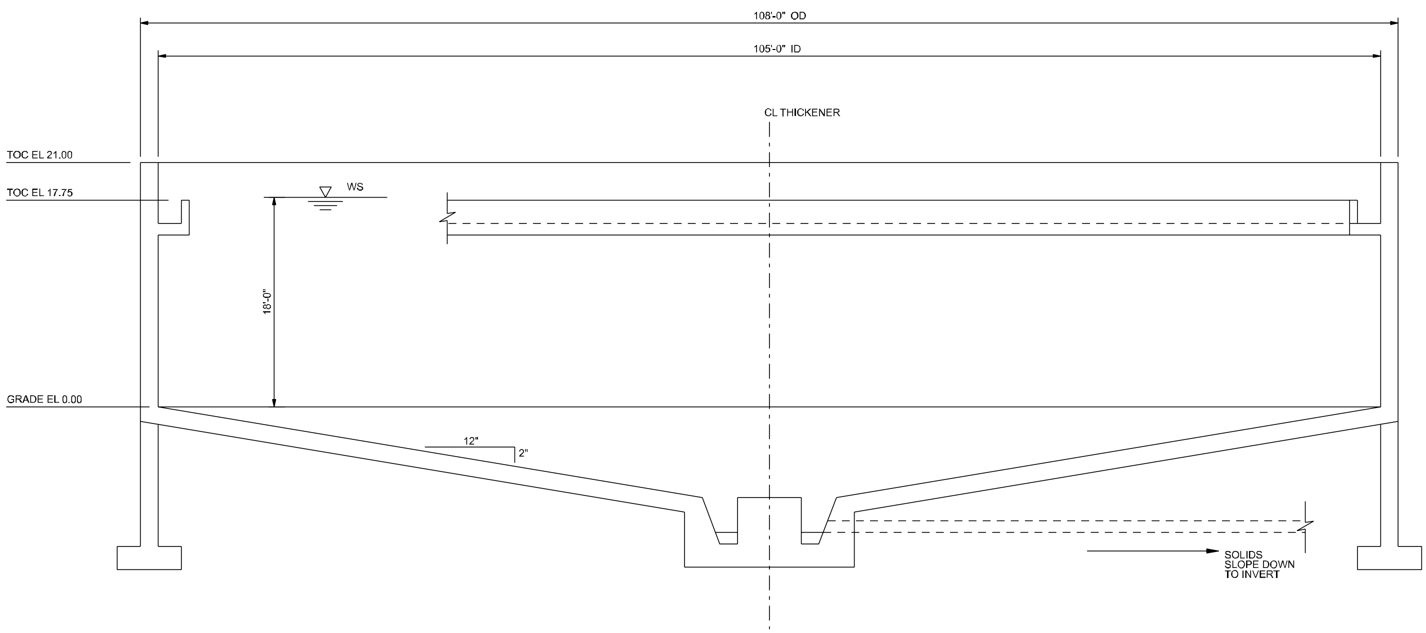


FIGURE 4-9
RESIDUALS PROCESSING COMPLEX
OVERALL PLAN SCALE 1"=20'

0 20 40 60
Scale In Feet

CH2MHILL



THICKENER SECTION A
3/16"=1'-0" M-4

FIGURE 4-10
GRAVITY THICKENERS
SECTION

CH2MHILL

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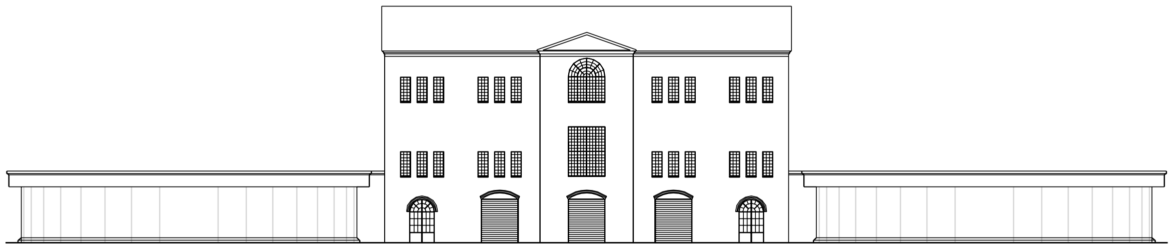
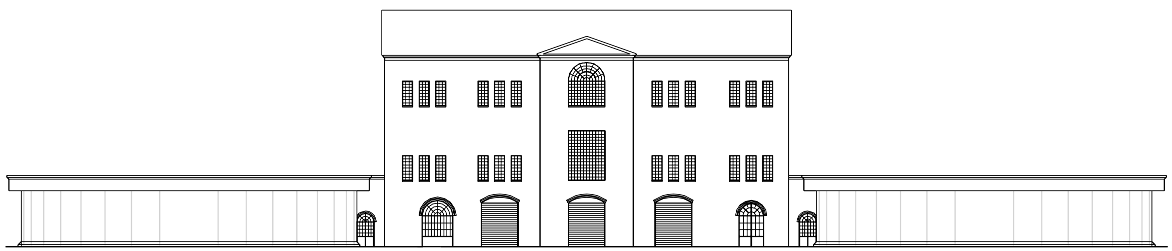


EAST ELEVATION
SCALE 1" = 20'-0"

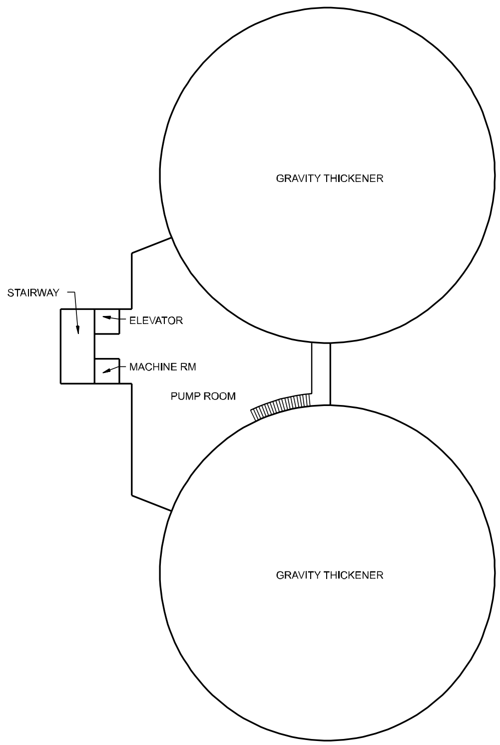


WEST ELEVATION
SCALE 1" = 20'-0"

FIGURE 4-11
RESIDUALS PROCESSING COMPLEX
ELEVATIONS SCALE 1" = 20'-0"

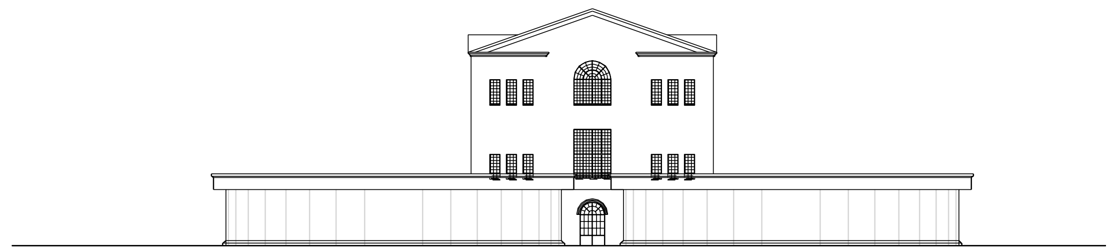
0 20 40 60
Scale In Feet

CH2MHILL



BASEMENT PLAN

SCALE 1" = 20'-0"



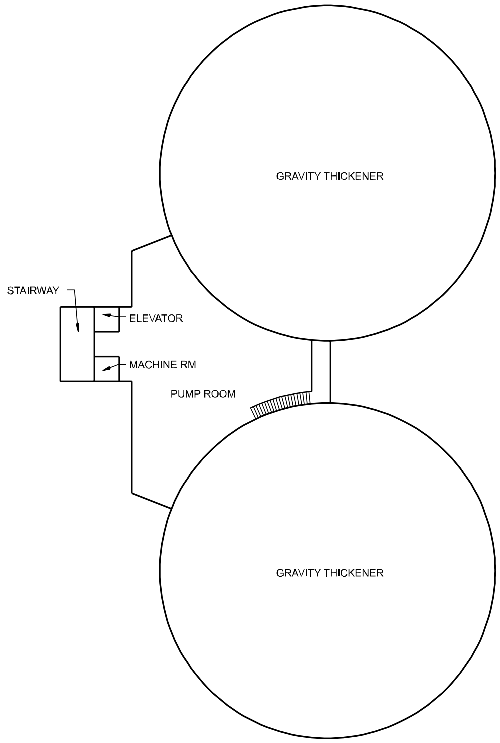
NORTH ELEVATION (SOUTH SIMILAR)

SCALE 1" = 20'-0"

FIGURE 4-12
RESIDUALS PROCESSING COMPLEX
ELEVATIONS AND BASEMENT PLAN SCALE 1" = 20'-0"

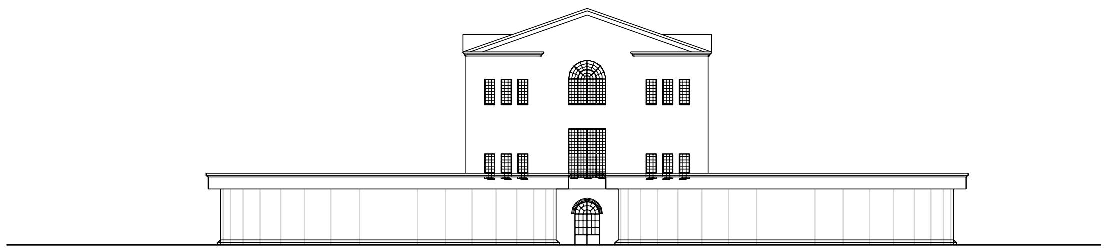
0 20 40 60
Scale In Feet

CH2MHILL



BASEMENT PLAN

SCALE 1" = 20'-0"



NORTH ELEVATION (SOUTH SIMILAR)

SCALE 1" = 20'-0"

FIGURE 4-12
RESIDUALS PROCESSING COMPLEX
ELEVATIONS AND BASEMENT PLAN SCALE 1" = 20'-0"

0 20 40 60
Scale In Feet

CH2MHILL

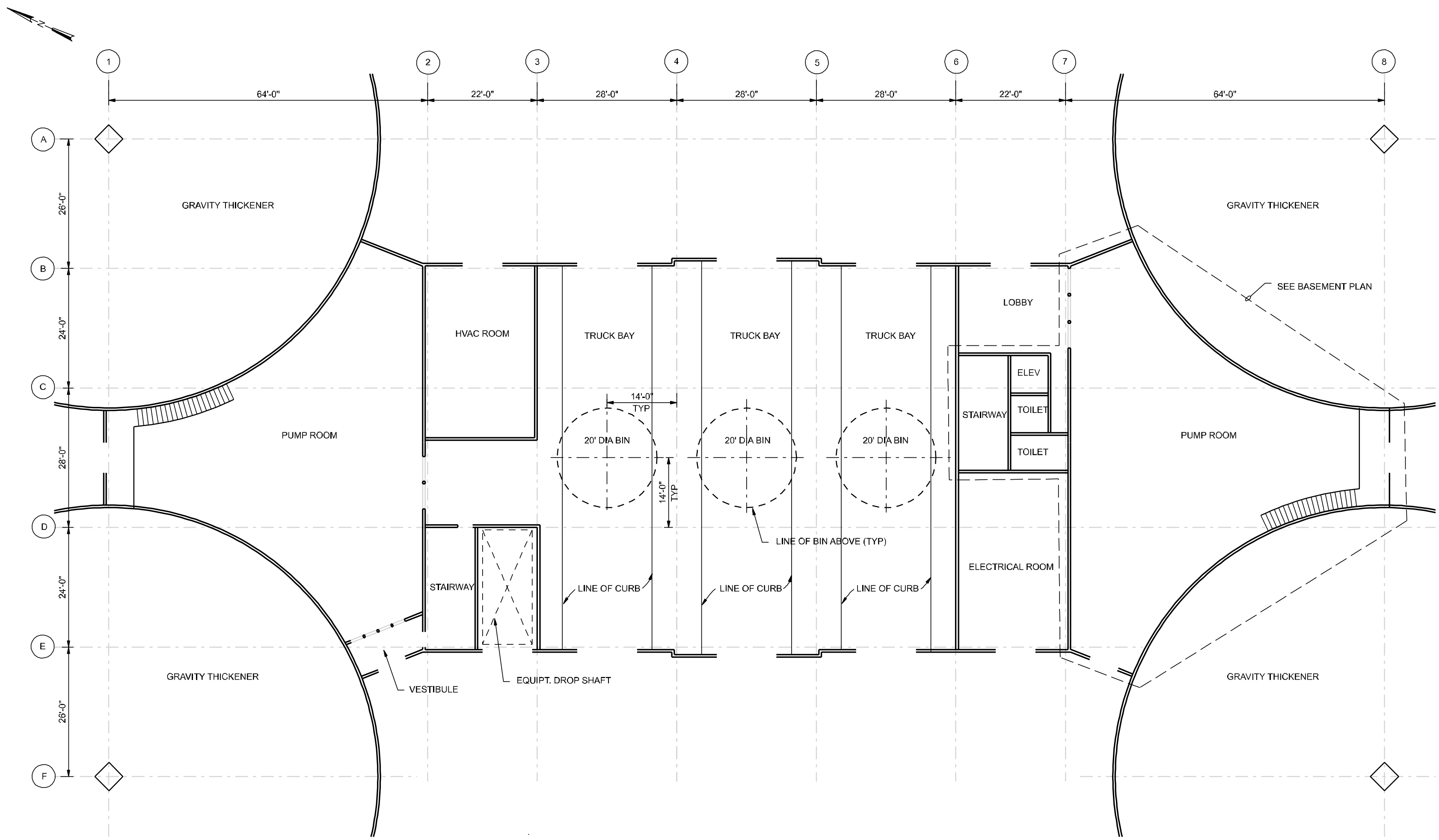


FIGURE 4-13
RESIDUALS PROCESSING COMPLEX
FIRST FLOOR PLAN SCALE 3/32" = 1'-0"

3/32"=1'-0"

CH2MHILL

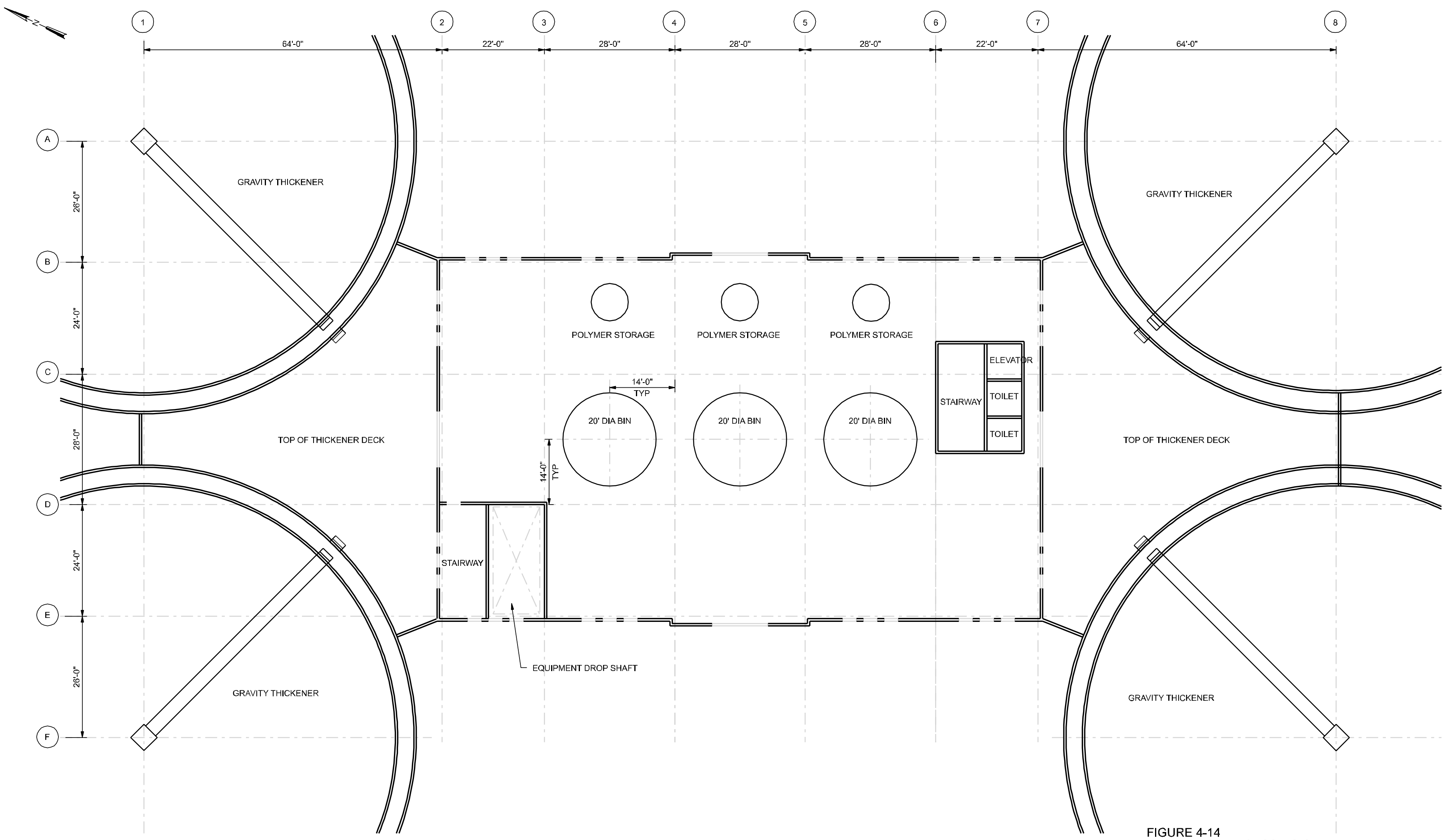


FIGURE 4-14
RESIDUALS PROCESSING COMPLEX
SECOND FLOOR PLAN SCALE 3/32" = 1'-0"

3/32"=1'-0"

CH2MHILL

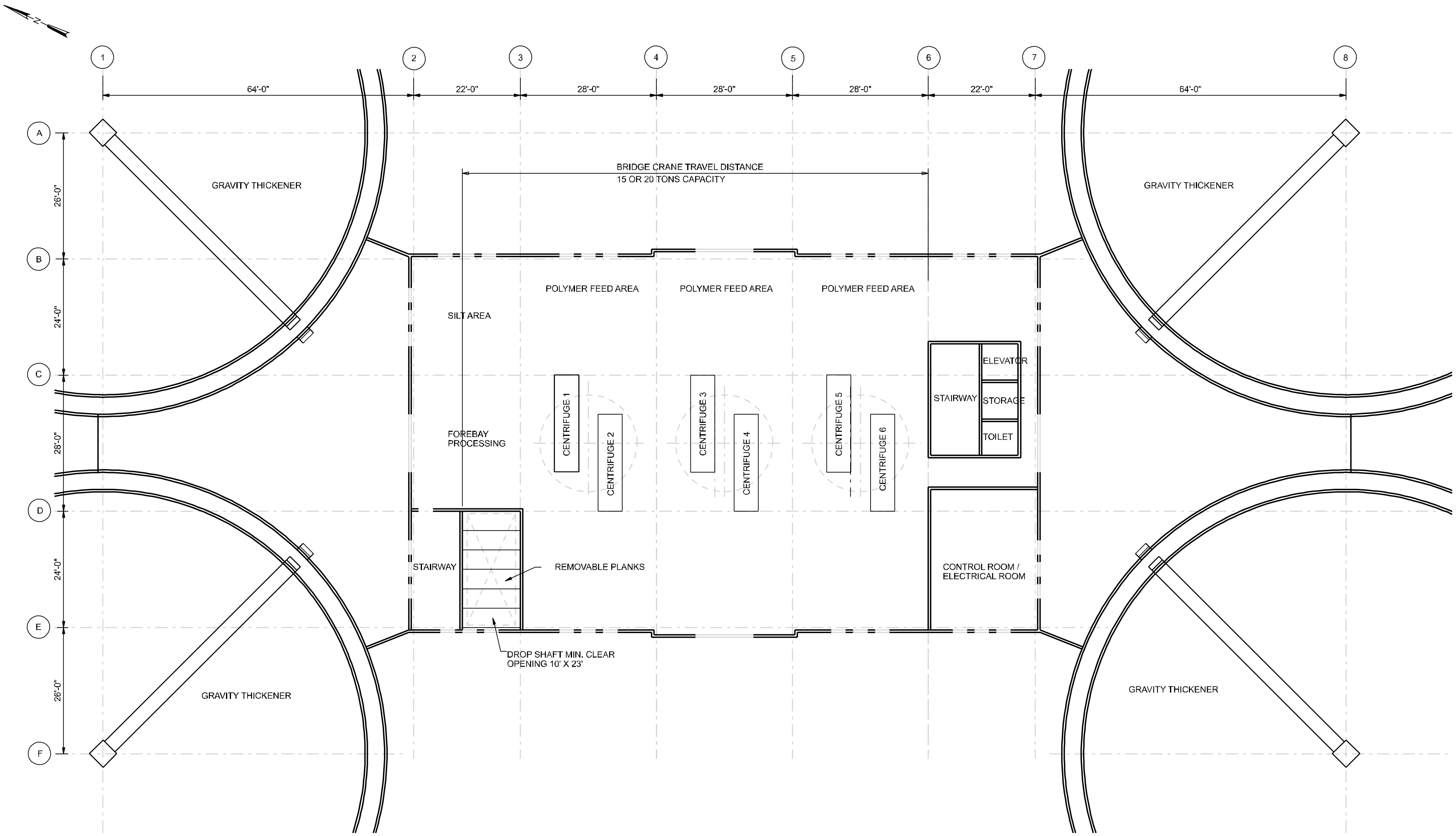
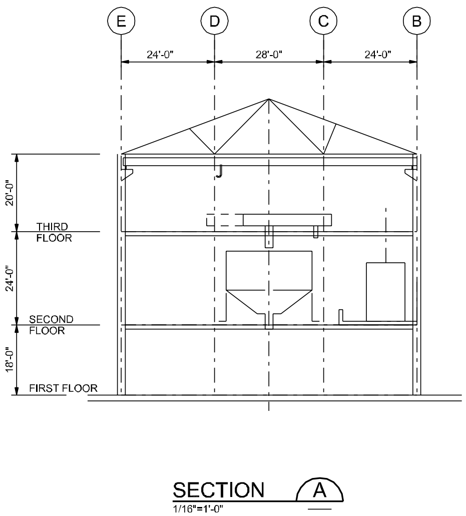
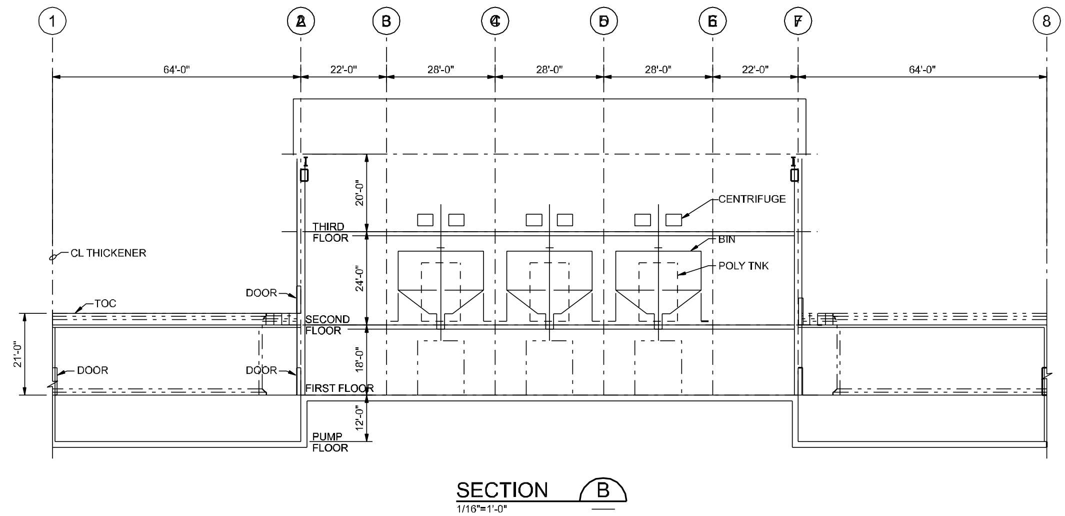


FIGURE 4-15
RESIDUALS PROCESSING COMPLEX
THIRD FLOOR PLAN SCALE 3/32" = 1'-0"

CH2MHILL





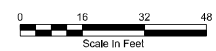


FIGURE 4-16
RESIDUALS PROCESSING COMPLEX
SECTION

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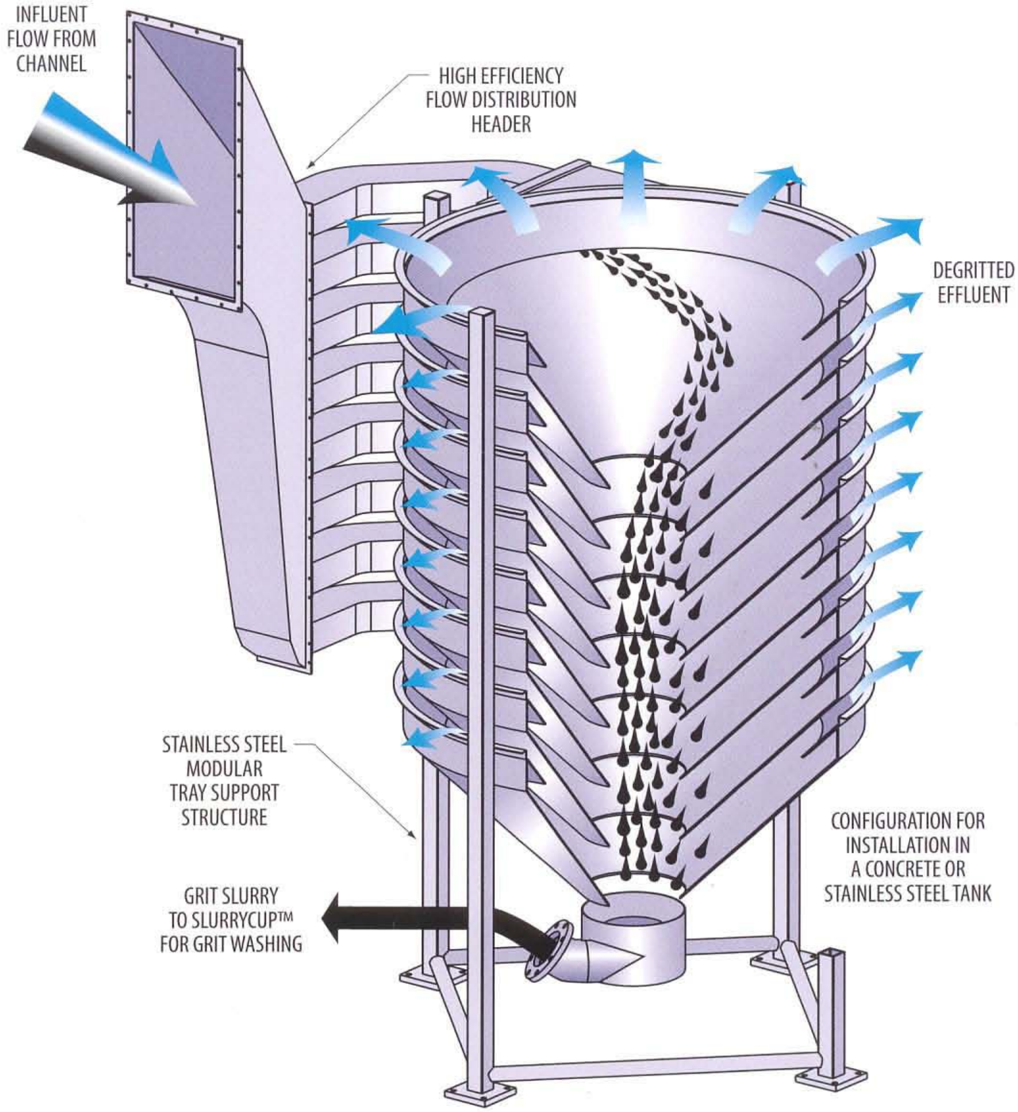
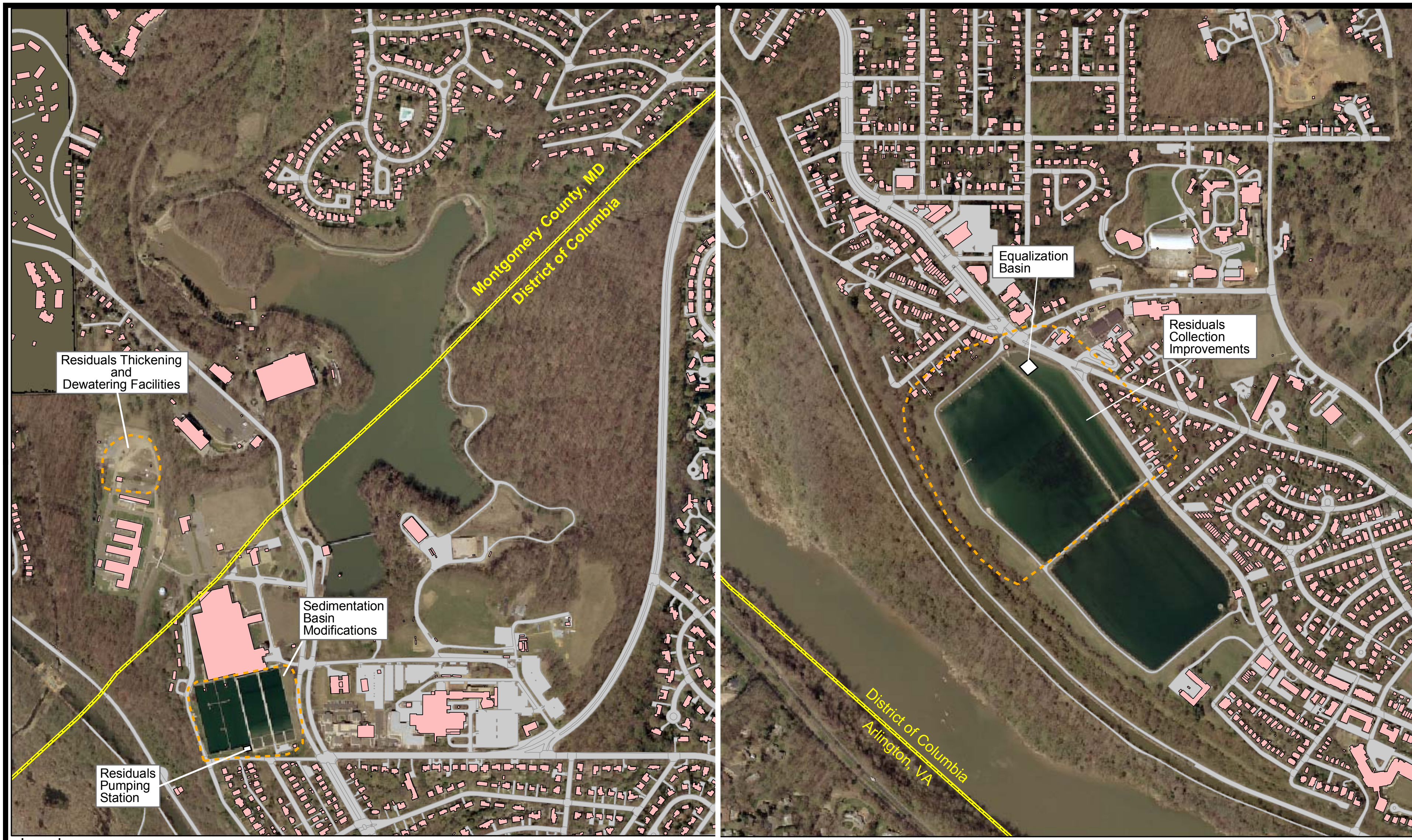
EUTEK SYSTEMS™

HEADCELL™ Settleable Solids Separator



FEATURES	BENEFITS
✦ Large surface area with short settling distances	✦ Protects equipment and processes from abrasive wear and sedimentation
✦ Compact, yet expandable design	✦ Effective use of valuable space
✦ All-hydraulic design with no moving parts	✦ Long component life with minimal wear
✦ Structured flow configuration	✦ Eliminates short circuiting, enhancing grit capture
✦ Continuous boundary layer flow over hydrophobic surfaces	✦ Minimal grease build-up
✦ Clean, dry grit when washed and dewatered by the EUTEK® SYSTEMS™ SLRRYCUP™ and GRIT SNAIL™	✦ Meets stringent environmental requirements with less odors

Figure 4-17
Settleable Solids Separator



Legend

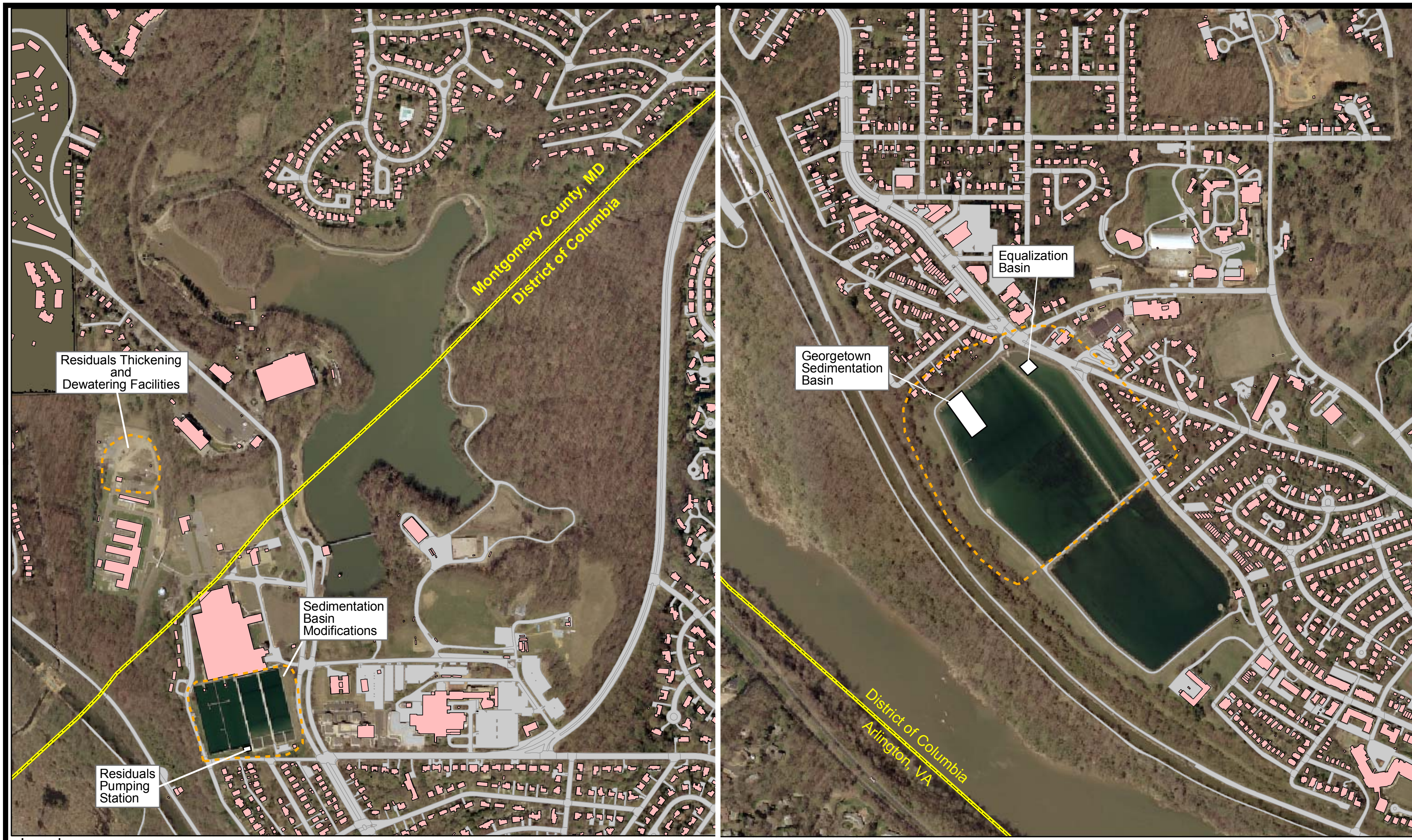
- Area of Potential Modifications
- County Boundary
- Existing Buildings
- Roads

The geographic information shown on this map is based on data from the District of Columbia Geographic Information System (DC GIS). The District Government makes no warranty, express or implied, and disclaims all implied warranties of suitability of the DC GIS product for a particular purpose.

0 300 600 Feet

Figure 4-18
Site Plan - Base Case

CH2MHILL



Legend

- Area of Potential Modifications
- County Boundary
- Existing Buildings
- Roads

The geographic information shown on this map is based on data from the District of Columbia Geographic Information System (DC GIS). The District Government makes no warranty, express or implied, and disclaims all implied warranties of suitability of the DC GIS product for a particular purpose.

Figure 4-21
Site Plan - New Georgetown Sedimentation Basin

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SECTION 5

Alternatives for Detailed Evaluation

This section includes a short description of the alternatives that will be evaluated in more detail during the Feasibility Study. Additional details of these alternatives will be available in the draft EIS.

5.1 Alternative 1

The no-action alternative is retained as a NEPA requirement.

5.2 Alternative 2

Residuals from the Dalecarlia Sedimentation Basins and the Georgetown Reservoir would be collected and thickened/dewatered at the Dalecarlia WTP before being disposed of in the Dalecarlia monofill. Residuals from the Forebay would be processed separately as is currently practiced and periodically hauled offsite.

5.2.1 Facilities

Figure 5-1 shows the location of the sedimentation basins to be upgraded (as shown in "base case" from Section 4), the preliminary location of thickening and dewatering facilities, and the approximate footprint of the monofill. As described in Section 4, and as shown in Figures 4-18 through 4-21, four options are under consideration for the collection of water treatment residuals.

As currently conceived, the monofill would be approximately 50 ft tall on the Dalecarlia Parkway side and 80 ft tall on the Dalecarlia Reservoir side. The footprint of the monofill is anticipated to occupy approximately 30 acres.

5.2.2 Conveyance and Transport

Pipelines would convey coagulated residuals from both the Dalecarlia sedimentation basins and the Georgetown Reservoir to the Dalecarlia thickening facility, unless all sedimentation capacity is centralized at the Dalecarlia WTP. After thickening and dewatering, onsite trucks would be used to haul the residuals to the monofill. On average, six onsite truck trips per day (6 days per week) would be required.

5.3 Alternative 5

This alternative would eliminate truck traffic associated with residuals on the roads surrounding the Washington Aqueduct Reservation by conveying thickened residuals via a dedicated, dual pipeline to the Blue Plains WWTP for further processing and disposal. Residuals from the Forebay would be processed separately for onsite disposal, as is currently practiced. Figure 5-2 provides an overview of this alternative.

5.3.1 Facilities

This alternative would involve residuals collection at the Georgetown Reservoir and at the Dalecarlia WTP, followed by onsite thickening, as shown in Figures 4-18 through 4-20. The thickened residuals would then be pumped to Blue Plains via a dedicated pipeline. Dewatering facilities, however, would be located at Blue Plains.

5.3.2 Conveyance and Transport

Residuals would be conveyed from both the onsite sedimentation basins and the Georgetown Reservoir to the Dalecarlia thickening facility. A dedicated, dual pipeline within existing rights of way would convey the thickened residuals to Blue Plains for final processing. This pipe would be approximately 10 miles long and 12 in. in diameter.

5.4 Alternative 25

This alternative consists of thickening and dewatering water treatment residuals at the Dalecarlia WTP. Residuals from the Dalecarlia sedimentation basins and the Georgetown Reservoir would be collected and thickened/dewatered at the Dalecarlia WTP. The dewatered residuals would be disposed of by contract hauling from Dalecarlia WTP to a permitted disposal facility.

5.4.1 Facilities

Figures 4-18 through 4-21 show the potential locations for the facilities associated with this alternative. The figures show various options for sedimentation and residuals collection improvements and the preliminary location of thickening and dewatering facilities.

5.4.2 Conveyance and Transport

Pipelines would convey water treatment residuals from both the onsite sedimentation basins and the Georgetown Reservoir to the Dalecarlia thickening facility. After thickening and dewatering, the residuals would be hauled by truck to a permitted offsite disposal facility. The estimated number of trucks is approximately eight per day (5 days per week) on average with a peak number of approximately 33 trucks per day (6 days per week) under maximum loading conditions.

5.5 Cost Summary

Table 5-1 is a summary of order of magnitude costs for the three alternatives that will be retained for further evaluation during the EIS. Costs for sedimentation and residuals collection options, as discussed in Section 4, are also summarized in Table 5-1. As was discussed in Section 4, previous cost estimates by WR&A for facilities such as residuals collection, thickening, and dewatering were updated for inflation and used as the basis for this estimate.

For Alternative 5 (i.e., dedicated pipeline to Blue Plains), it was assumed that a dewatering building, equivalent in cost to the one proposed for the Dalecarlia WTP, would need to be constructed at Blue Plains. This assumption was necessary because of the current uncertainty associated with the availability of dewatering capacity at Blue Plains.

The cost for the monofill was based on the cost for a monofill of similar size for lime residuals that was constructed in Northern Virginia in the mid-1990s. Actual bid costs were used as the basis for the estimate and were updated for inflation.

Table 5-2 presents preliminary present worth costs for the “base case” residuals collection and sedimentation option for each of the three alternatives to be retained for detailed evaluation in the DEIS. The base case option includes the retrofit of the existing Dalecarlia sedimentation basins with residuals collection equipment and the installation of a dredging system to collect residuals from the Georgetown Reservoir, as well as a thickening and dewatering facility. The present worth cost was calculated for a 20-year project life at a discount factor (i.e., interest rate) of 3 percent.

Table 5-3 is a summary of the assumptions used to create the annual operations and maintenance (O&M) costs used in the evaluation. The assumptions will be refined further as additional detail is developed for each of the alternatives. At this preliminary level of detail, it can generally be concluded that the monofill alternative (Alternative 2) has the lowest present worth cost. Onsite processing with hauling of dewatered residuals to an offsite location (Alternative 25) has the second lowest present worth cost, and the dedicated pipeline route to the Blue Plains WWTP (Alternative 5) has the highest present worth cost.

The costs presented in this Engineering Feasibility Study are preliminary. It is important to note that cost will be only one of the factors to be considered in choosing the recommended alternative for implementation. The DEIS will evaluate several other factors, specifically pertaining to environmental and other impacts, that will be used by Washington Aqueduct to choose the recommended alternative for implementation.

TABLE 5-1
Order-of-Magnitude Cost Summary for the Selected Alternatives

	Alternative 2 Dalecarlia Monofill				Alternative 5 Dedicated Pipeline to the Blue Plains WWTP				Alternative 25 Onsite Processing with Hauling to an Offsite Location			
	Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Retrofit of Existing Basins with Collection Equipment	$12,592,000	——	$12,592,000	$12,592,000	$12,592,000	——	$12,592,000	$12,592,000	$12,592,000	——	$12,592,000	$12,592,000
Modifications to Basins 1 & 2 Only	——	$36,676,000	——	——	——	$36,676,000	——	——	——	$36,676,000	——	——
New Sedimentation Basin at Dalecarlia	——	——	$23,746,000	——	——	——	$23,746,000	——	——	——	$23,746,000	——
Dredging System at Georgetown	$7,441,000	——	——	——	$7,441,000	——	——	——	$7,441,000	——	——	——
New Sedimentation Basin at Georgetown	——	——	——	$14,613,000	——	——	——	$14,613,000	——	——	——	$14,613,000
Subtotal – Sedimentation and Residuals Collection	**$20,033,000**	**$36,676,000**	**$36,338,000**	**$27,205,000**	**$20,033,000**	**$36,676,000**	**$36,338,000**	**$27,205,000**	**$20,033,000**	**$36,676,000**	**$36,338,000**	**$27,205,000**
Gravity Thickeners and Thickened Residuals Pump Station	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000	$9,670,000
Dewatering Building	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000	$19,720,000
Miscellaneous Support Facilities	$774,000	$774,000	$774,000	$774,000	$774,000	$774,000	$774,000	$774,000	$774,000	$774,000	$774,000	$774,000
Subtotal – Collection and Processing Facilities	**$50,197,000**	**$66,840,000**	**$66,502,000**	**$57,369,000**	**$50,197,000**	**$66,840,000**	**$66,502,000**	**$57,369,000**	**$50,197,000**	**$66,840,000**	**$66,502,000**	**$57,369,000**
Dalecarlia Monofill	$6,697,000	$6,697,000	$6,697,000	$6,697,000	——	——	——	——	——	——	——	——
Thickened Residuals Pump Station and Pipeline	——	——	——	——	$13,434,000	$13,434,000	$13,434,000	$13,434,000	——	——	——	——
Total ($2004)	**$56,894,000**	**$73,537,000**	**$73,199,000**	**$64,066,000**	**$63,631,000**	**$80,274,000**	**$79,936,000**	**$70,804,000**	**$50,197,000**	**$66,840,000**	**$66,502,000**	**$57,369,000**
Escalated to Mid-Point of Construction (July 2008)	**$65,883,000**	**$85,156,000**	**$84,764,000**	**$74,188,000**	**$73,685,000**	**$92,957,000**	**$92,566,000**	**$81,990,000**	**$58,128,000**	**$77,401,000**	**$77,009,000**	**$66,433,000**

TABLE 5-2
Preliminary Net Present Value for the Selected Alternatives

Residuals Process	Alternative 2 Dalecarlia Monofill	Alternative 5 Dedicated Pipeline Route to the Blue Plains WWTP	Alternative 25 Onsite Processing with Hauling to an Offsite Location
Capital Costs			
Collection and Processing	$50,198,000	$50,198,000	$50,198,000
Additional Facilities	$6,697,000	$13,434,000	$0
Total Capital Cost ($2004)	**$56,895,000**	**$63,632,000**	**$50,198,000**
Annual O&M Costs			
Labor (Thickening and Dewatering)	$374,000	$374,000	$374,000
Labor (Monofill Operation)	$69,000	$0	$0
Chemicals (Thickening and Dewatering)	$238,000	$238,000	$238,000
Power	$117,000	$192,000	$117,000
Other (Monofill-Specific Costs)	$79,000	$0	$0
Other (Contract Hauling)	$0	$1,194,000	$1,194,000
Total (Annual O&M Costs)	**$877,000**	**$1,998,000**	**$1,923,000**
Present Worth Costs			
Present Worth of Annual Costs	$13,048,000	$29,725,000	$28,609,000
Salvage Value	$0	$0	$0
Net Present Value	**$69,943,000**	**$93,357,000**	**$78,807,000**

TABLE 5-3
Assumptions for the Preliminary Net Present Value Calculations

Category	Assumptions
Residuals Production	
Production	32 dry tons/day @ 30% dry solids; 109 wet tons/day
Average Operating Period	16 hours/day; 5 days/week; 52 weeks/year
Chemicals	
Polymer Use	8 to 10 Lbs. active material per ton of dry solids
Polymer Cost	$2.00 per pound of active material
Power	
Electrical Power Costs	$0.045 to $0.070 per KwH ($0.06/KwH was used for the evaluation)
Labor Costs	
Burdened Operations Labor Costs	$33.00 per hour
Burdened Managerial Labor Costs	$47.00 per hour
Managerial to Operations Ratio	1 to 6 (for thickening and dewatering only)
Thickening and Dewatering Labor	2 people; 16 hours/day
Landfill Labor	1 person; 40 hours/week
Contract Hauling	
Contract Hauling	$30.00 per wet ton
Net Present Value Calculations	
Discount Rate	3%
Present Worth Period	20 years
Salvage Value	None

Other Assumptions:

1. Maintenance costs for equipment and facilities are not included in the evaluation.
2. Annual costs for the monofill and costs for contract hauling are based on discussions with the Upper Occoquan Sewage Authority (Centreville, VA).
3. Costs for contract hauling will depend on the competitive environment and hauling distances.
4. Capital costs are not escalated to the mid-point of construction.
5. Cost calculations for Alternative 5 assume that the capital and annual costs to thicken at the Dalecarlia WTP and dewater at Blue Plains are the same as an all-Dalecarlia WTP operation.

Legend

Approximate Location of New/Modified Facilities

County Boundary

Existing Buildings

Roads

The geographic information shown on this map is based on data from the District of Columbia Geographic Information System (DC GIS). The District Government makes no warranty, express or implied, and disclaims all implied warranties of suitability of the DC GIS product for a particular purpose.

0 375 750 1,500 Feet

Figure 5-1
Monofill at Reservoir

CH2MHILL

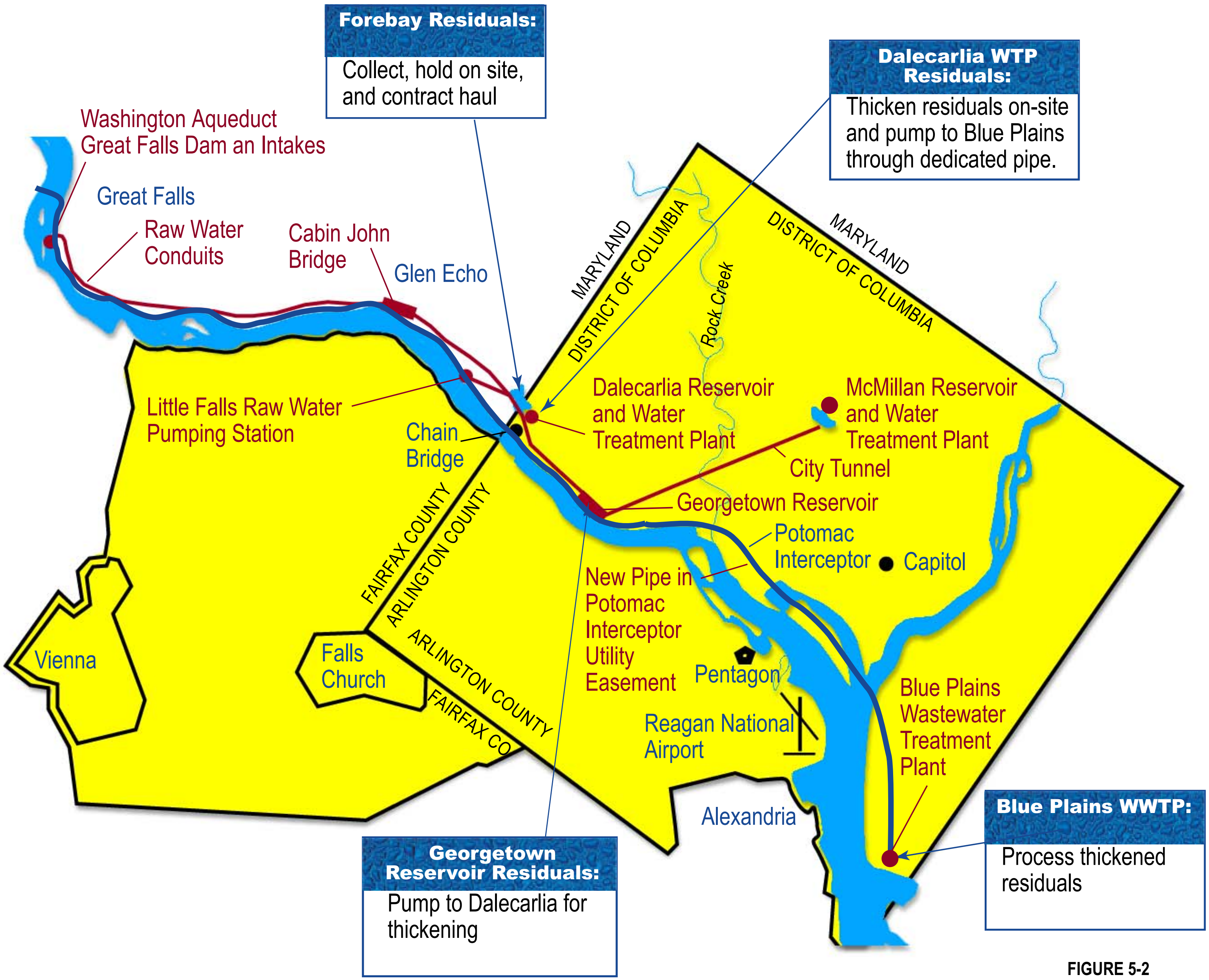

FIGURE 5-2
Overview of Blue Plains Alternatives

CH2MHILL

SECTION 6
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Appendix A
Descriptions of Alternatives

Appendix A

Tables A-1 through A-5 identify each of the residuals-handling steps (i.e., collection, conveyance, processing, and disposal) required for each alternative, list collection and treatment locations, and describe the anticipated residuals disposal location for each alternative.

TABLE A-1
Description of Alternatives That Do Not Require Continuous OffsiteTrucking from the Dalecarlia Water Treatment Plant

Location	Collection	Conveyance	Processing	Disposal
Alternative 2: Process water treatment residuals at Dalecarlia WTP and dispose in Dalecarlia monofill. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill
Forebay	Collect Forebay residuals using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years
Alternative 3: Coprocess water treatment and Forebay residuals at Dalecarlia WTP and codispose in Dalecarlia monofill				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals Dalecarlia monofill
Forebay	Collect Forebay residuals using current methods	Pump residuals to Dalecarlia thickening facility along with water treatment residuals	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to Dalecarlia monofill

TABLE A-1
Description of Alternatives That Do Not Require Continuous OffsiteTrucking from the Dalecarlia Water Treatment Plant

Location	Collection	Conveyance	Processing	Disposal
Alternative 4: Pump unthickened water treatment residuals via Potomac Interceptor to the District of Columbia Water and Sewer Authority (DC WASA) Blue Plains Wastewater Treatment Plant. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals into the Potomac Interceptor	Process residuals at Blue Plains with raw sewage	Transport dewatered residuals for disposal per current Blue Plains methods
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals from Dalecarlia to Potomac Interceptor	Process residuals at Blue Plains with raw sewage	Transport dewatered residuals for disposal per current Blue Plains methods
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years
Alternative 5: Thicken water treatment residuals at Dalecarlia WTP, then pump via a new pipeline to DC WASA Blue Plains Wastewater Treatment Plant. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to Blue Plains via a new dual pipeline	Thicken collected residuals at Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to Blue Plains via a new dual pipeline	Thicken collected residuals at Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-1
Description of Alternatives That Do Not Require Continuous OffsiteTrucking from the Dalecarlia Water Treatment Plant

Location	Collection	Conveyance	Processing	Disposal
Alternative 6: Thicken water treatment residuals at Dalecarlia WTP, then transport by barge to DC WASA Blue Plains Wastewater Treatment Plant. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Transport thickened residuals to Blue Plains by barge	Thicken collected residuals at Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Transport thickened residuals from Dalecarlia to Blue Plains by barge	Thicken collected residuals at the Dalecarlia Process thickened residuals at Blue Plains	Transport dewatered residuals for disposal per current Blue Plains methods
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years
Alternative 7: Thicken water treatment residuals at Dalecarlia WTP, then pump via pipeline to neighboring water utility. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to WSSC or FCWA facility	Thicken collected residuals at Dalecarlia Dewater thickened residuals at WSSC or FCWA	Dispose of dewatered residuals with residuals from host facility
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Pump thickened residuals from Dalecarlia to WSSC or FCWA facility	Thicken collected residuals at Dalecarlia Dewater thickened residuals at WSSC or FCWA	Dispose of dewatered residuals with residuals from host facility
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-1
Description of Alternatives That Do Not Require Continuous OffsiteTrucking from the Dalecarlia Water Treatment Plant

Location	Collection	Conveyance	Processing	Disposal
Alternative 8: Thicken water treatment residuals at Dalecarlia WTP and pump via pipeline to new dewatering location. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from the existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to new offsite dewatering facility	Thicken the collected residuals at Dalecarlia Dewater the thickened residuals at offsite facility	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility Pump thickened residuals from Dalecarlia to a new dewatering facility	Thicken collected residuals at Dalecarlia facility Dewater the thickened residuals at offsite facility	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-2
Description of Alternatives With Discharge to the Potomac River

Location	Collection	Conveyance	Processing	Transport
Alternative 9: Process most WTP residuals at Dalecarlia WTP and haul offsite, but dilute some residuals for discharge back to Potomac River. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump portion of residuals to Dalecarlia thickening facility	Thicken and dewater portion of collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
		Pump portion of residuals to Dalecarlia storage and dilution facility (10% assumed)		Discharge diluted residuals to Potomac River
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals from Dalecarlia to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia WTP thickening facility	Thicken and dewater collected residuals at Dalecarlia thickening facility	Haul dewatered residuals to offsite disposal facility every 7 years
Alternative 10: Renegotiate NPDES Permit to allow discharge of all residuals to Potomac River				
Dalecarlia WTP	Renegotiate NPDES Permit to discharge all water treatment residuals to the Potomac River			
Georgetown Reservoir	Renegotiate NPDES Permit to discharge all water treatment residuals to the Potomac River			
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia WTP thickening facility	Thicken and dewater collected residuals at Dalecarlia thickening facility	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-2
Description of Alternatives With Discharge to the Potomac River

Location	Collection	Conveyance	Processing	Transport
Alternative 11: Process water treatment residuals at Dalecarlia WTP and haul offsite. Process Forebay residuals by current methods and periodically haul. Dilute treatment side streams and discharge to the Potomac River				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump portion of residuals to Dalecarlia thickening facility Pump thickener overflow and centrate to onsite storage and dilution facility	Thicken and dewater portion of collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location Discharge diluted thickener overflow and centrate to Potomac River
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals from Dalecarlia to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-3
Description of Alternatives Involving the Dalecarlia Reservoir

Location	Collection	Conveyance	Processing	Transport
Alternative 12: Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals. Dispose in Dalecarlia and McMillan monofills				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia facility	Haul dewatered residuals to monofills on Dalecarlia and McMillan sites
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to monofills on Dalecarlia and McMillan sites
McMillan WTP Facilities				Haul dewatered residuals to monofill on the McMillan site
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia facility	Haul dewatered residuals to Dalecarlia and McMillan monofills
Alternative 13: Store all residuals in the Dalecarlia Reservoir prior to processing at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia facility	Haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location

TABLE A-3
Description of Alternatives Involving the Dalecarlia Reservoir

Location	Collection	Conveyance	Processing	Transport
Alternative 14: Construct new sedimentation basins at the Dalecarlia Reservoir and process all residuals at Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal				
Dalecarlia WTP	Collect water treatment residuals from new sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Abandon Georgetown Reservoir; all coagulation to occur at Dalecarlia			
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Haul dewatered residuals to a permitted offsite location
Alternative 15: Coagulate all flow in the Dalecarlia Reservoir and process all residuals at the Dalecarlia WTP. Coprocess Forebay and water treatment residuals and haul to offsite disposal				
Dalecarlia WTP	Add Coagulant at Dalecarlia Lift Station; Coagulate in the Dalecarlia Reservoir Dredge the Dalecarlia Reservoir	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Abandon Georgetown Reservoir; all coagulation to occur at Dalecarlia			
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to permitted offsite location

TABLE A-4
Description of Alternatives with Facilities at the McMillan Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 16: Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer's treatment facility. Contract haul dewatered residuals. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan thickening facility Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan facility Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan thickening facility Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan facility Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
McMillan WTP	Collect combined Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan thickening facility Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul the dewatered residuals from host facility to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-4
Description of Alternatives with Facilities at the McMillan Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 17: Coprocess Forebay and water treatment residuals at the McMillan WTP. Dispose of residuals via contract hauling from McMillan WTP				
(Same as Alternative 18 w/ coprocessing)				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
McMillan WTP Facilities	N/A	Pump water treatment residuals from Dalecarlia WTP and Georgetown Reservoir to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect water treatment residuals from reservoir using current methods	Pump Forebay residuals to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Alternative 18: Process water treatment residuals at the McMillan WTP and haul offsite. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan thickening facility	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
McMillan WTP Facilities	Collect Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan	Thicken and dewater collected residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-4
Description of Alternatives with Facilities at the McMillan Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 19: Thicken water treatment residuals at the McMillan WTP and dewater at an existing wholesale customer's treatment facility. Dispose of residuals via contract hauling from the existing facility. Discharge Forebay residuals to the Potomac River				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
McMillan WTP Facilities	Collect Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan Pump thickened residuals to Blue Plains, Arlington, or Falls Church dewatering facility	Thicken collected residuals at McMillan Dewater thickened residuals at Blue Plains, Arlington, or Falls Church facility	Contract haul dewatered residuals from host facility to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Potomac River	None	None

TABLE A-4
Description of Alternatives with Facilities at the McMillan Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 20: Thicken water treatment residuals at the Dalecarlia WTP and the Georgetown Reservoir and dewater at the McMillan WTP. Dispose of water treatment residuals via contract hauling from McMillan WTP. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility Pump thickened residuals to McMillan dewatering facility	Thicken collected residuals at Dalecarlia facility Dewater thickened residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Georgetown thickening facility Pump thickened residuals to McMillan	Thicken collected residuals at Georgetown Dewater thickened residuals at McMillan	Contract haul dewatered residuals from McMillan to a permitted offsite location
McMillan WTP Facilities	Collect thickened Dalecarlia and Georgetown Reservoir water treatment residuals	Pump residuals to McMillan	Dewater residuals at McMillan	Contract haul dewatered residuals to offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years
Alternative 21: Store residuals in lagoons at Forebay, Dalecarlia WTP, and McMillan WTP. Thicken and dewater residuals with portable equipment and dispose via contract hauling from all locations				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia storage lagoon	Thicken and dewater collected residuals at Dalecarlia with portable equipment	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan storage lagoon	Thicken and dewater collected residuals at McMillan with portable equipment	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to Dalecarlia storage lagoon	Thicken and dewater collected residuals at Dalecarlia with portable equipment	Contract haul dewatered residuals to a permitted offsite location

TABLE A-4
Description of Alternatives with Facilities at the McMillan Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 22: Store water treatment residuals in Dalecarlia and Georgetown Reservoirs, prior to thickening and dewatering at the Dalecarlia and McMillan WTPs. Dispose of water treatment residuals via contract hauling from the Dalecarlia and McMillan WTPs. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Add coagulant at Dalecarlia Lift Station	Pump collected residuals to the Dalecarlia Reservoir	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
	Collect water treatment residuals from existing sedimentation basins	Pump dredged residuals to Dalecarlia thickening facility		
	Dredge Dalecarlia Reservoir			
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan Reservoir	Thicken and dewater dredged residuals at McMillan facility	Contract haul dewatered residuals to a permitted offsite location
McMillan WTP Facilities	Dredge the McMillan Reservoir	Pump dredged residuals to the McMillan thickening facility	Thicken and dewater dredged residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-4
Description of Alternatives with Facilities at the McMillan Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 23: Store water treatment residuals in McMillan Reservoir prior to dewatering at the McMillan WTP. Dispose of water treatment residuals via contract hauling from the McMillan WTP. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to McMillan Reservoir	Thicken and dewater dredged residuals at McMillan facility	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to McMillan Reservoir	Thicken and dewater dredged residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
McMillan WTP Facilities	Dredge the McMillan Reservoir	Pump dredged residuals to the McMillan thickening facility	Thicken and dewater dredged residuals at McMillan	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-5
Description of Alternatives with Facilities at the Dalecarlia Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 24: Coprocess Forebay and water treatment residuals at Dalecarlia WTP. Dispose of residuals via contract hauling from the Dalecarlia WTP				
Same as Alternative 25 w/ coprocessing				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Alternative 25: Process water treatment residuals at the Dalecarlia WTP; and dispose via contract hauling. Process Forebay residuals by current methods and periodically haul				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening facility	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia	Thicken and dewater collected residuals at Dalecarlia	Contract haul dewatered residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir using current methods	Pump residuals to existing holding pond	Transfer residuals from holding pond to onsite drying bed	Haul dewatered residuals to offsite disposal facility every 7 years

TABLE A-5
Description of Alternatives with Facilities at the Dalecarlia Water Treatment Plant

Location	Collection	Conveyance	Processing	Transport
Alternative 26: Use plasma oven technology to process Forebay and water treatment residuals at the Dalecarlia WTP. Dispose of residuals via contract hauling from the Dalecarlia WTP				
Same as Alternative 25 w/ coprocessing and plasma oven step				
Dalecarlia WTP	Collect water treatment residuals from existing sedimentation basins	Pump residuals to Dalecarlia thickening/ dewatering/plasma oven facility	Use plasma oven process following thickening and dewatering on collected residuals at Dalecarlia	Contract haul processed residuals to a permitted offsite location
Georgetown Reservoir	Collect water treatment residuals from reservoir	Pump residuals to Dalecarlia thickening/ dewatering/plasma oven facility	Use plasma oven process following thickening and dewatering on collected residuals at Dalecarlia	Contract haul processed residuals to a permitted offsite location
Forebay	Collect Forebay residuals from reservoir	Pump residuals to Dalecarlia thickening/ dewatering/plasma oven facility	Use plasma oven process following thickening and dewatering on collected residuals at Dalecarlia	Contract haul processed residuals to a permitted offsite location

Appendix B
Alternative Feasibility—Transporting Liquid Residual by Barge from Washington Aqueduct to Blue Plains on the Potomac River

Regardless of which operation is considered, navigation between the Washington Aqueduct and Key Bridge is not feasible for several reasons detailed below.

NAVIGATIONAL RESTRICTIONS AND WEATHER CONCERNS

Portions of NOAA Chart 12285 Potomac River have been compiled on Sheets 1 and 2 in Appendix A. These drawings identify key landmarks and bridges along the proposed barge route and describe local water depths, bottom conditions, and tide, current, and weather conditions as given in the U.S. Coast Pilot, Atlantic Coast. The primary navigational constraints on any barge transport operation are identified as follows:

- Arlington Memorial Bridge: clear width of 80 ft with vertical clearance of 30 ft;
- 14th St. Bridge Complex: clear width of 104 ft with vertical clearance of 18 ft above Mean High Water (MHW) resulting in maximum air draft of 14 to 16 ft for barge/pushboat operation;
- Obstructions (old stone bridge piers) at 10 feet below Mean Low Water (MLW) just north of Key Bridge;
- Strong currents, irregular water depths and bottom conditions, numerous rocks and shallows north of Key Bridge to Washington Aqueduct;
- Minimum water depth of 10 feet below MLW resulting in maximum water draft of 7 ft for barge/pushboat operation between Key Bridge and Marbury Pt.;
- Transit distance of 6.5 nm with maximum speed of 5 knots for 4.1 nm from Key Bridge to Hains Pt. and 8 knots for 2.4 nm from Hains Pt. to the Blue Plains plant at Marbury Pt.;
- One-way transit time estimated to range from 1.5 to 2.5 hours for small barge/push boat operation making only 2.5 knots against the current;
- Average ebb and flood currents of approx. 0.6 knots from Key Bridge to Hains Pt. and up to 1 knot from Hains Pt. to Marbury Pt.; and
- Transit above Key Bridge to the Washington Aqueduct facility, a distance of 3.2 nm, is unsafe for navigation for all but very limited recreational craft such as kayaks and canoes, conditions permitting, and emergency response vessels.

The barge operation between Key Bridge and Marbury Pt. may also be affected by seasonal adverse weather conditions including ice on the river in the coldest winter months, higher than normal water levels, flooding and swift currents caused by rapid snow and ice melt, heavy rains, or tropical storm activity along the Atlantic coast. The occurrence or passing of one or more of these events may temporarily halt a barge operation on the river for several days at a time. Refer to Sheet 1 for additional detailed information regarding navigation and weather concerns.

DUAL BARGE OPERATIONAL SCENARIO

It was estimated that a single hopper barge with dimensions of 260 ft long by 52 ft wide by 9 ft draft can hold 885,000 gallons of liquid residual corresponding to a load of 7.46 million lbs (3,730 tons or 3,330 long tons). However, the beam and draft of this size barge are considered unsafe for navigation based on limiting water depths and bridge clearances along the route. In addition, small pushboats capable of operating within the water depth and bridge clearance limitations identified will likely not have enough power to maneuver the barges effectively and safely. Moran Towing, the largest towing company on the east coast indicated that their tugs do not operate in this area of the Potomac River due to minimum air and water draft requirements of 45 and 15 feet, respectively.

MULTIPLE BARGE OPERATIONAL SCENARIO

It was estimated that at least three smaller single hopper barges with minimum dimensions of 150 ft long by 40 ft wide by 7 ft draft would be required to handle the daily load of liquid residual. Each barge could hold on the order of 295,000 gallons of liquid residual corresponding to a load of 2.48 million lbs (1,250 tons or 1,110 long tons). Based only on the information available on the NOAA Chart and contained in the U.S. Coast Pilot, the small barge dimensions would be considered safe for navigation under most conditions normally experienced on the Potomac River between Key Bridge and Marbury Pt. A marine contractor from Chesapeake, Virginia, has indicated that small pushboats, properly powered, are capable of operating within the water depth and bridge clearance limitations identified and would be able to safely and effectively maneuver the barges. Other considerations impacting the feasibility of the multiple barge operational scenario are as follows:

- Difficult coordination and scheduling and significant manpower and facility requirements for loading, unloading, and transit of three barges in each 24-hour period, five days per week;
- Locations in the river to safely stand-down one or more barges to allow opposing barge traffic to pass would have to be identified;
- Facilities at each end of the transit route would have to accommodate at least two barges for weekends and periods when environmental conditions make the river unnavigable for this operation; and
- Alternate means of handling or storing the liquid residual would be required during periods when environmental conditions make the river unnavigable for this operation.

Phonecon with Precon Marine, Chesapeake, Virginia (POC: Joe Anson, 757-545-4400)

Precon could support this operation with the small barges using small pushboats that have radar equipment set at low elevation and by folding down communications antennas. They can provide pushboats with 5 or 6 feet of draft to move barges. This company was involved in a similar operation on the Schuylkill River, Philadelphia, PA. Precon Marine has also worked in and around the 14th St. Bridge Complex, so they are familiar with this part of the Potomac River, bridge clearances, and water depth issues. Barge freeboard is not a problem under bridges. They identified water depths as the most significant limit to an efficient operation. Self-propelled barges are normally not well controlled and not used for an operation such as this. Self-propelled barges are designed more for operating in one local area for small personnel, equipment or fuel shuttle or transfer tasks.

Phonecon with Norfolk Dredging Co., Norfolk, VA (POC: Mike Haverty, 757-547-9391)

In his opinion, there is no question that establishing a pipeline/pumping operation for the 6.5 nm or longer route would be more cost effective than any sort of barge operation, particularly given the limitations with bridge clearances and navigational water depth. His company would have or could acquire small pushboats that would maneuver the smaller barges at speeds slower than 5 knots. He thinks the biggest limitation is the 18 ft clearance at the 14th St. Bridge Complex. He suggests that the labor associated with handling and re-handling the liquid residual will be costly compared to an operation strictly involving a pipeline/pumping operation because unloading/loading/transit requires an operator, a mate, an engineer, and a deckhand to secure barge at each end of route. Norfolk Dredging Co. (NDC) has pumped slurry 60,000 feet, nearly 10 nm, using pipeline and two booster pumps. NDC suggests that a this would be much more efficient and less costly than barging the liquid residual product. NDC further suggests calling GIW Co. in Georgia, (POC: Ben

Hagler, 706-738-0303), for information regarding the specification and engineering requirements for a pipeline/pumping operation.

Phonecon with U.S. Army Corps of Engineers, Baltimore District (POC: George Harrison, 410-962-6002)

The Corps performs maintenance dredging in the Anacostia and Washington Channels and directly across from Bowling Air Force Base, essentially from Hains Pt. to Marbury Pt. The Corps does not maintain the Georgetown Channel where the majority of the barge traffic route would be. Any required dredging within the Georgetown Channel would require extensive coordination between regulatory agencies for permitting approval. There would also likely be significant opposition by businesses and residential communities along both sides of the Georgetown Channel to this entire barge transport operation. He suggests calling local Coast Guard about navigation rules/restrictions north of Hains Pt.

Phonecon with U.S. Coast Guard Sector Baltimore, Waterways Management Branch (POC: Ron Houck, 410-576-2674)

The Coast Guard generally leaves control and response for this area of the Potomac River to the Washington D.C Marine Police. It was confirmed that only two aids to navigation are found marking the Georgetown Channel between Hains Pt. and the 14th St. Bridge Complex. The lack of navigation aids will require careful attention to pilotage of the barges for most of the route between Hains Pt. and Key Bridget and increases the risk of grounding the barges at various locations along the route.

Phonecon with Harbormaster, Washington D.C. Marine Police (POC: Lt. Al Durham, 202-727-4582)

The marine police respond to emergencies and security concerns on the Potomac River adjacent to the District. Because there is no maintenance dredging of Georgetown Channel nor aids to navigation, mariners are responsible to manage their vessels within the waterway using latest available navigation charts and ancillary navigation equipment onboard their vessels. The harbormaster emphasized that navigating above Key Bridge is very dangerous due to strong and variable currents and irregularity of water depths and bottom conditions including rocks, shoals, and numerous obstructions. The marine police respond to emergencies above Key Bridge via 24-ft Boston Whaler with draft of about 1 ft. Because of the treacherous conditions, regulations require that all boaters on the river above Key Bridge wear personal flotation devices (PFDs) at all times. The marine police would likely oppose any sort of barge operation above Key Bridge.

MAJOR OBSTACLES TO THE BARGE OPERATION

- No navigable access from Key Bridge to the Washington Aqueduct facility. Because operation is only feasible from Key Bridge to Marbury Pt., getting the liquid residual from the Washington Aqueduct facility to the Key Bridge or privately owned commercial wharves at Georgetown still must be addressed. Note: a privately owned commercial wharf at Georgetown, just north of Rock Creek, was known to be operational in 1980, receiving sand and gravel and stone shipped by barge.
- Potential for initial dredging and periodic maintenance dredging requirements to maintain navigable waterway for this type of operation.
- Periods when barge operations may be shut down due to weather requiring storage or other means of handling liquid residual.
- Whether the transport operation is owned and operated by the respective facilities or the service is contracted, the entire operation requires significant capital investment and

annual spending for facilities, equipment, and personnel at each end of the route and operations and maintenance of same.

APPENDIX A

Sheet 1	Potomac River – Hains Pt. to Chain Bridge
Sheet 2	Potomac River – Marbury Pt. to Hains Pt.

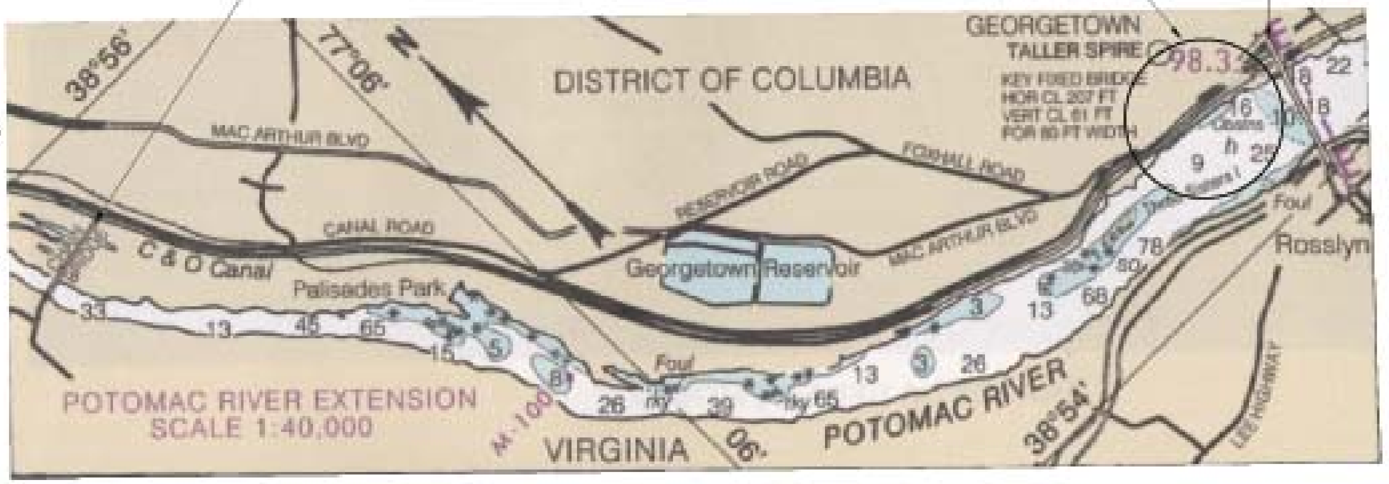
CHAIN BRIDGE (HEAD OF TIDEEWATER NAVIGATION ON THE POTOMAC RIVER)

NORTHERN LIMIT FOR BARGE OPERATIONS

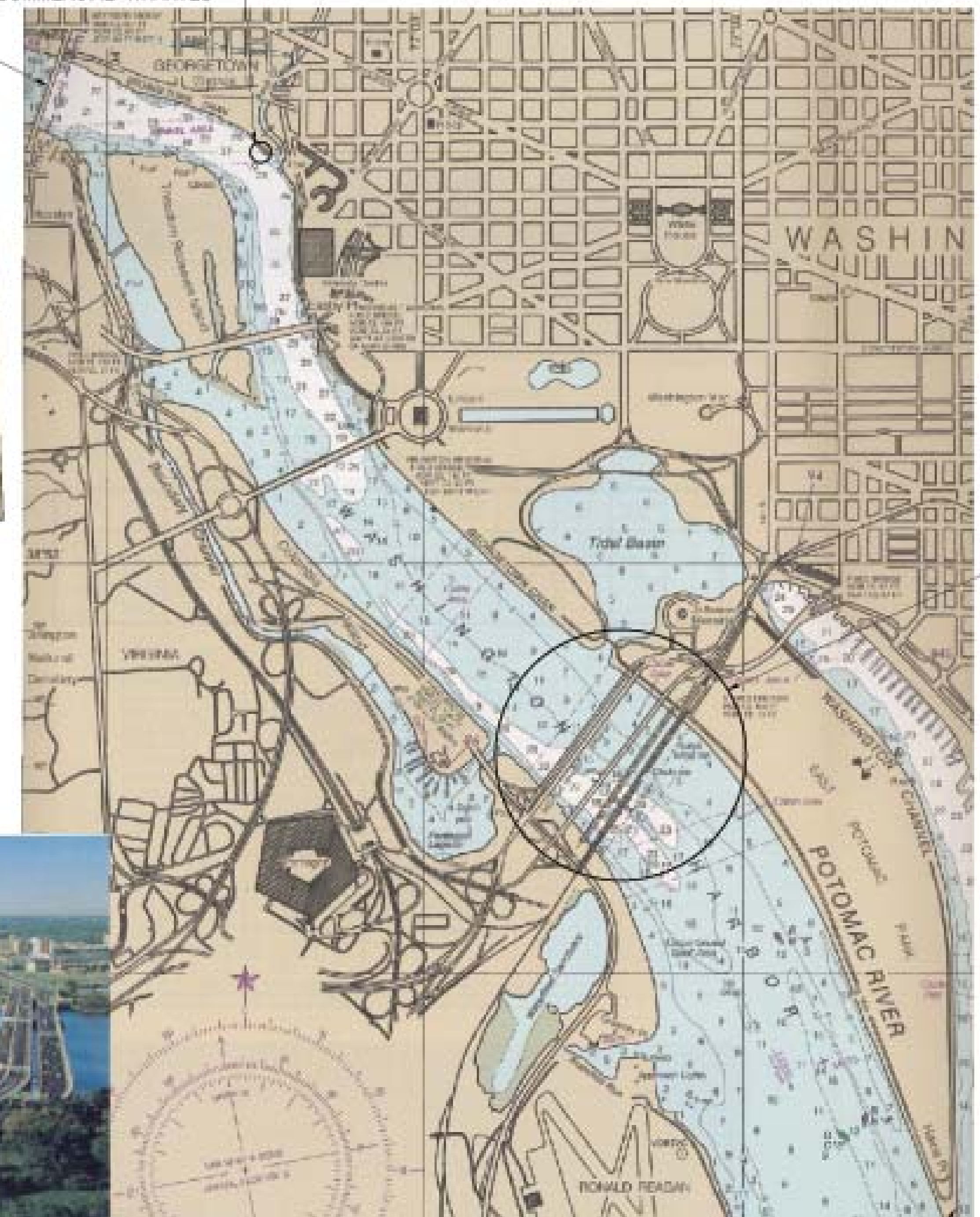
KEY BRIDGE

PRIVATELY OWNED COMMERCIAL WHARVES

TO WASHINGTON AQUEDUCT (APPROX. 0.5 NM ABOVE CHAIN BRIDGE)



PLAN: CHAIN BRIDGE TO KEY BRIDGE



PLAN: KEY BRIDGE TO HAINS PT.

14TH ST. BRIDGE COMPLEX (SEE PHOTO LOOKING SOUTH)

HAINS PT.

NOTES:

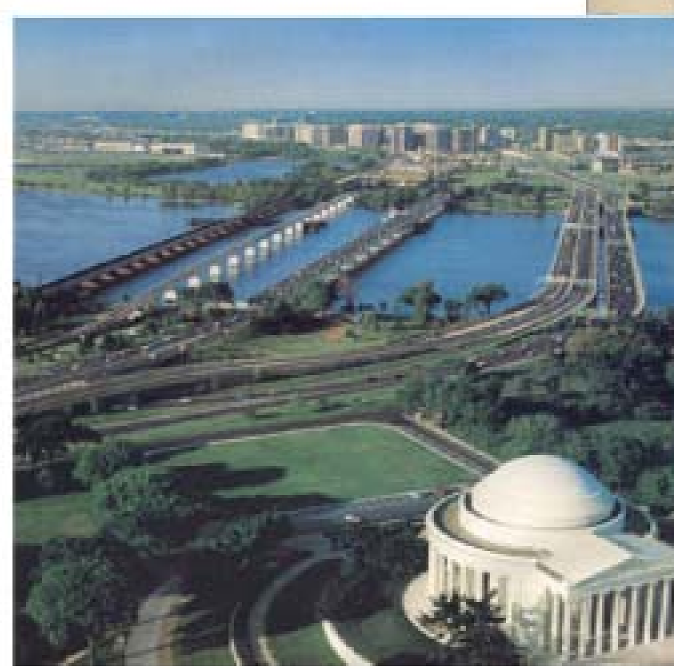
1. REFERENCES:
   A. UNITED STATES COAST PILOT, ATLANTIC COAST: SANDY HOOK TO CAPE HENRY, 2002 (35TH) EDITION, CHAPTER 12: CHESAPEAKE BAY, POTOMAC RIVER.
   B. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) CHART 12285 POTOMAC RIVER, 35TH EDITION, JANUARY 2003.

2. NAVIGATION REGULATIONS AND NOTES:
   A. THE DISTRICT OF COLUMBIA HARBORMASTER, HARBOR PRECINCT OF THE METROPOLITAN POLICE DEPARTMENT, REGULATES THE OPERATION, NAVIGATION, MOORING, AND ANCHORING OF ALL VESSELS WITHIN THE WATERS OF THE DISTRICT OF COLUMBIA.
   B. COMMERCIAL TUG SERVICE IS NOT AVAILABLE FOR HIRE AT ALEXANDRIA OR WASHINGTON D.C.
   C. SPEED LIMIT IS 10 MPH (8.7 KNOTS) WHEN PASSING THE WHARF AREA OF ALEXANDRIA, EXCEPT FOR EMERGENCIES.
   D. SPEED LIMIT IS 6 MPH (5.2 KNOTS) NORTH OF HAINS PT.
   E. A PRIVATELY BUOYED CHANNEL WITH REPORTED DEPTHS OF APPROXIMATELY 12 FEET LEADS TO MARBURY POINT. THE BLUE PLAINS ADVANCED WASTEWATER TREATMENT PLANT IS JUST NORTH OF MARBURY POINT.
   F. A GOVERNMENT PIER AT THE NAVAL RESEARCH LAB, ABOUT 0.4 MILES NORTH OF MARBURY POINT, EXTENDS OUT TO DEEP WATER WITH USE RESTRICTED TO GOVERNMENT VESSELS.
   G. GEORGETOWN CHANNEL EXTENDS FROM HAINS PT. TO JUST ABOVE CHAIN BRIDGE. VESSEL TRAFFIC SHOULD NOT ATTEMPT TO PASS BETWEEN THEODORE ROOSEVELT ISLAND AND THE VIRGINIA SHORE.
   H. DISTANCE FROM MARBURY POINT TO THE WASHINGTON AQUEDUCT JUST NORTH OF FRANCIS SCOTT KEY BRIDGE IS APPROXIMATELY 6.5 NAUTICAL MILES. STONE PIERS OF THE FORMER AQUEDUCT BRIDGE, JUST NORTH OF KEY BRIDGE, HAVE BEEN REMOVED TO A DEPTH OF 10 FEET EXCEPT FOR THE ONE NEAREST THE VIRGINIA SHORE, WHICH IS 9 FEET ABOVE WATER.
   I. CONTROL WATER DEPTH AT MID-CHANNEL IN THE GEORGETOWN CHANNEL RANGES FROM 12 FEET BETWEEN HAINS PT. AND BUOY 4, THEN 11 FEET TO 0.4 MILES BELOW ARLINGTON MEMORIAL BRIDGE, THEN 14 FEET TO THE FRANCIS SCOTT KEY BRIDGE. ABOVE KEY BRIDGE, WATER DEPTHS VARY WITH SHOALS AND ROCKS. CONTROL DEPTHS ARE NOT GIVEN FOR THE CHANNEL BETWEEN MARBURY PT. AND HAINS PT. THE CHART SUGGESTS A MINIMUM WATER DEPTH OF 23 FEET FOR THIS AREA. THESE WATER DEPTHS ARE RELATIVE TO MEAN LOWER LOW WATER (MLLW).
   J. ABOVE KEY BRIDGE AND BEYOND CHAIN BRIDGE TO THE WASHINGTON AQUEDUCT FACILITY, WATER DEPTHS AND BOTTOM CONDITIONS ARE HIGHLY IRREGULAR AND DANGEROUS AND NOT CONSIDERED SAFE FOR NAVIGATION. USE OF THIS PORTION OF THE RIVER IS LIMITED TO RECREATIONAL PURSUITS. CHAIN BRIDGE IS CONSIDERED THE HEAD OF TIDEWATER FOR NAVIGATION ON THE POTOMAC RIVER.

3. TIDES, CURRENT, AND WEATHER:
   A. THE MEAN TIDE RANGE IS 2.9 FEET FROM MEAN LOW WATER (MLW) TO MEAN HIGH WATER (MHW).
   B. CURRENTS VARY AND USUALLY RUN IN THE DIRECTIONS OF THE CHANNELS. AVERAGE EBB AND FLOOD CURRENTS ARE ON THE ORDER OF 0.6 KNOTS FROM HAINS PT. TO KEY BRIDGE AND AS MUCH AS 1 KNOT SOUTH OF HAINS PT. TO MARBURY PT.
   C. THE CHANNEL NORTH OF KEY BRIDGE TO CHAIN BRIDGE, APPROXIMATELY 2.7 MILES, HAS UNPREDICTABLE CURRENTS AND NUMEROUS SHOALS AND ROCKS. THIS PART OF THE CHANNEL IS USED BY SMALL CRAFT WITH LOCAL KNOWLEDGE; MARINERS ARE ADVISED TO EXERCISE CAUTION.
   D. DURING COLD WINTERS, ICE MAY DEVELOP ON THE RIVER CAUSING FLOODING IN THE SPRING FROM ICE PIECES BREAKING UP. OCCASIONAL OVERFLOWS FROM THE POTOMAC RIVER RESULT FROM HEAVY RAIN OVER THE BASIN AND/OR MELTING SNOW. THERE IS LITTLE OR NO FLOOD CURRENT DURING HEAVY RAINS OR TIMES OF RAPID ICE/SNOW MELT.
   E. THE POTOMAC RIVER CAN ALSO EXPERIENCE ABOVE NORMAL TIDES WITH FLOODING ASSOCIATED WITH HURRICANE OR SEVERE STORMS ALONG THE COAST.

4. BRIDGE CLEARANCES:
   A. GEORGETOWN CHANNEL IS CROSSED BY EIGHT BRIDGES BETWEEN HAINS PT. AND CHAIN BRIDGE. ALL BRIDGES HAVE FIXED SPANS OR DRAWSPANS FIXED IN THE CLOSED POSITION. THE TABLE BELOW PROVIDES THE VERTICAL AND HORIZONTAL BRIDGE STRUCTURE CLEARANCES.

POTOMAC RIVER FIXED BRIDGE	HORIZONTAL CLEARANCE (FEET)	VERTICAL CLEARANCE (FEET ABOVE MHW)
RAILROAD	104	18
WMATA METRORAIL	104	18
14TH STREET NORTHBOUND	104	18
14TH STREET EXPRESS	104	18
14TH STREET SOUTHBOUND	104	18
ARLINGTON MEMORIAL	80	30
ROOSEVELT MEMORIAL	198	24
FRANCIS SCOTT KEY	80	61



14TH ST. BRIDGE COMPLEX

1250' 0 1250' 2500' 3750'
1" = 1250'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

DSGN	SDR
DR	ARD/SDR
CHK	
APVD	

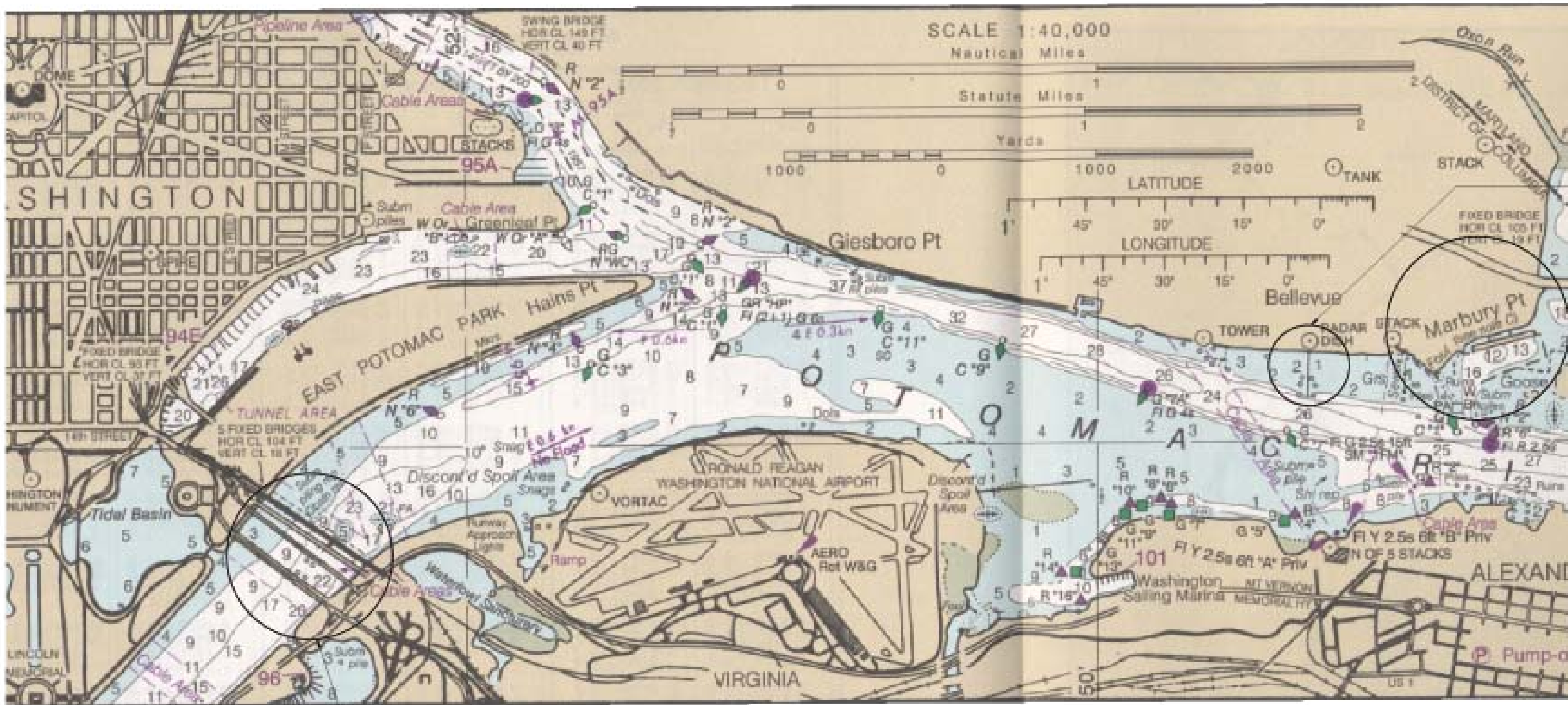
NO. | DATE | REVISION | BY | APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL
ONE HARVARD CIRCLE
WEST PALM BEACH, FLORIDA 33409
LB 0002934 AA C000656

POTOMAC RIVER - HAINS PT. TO CHAIN BRIDGE
RESIDUAL TRANSPORT BY BARGE ALTERNATIVE

SHEET 1
DWG 186970-1
DATE 03/10/04
PROJ



NRL PIER (GOVERNMENT USE)

BLUE PLAINS PLANT AND PRIVATE PIER WITH ACCESS CHANNEL

14TH ST. BRIDGE COMPLEX

N

PLAN: MARBURY PT. TO HAINS PT.

1250' 0 1250' 2500' 3750'
1" = 1250'-0"

NOTES:

1. SEE SHEET 1 FOR NOTES APPLICABLE TO THE PORTION OF THE POTOMAC RIVER FROM MARBURY PT. TO HAINS PT.

PRELIMINARY
NOT FOR CONSTRUCTION

DSGN	SDR	NO.	DATE	REVISION	BY
DR	ARD/SDR				
CHK					
APVD					

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL
ONE HARVARD CIRCLE
WEST PALM BEACH, FLORIDA 33409
LB 0002934 AA C000656

POTOMAC RIVER - MARBURY PT. TO HAINS PT.
RESIDUAL TRANSPORT BY BARGE ALTERNATIVE

SHEET 2
DWG 186970-2
DATE 03/10/04
PROJ

Appendix C
Manufacturer's Information

F.B. Leopold Co., Inc.

FEATURED PRODUCTS

Back to all featured products of this company

CT2 Submerged Sludge Collector

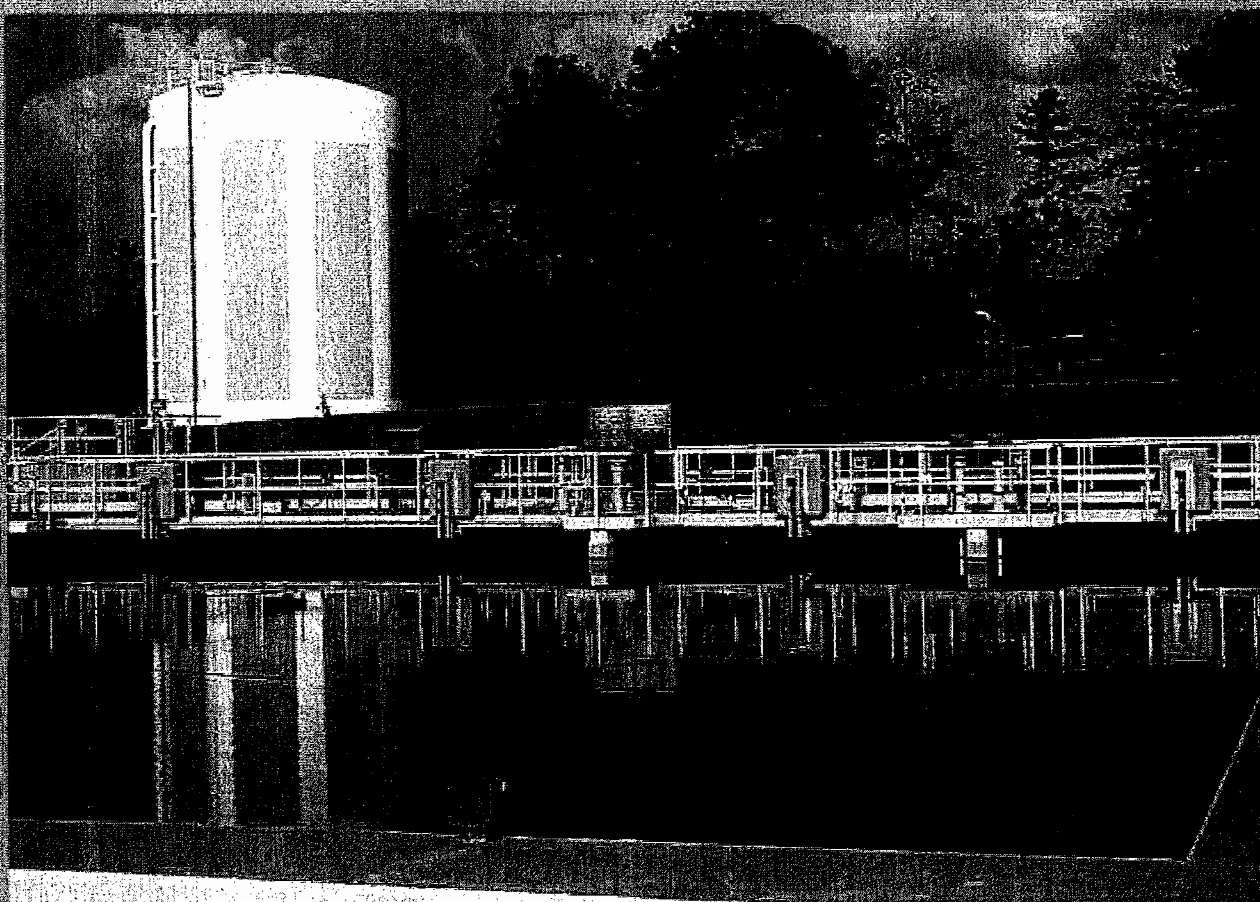
The advanced features and performance of the CT2 evolved from the Leopold Clari-Trac™ sluc system. For over ten years, these units have quietly done their job, delivering reliable operation, maintenance costs and good sludge production to hundreds of facilities. By simplifying the wate process, the CT2 increases plant efficiency, reduces maintenance time, and total system opera The CT2 submerged sludge collector operates on the simple principle, but powerful force, of gr pressure in the main tank forces the sludge through the header collector into the outlet piping a sludge removal trough. Careful selection of smooth bore piping for the suction header keeps he minimum for the most efficient sludge removal and low driving head requirements. The CT2 sys optimum choice for flat bottomed or sloped floor tanks. As the suction head glides through the s removes the settled sludge without gross disturbance and with minimal dilution. The CT2 syster high-rate sedimentation applications, has multi-pass control options, and a double header can b heavy sludge production. Engineered simplicity is integral to the design of the CT2 system. Usir head to push sludge from the basin eliminates pumping costs. Cable drives require far less pow compared to other submerged sludge collectors, the CT2 is far simpler to maintain because it h number of moving parts. CT2 has a Fit and Forget quality that not only simplifies the water treat but also reduces total system operation costs. The header, locked onto the guide rail, goes whe you want it. The cable drive pulls the header through the sludge with a positive motion and mini disturbance, removing the sludge without dilution. For the most efficient and cost-effective sludg system, the CT2 is the best choice.

Brand: CT2 Submerged Sludge Collector
Date of introduction: August 6, 2002

Main categories	**Subcategories**
Sludge	Sludge collectors

The Leopold CT2 Submerged Sludge Collector

Sludge Sucker™



Sludge Removal Systems

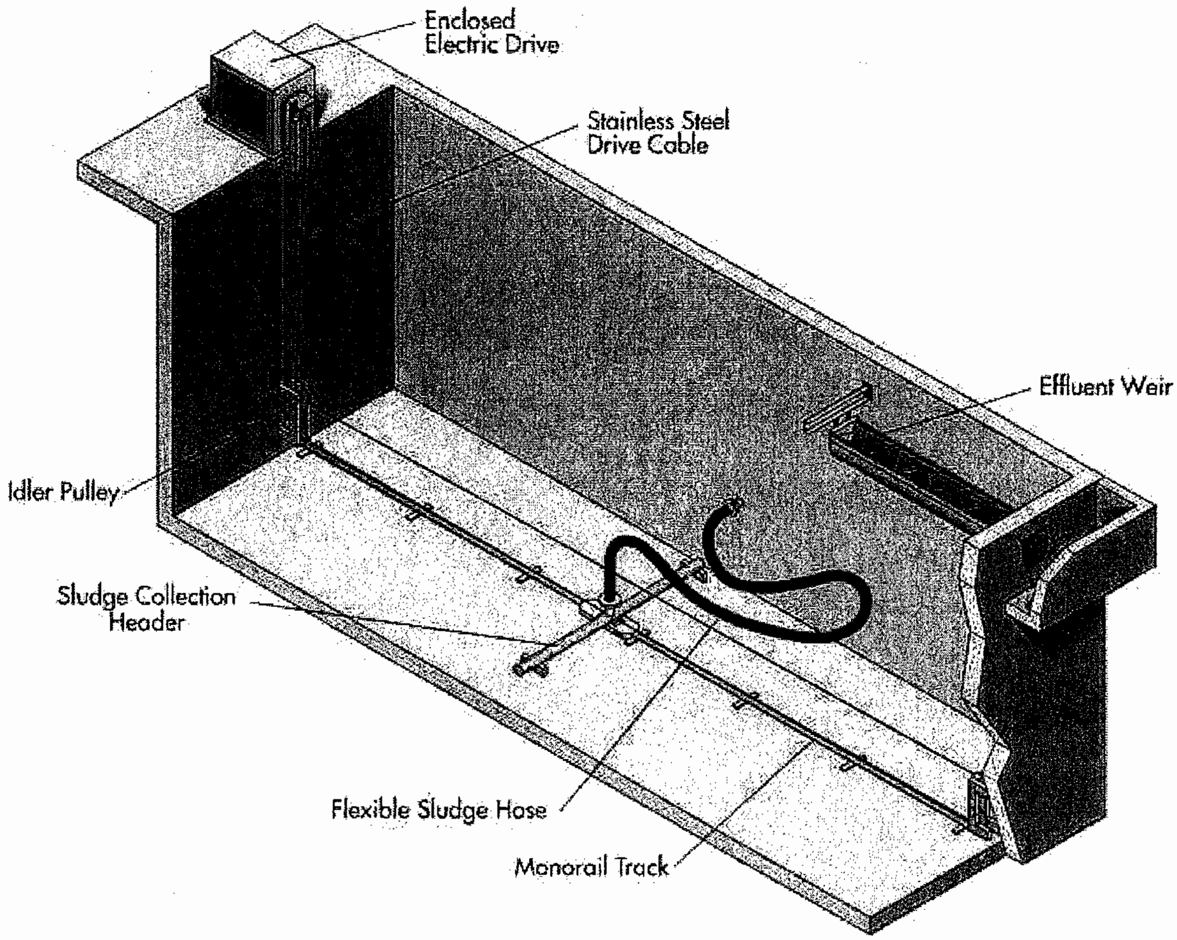
General Filter Company

Sludge Sucker

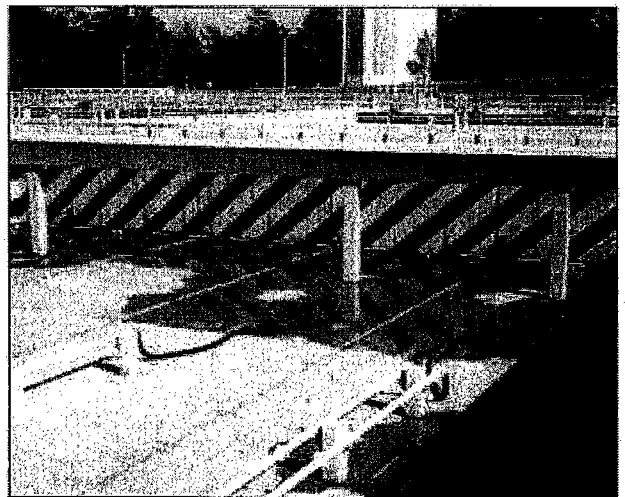
General Filter Company's Sludge Sucker™ is a gravity driven sludge collecting mechanism for cost effective and efficient removal of lightweight sludges from rectangular settling basins. It is available in two configurations to best fit either your retrofit needs into existing basins or a new installation. Where obstructions exist at the surface of the basin, the totally submerged version is preferred. The floating type is much easier to monitor and has no moving parts below the water surface. Corrosion resistant materials throughout and a positive cable drive system generate very low maintenance cost. Simplicity is the key and when combined with the following key features and advantages, Sludge Sucker is your economical and efficient sludge removal unit of choice.

Key Features and Advantages

- **Positive Cable Drive Assembly**
- **Corrosion-Resistant Submerged Parts**
- **Collector Arm Movement Visible from Drive Cable**
- **Wheeled Track Design is Standard for Positive Tracking**
- **Rapid Sludge Removal with Variable Speed Collection Header**
- **Solid State Control Panel for Programmable Operation**
- **Readily Accessible Service Panels for Easy Drive Maintenance**
- **Low Capital, Operating and Maintenance Costs**
- **Modular Lightweight Construction Results in Easy Installation**



Operation

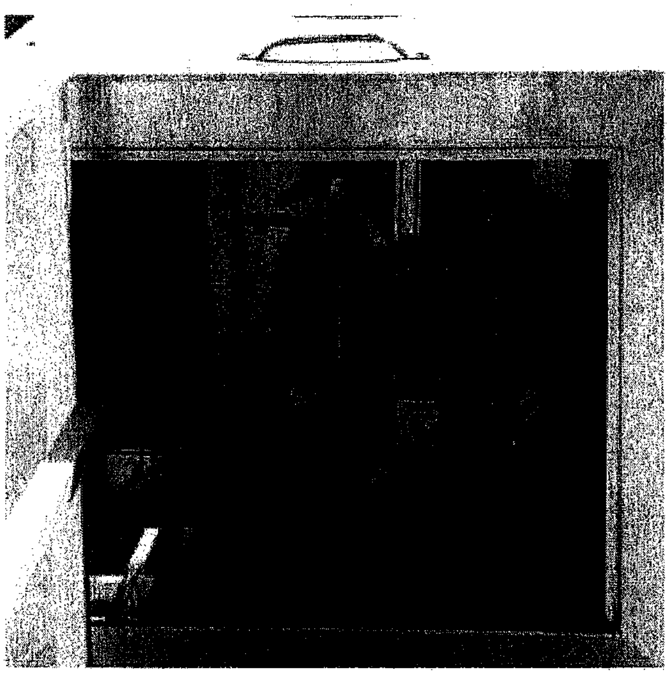


20 Sludge Sucker units installed in a 25 MGD facility.

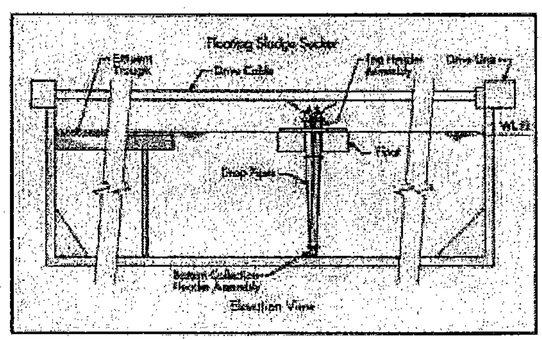
Operational simplicity is accomplished by hydraulic pressure between the water surface and sludge discharge pipe elevation which forces sludge collecting in the bottom of the basin through orifices located in a header pipe. The sludge then migrates through a durable flexible hose which, in turn, is connected to the sludge discharge pipe. A truck assembly, with header pipe attached, is pulled smoothly across the basin by a cable system connected to a drive assembly conveniently mounted above water. For versatile sludge removal, a programmable controller lets you easily adjust the speed of travel at various locations in the basin. Single units are used for basins typically up to 30 ft. wide while multiple units can be provided for wider basins.

Floating Sludge Sucker

Optional features and advantages can be realized with the unique Floating Sludge Sucker. As opposed to the submerged, rail type Sludge Sucker, the floating unit has the added benefit of being drawn across the basin on an easily accessible "pontoon-like" float system. This allows the Sludge Sucker to be pulled continuously and effortlessly across an open type basin with minimal loading on the drive system and allows you to see the unit in motion. Other notable features include a separate priming valve and sight glass for each collection header. For added convenience when multiple units are used, each header also has its own sludge valve which allows the rate of sludge removal to be adjusted separately. As with the submerged type mechanism, reliability and simplicity are synonymous with the Floating Sludge Sucker.



Electric drive unit with aluminum enclosure



Floating Sludge Sucker.

Applications

The primary application for Sludge Sucker sludge collecting systems is in surface water treatment plants for effective removal of light sludges such as alum or ferric hydroxide, or light iron and manganese precipitates in potable water supplies. The Sludge Sucker is ideally suited in light sludge applications when lower capital cost and long-term reliability is essential to the proper operation of your treatment facility.

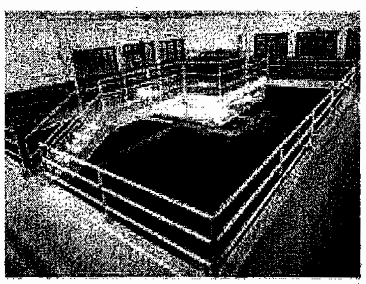
Sludge Sucker can be easily retrofitted into most any existing rectangular settling basin that has no sludge collecting mechanism. It is especially effective for retrofitting basins that are cluttered with overhead obstructions such as crosswalks, skimmers, troughs, tube settlers, or anything that projects from the walls above the bottom of the basin. Accumulated sludge can be readily removed from beneath these obstacles.

The cost-effective Sludge Sucker can also be used in certain industrial and municipal wastewater applications with either the floating or submerged type designs. For your next sludge removal system design, specify Sludge Sucker as the design of choice.

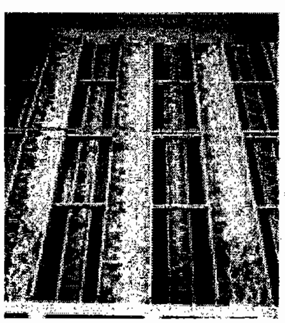
Other General Filter Products

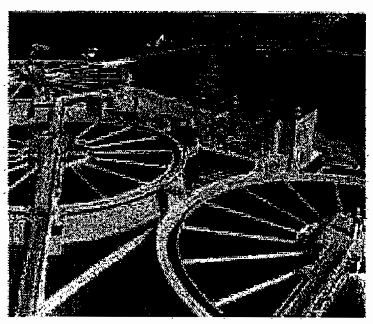
If it's in the water, General Filter's engineered processes and equipment can take it out, economically and dependably. Our comprehensive line includes solutions to simple and complex water treatment and conditioning needs, all backed by working installations and years of experience. Our line includes:

- Floc-clarifiers
- CONTRAFLO® solids contact clarifiers
- SPIRACONE® sludge blanket clarifiers
- Sludge thickeners
- SURF® for surface water treatment
- Vertical and horizontal pressure filters
- Aerators
- CenTROL® gravity filters
- AERALATER® packaged treatment
- MULTIWASH® Filtration Process
- Gravity filtration equipment
- MULTICRETE II™ monolithic underdrain system
- Surface washers
- ESSD™ filter washtroughs and launder systems
- Control consoles



Clockwise from upper left:
Concrete CenTROL Filter;
CONTRAFLO Clarifiers;
MULTIWASH Filtration Process.





For more information, contact your local General Filter sales representative, or:

600 Arrasmith Trail, Ames, IA 50010-9021
Phone: 515/232-4121 Fax: 515/232-2571

General Filter's products and processes for water and wastewater treatment are protected by patents issued and pending in the United States and other countries.

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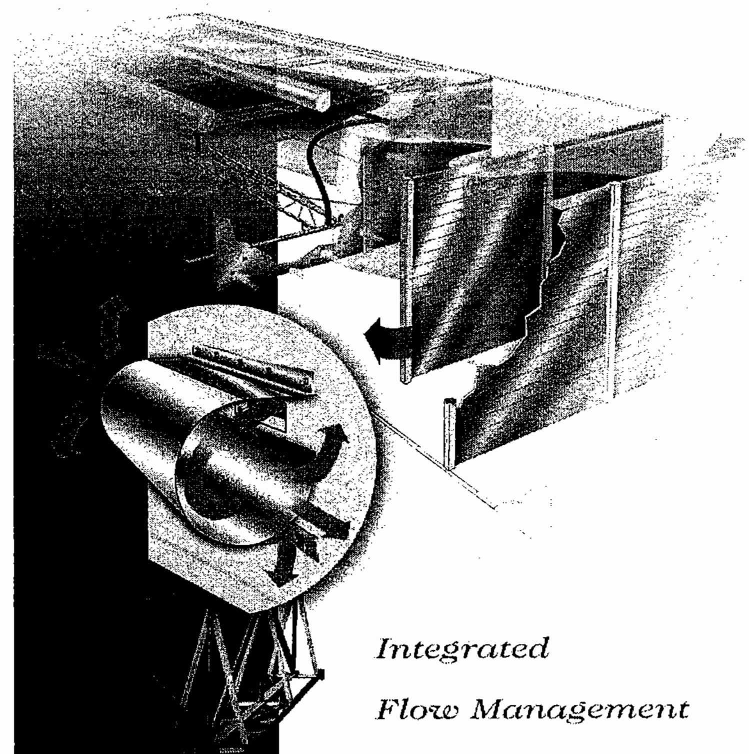
0505-596-50

MRI FLOW MANAGEMENT



Integrated
Flow Management
and Distribution Products

MEURER RESEARCH INC.

MRI

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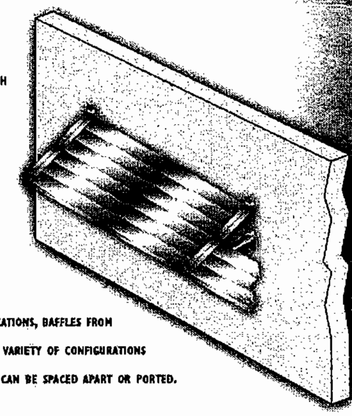
E-MAIL: SALES@MEURERRESEARCH.COM
WWW.MEURERRESEARCH.COM

MRI FLOW MANAGEMENT

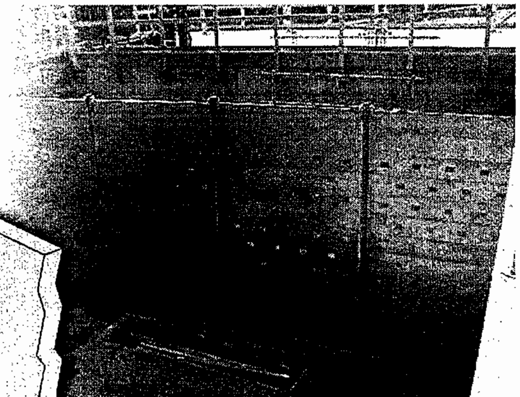
MRI baffles: *The key to efficient flow management.*

For more than 25 years, Meurer Research, Inc. (MRI) has been developing innovative sedimentation technology such as its patented inclined plate and tube settler systems, as well as the Cable-Vac™ sludge collector system. To achieve maximum performance in water and waste water clarifiers, MRI's considerable experience in settleable solids removal processes has led to the development of a complete family of flow management devices. These all-stainless steel products include baffles, troughs, supports and flow diffusers.

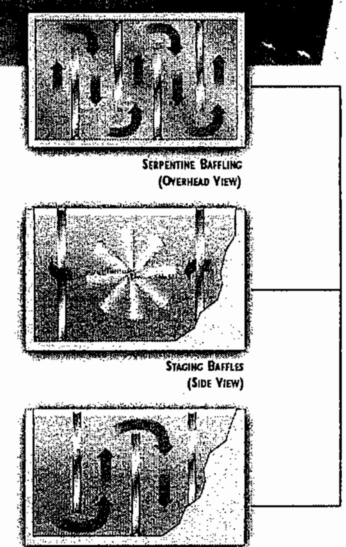
MRI's stainless steel planks slide into support channels mounted on concrete or stainless steel columns. Planks are typically 12" wide x 1-1/2" thick and up to 10' long. Other widths are also available.



In circular clarifiers, MRI's anti-roll baffles stop density currents which move up the outer wall of the clarifier, creating floc carry-over.



In flow distribution applications, baffles from Meurer can be set up in a variety of configurations as shown at right. Planks can be spaced apart or ported.



Serpentine Baffling (Overhead View)

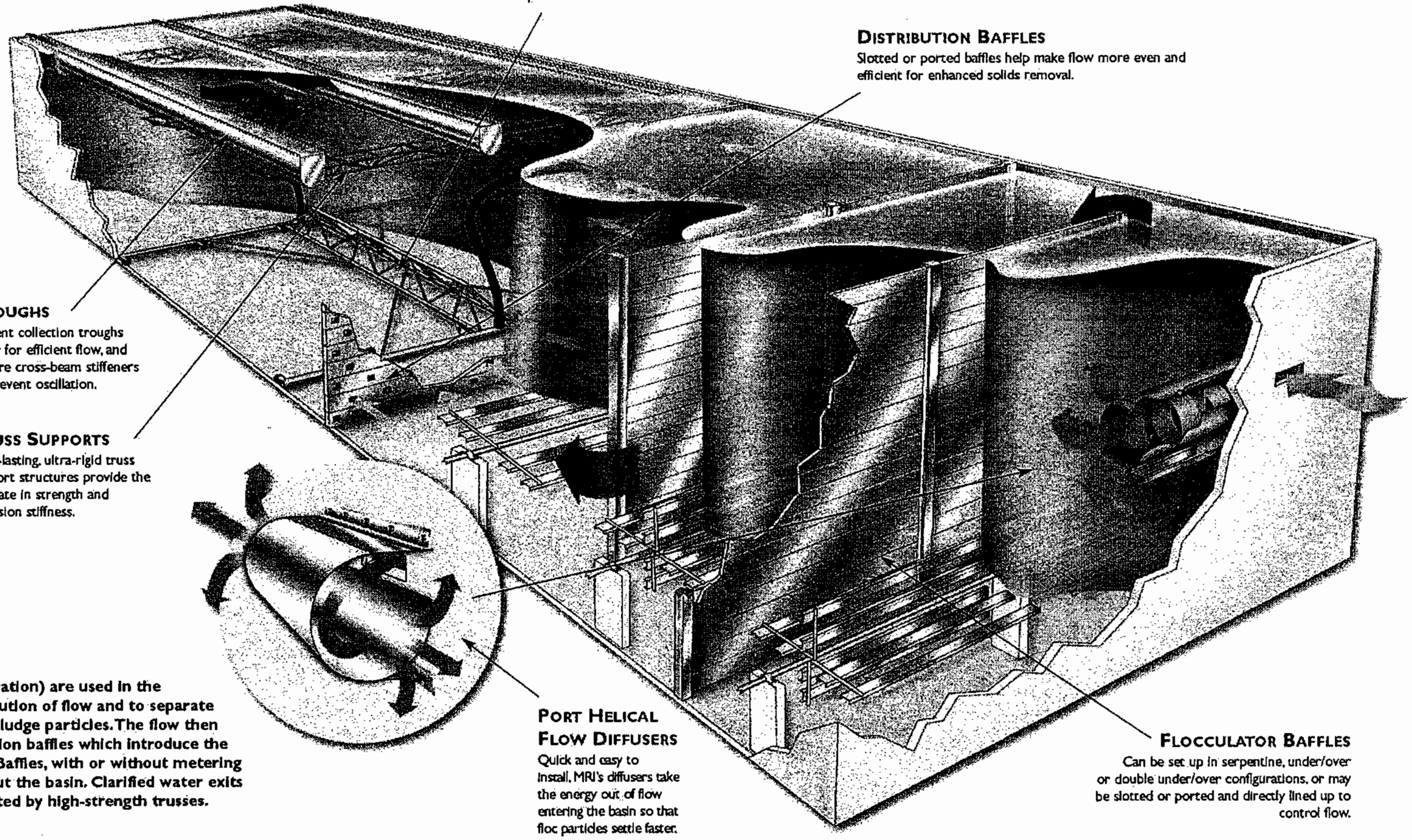
Staging Baffles (Side View)

Under/Over Baffling (Side View)

The strategic placement of baffles in flocculators, clarifiers and aerators helps control flow distribution and the duration of treatment at various stages in the process. MRI's stainless steel plank baffles provide a better alternative to redwood planks, fiberglass and concrete. They are quicker and easier to install or reconfigure, and—in the case of redwood planks—save natural resources and prevent possible chemical contamination from treated wood. Baffles can be installed or retrofitted in virtually any basin to improve efficiency, and may be slotted, ported or solid depending on the application.

High-quality products for every part of the treatment process.

Meurer Research, Inc. brings together all the components necessary for improved flow management and distribution to boost settling efficiency in clarifiers. Manufactured at MRI's facility in Colorado, the company's flocculation, distribution and aeration baffles can be retrofit to replace redwood planks. MRI baffles,* helical flow diffusers,* troughs* and trusses* are NSF-61 approved and manufactured of T304/316 stainless steel.



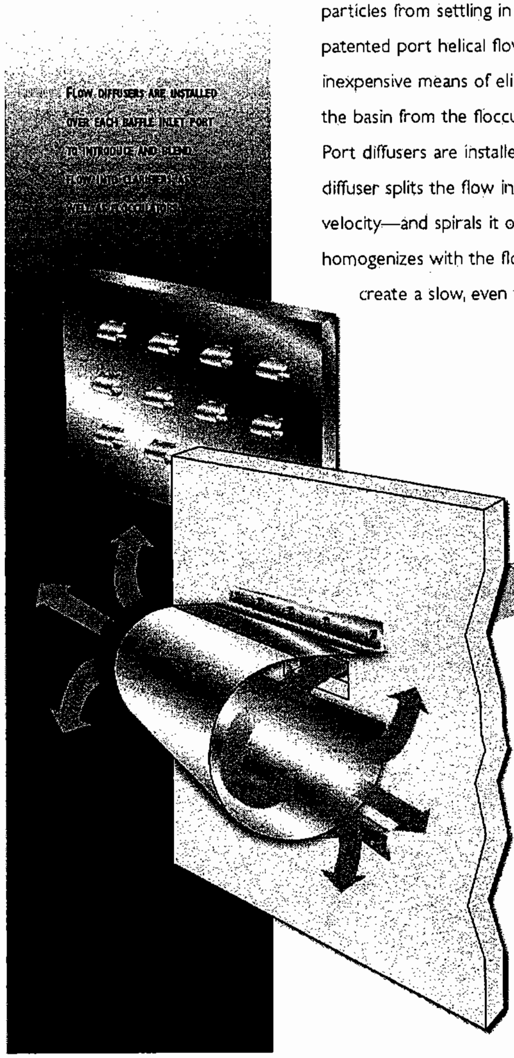
MRI FLOW MANAGEMENT AND DISTRIBUTION APPLICATIONS IN USE

Baffles (pictured here in a serpentine configuration) are used in the flocculation chamber(s) for controlling distribution of flow and to separate each stage to facilitate the agglomeration of sludge particles. The flow then enters the sedimentation basin through diffusion baffles which introduce the flow evenly across the full width of the basin. Baffles, with or without metering orifices, are also used to direct flow throughout the basin. Clarified water exits the system via MRI collection troughs supported by high-strength trusses.

Patented

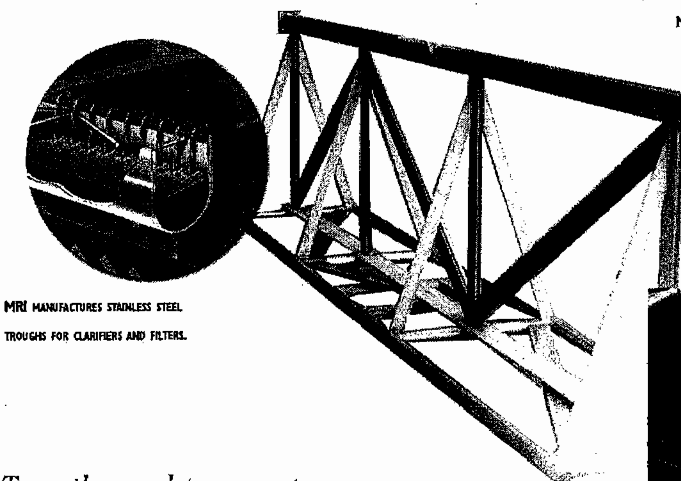
Port diffusers for more effective control of flow velocity.

Over time, higher treatment demand creates higher flows and velocities through inlet ports, which can prevent floc particles from settling in the sedimentation basin. MRI's patented port helical flow diffuser is designed as an inexpensive means of eliminating high flow rates entering the basin from the flocculators through the diffusion wall. Port diffusers are installed over each port on the wall. Each diffuser splits the flow in half—thereby reducing the velocity—and spirals it out each end. The exiting flow then homogenizes with the flow from adjacent diffusers to create a slow, even flow throughout the basin.

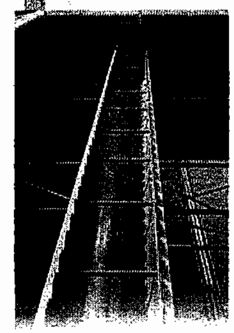


FLOW DIFFUSERS ARE INSTALLED OVER EACH BAFFLE INLET PORT TO INTRODUCE AND BLEND FLOW INTO CLARIFIERS AS WELL AS FLOCCULATORS.

THE PATENTED DESIGN OF THE PORT HELICAL FLOW DIFFUSER FROM MRI RAPIDLY DIFFUSES INLET VELOCITIES IN THE CLARIFIER TO PREVENT DISRUPTION OF THE FLOC. FLOW ENTERING THE DIFFUSER IS GENTLY SPLIT IN HALF, AND EXITS THE ENDS IN A SPIRALING MOTION AT LESS THAN .5 FPS. AS IT EXITS, THE FLOW COVERS A 180° AREA, WHICH FURTHER CUTS DOWN THE VELOCITY, ASSURING EVEN DISTRIBUTED FLOW IN THE REST OF THE BASIN.



MRI MANUFACTURES STAINLESS STEEL TROUGHS FOR CLARIFIERS AND FILTERS.



COUPLED WITH ULTRA-RIGID TRUSS SUPPORT SYSTEMS, MRI TROUGHS OFFER UNMATCHED STABILITY IN CLARIFIER FUNCTIONS. TROUGHS CAN BE MANUFACTURED WITH A FLANGED END OR CAN PROTRUDE THROUGH BASIN WALLS WITH A WATER STOP INCORPORATED INTO THE TROUGH. SLIDE GATES ARE ALSO AVAILABLE FOR ISOLATING INDIVIDUAL TROUGHS.

Troughs and trusses to keep the flow going strong.

Engineered for strength and longevity, MRI's stainless steel effluent collection troughs and filter troughs are designed with a special "tulip" round-bottom shape. Built-in cross-beam stiffeners guarantee stability with no oscillation during system operation. In addition, they come equipped with micro-adjustable weirs allowing for precise control.

Meurer's truss systems provide a "backbone" of stable support for troughs and baffles, as well as plate settlers and tube settlers. The structures utilize high-strength, stainless steel tubing designed into three-dimensional trusses resulting in stronger, yet lighter-weight alternatives to conventional steel beams. MRI truss support systems are also quicker and easier to install.

Since 1978, municipalities, utility companies and consulting engineers around the world have used Meurer Research, Inc. as their complete source for shallow depth sedimentation products. Integrated flow management and distribution components represent one more way in which MRI provides efficient, cost-effective water and waste water treatment solutions.

MRI FLOW MANAGEMENT

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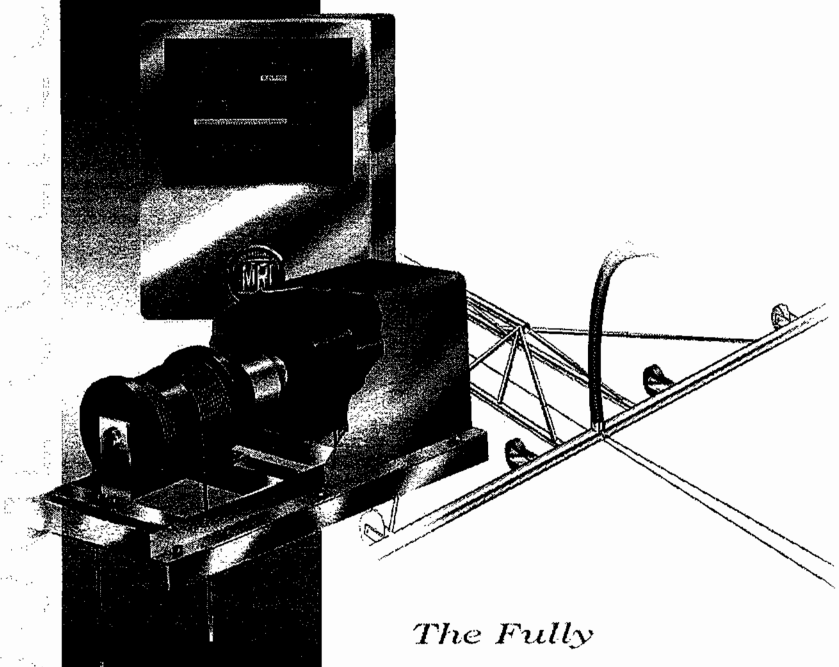
MRI SLUDGE COLLECTORS



The Fully
Engineered
Cable-Vac™ Sludge
Collector System

Sludge collection products built on experience.

Meurer Research, Inc. began developing high-quality equipment in 1978 to supply water and waste water treatment facilities with an effective, reliable and economical method of removing sludge from clarifiers. Over the years, the company has built upon those standards by incorporating new ideas and technology into the design and manufacture of its products, many of which have been patented. The latest result is a fully engineered, all-electric system that represents a breakthrough approach to sludge collection.

The ***Cable-Vac™*** sludge collector consists of three main components, each of which features a quality that today's plants count on to operate at peak levels. The uniquely designed tandem collector offers more efficient removal of solids. The reel-to-reel drive provides dependability and the simple control system ensures ease of operation. Coupled with its installation flexibility and corrosion-resistant longevity, the ***Cable-Vac™*** system is the ultimate choice for low-maintenance, cost-effective sludge collection in both new and existing basins.

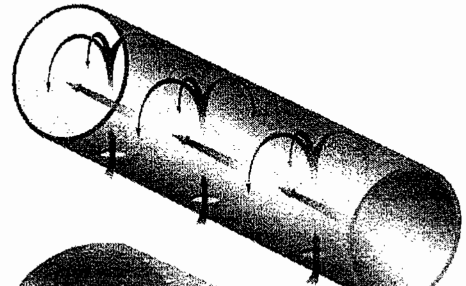


Figure A

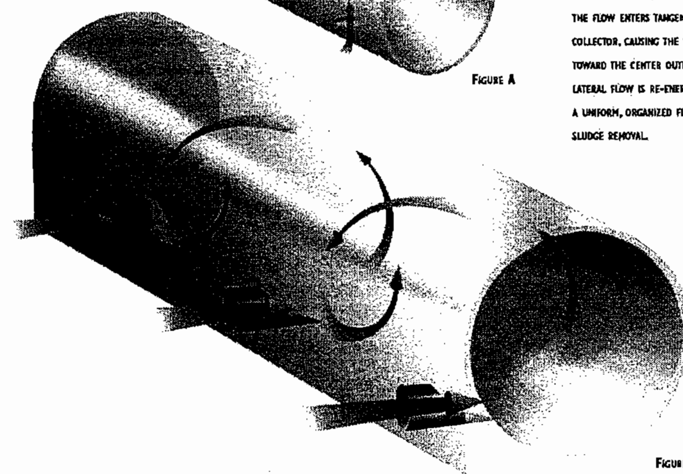
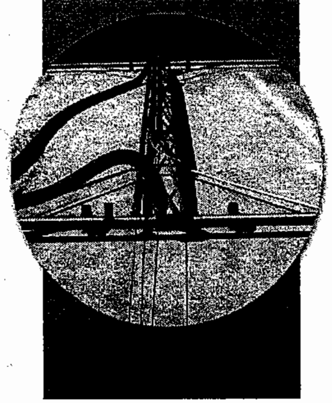


Figure B

In conventional sludge collectors (Figure A), the incoming flow entering the bottom and lateral flow moving toward the center outlet travel perpendicular to each other and collide at the orifices, resulting in a disrupted flow pattern and decreased sludge removal.

With MRI's unique tandem collector design (Figure B), the flow enters tangentially to the bottom of each collector, causing the lateral flow to travel in a spiral toward the center outlet. As it passes each orifice, the lateral flow is re-energized by the incoming flow to create a uniform, organized flow pattern that greatly enhances sludge removal.



Rio Verde Utilities, Inc., Arizona — MRI's all-stainless steel tandem collector provides two-way directional sludge collection and lasting strength.

A tandem collector designed for maximum efficiency.

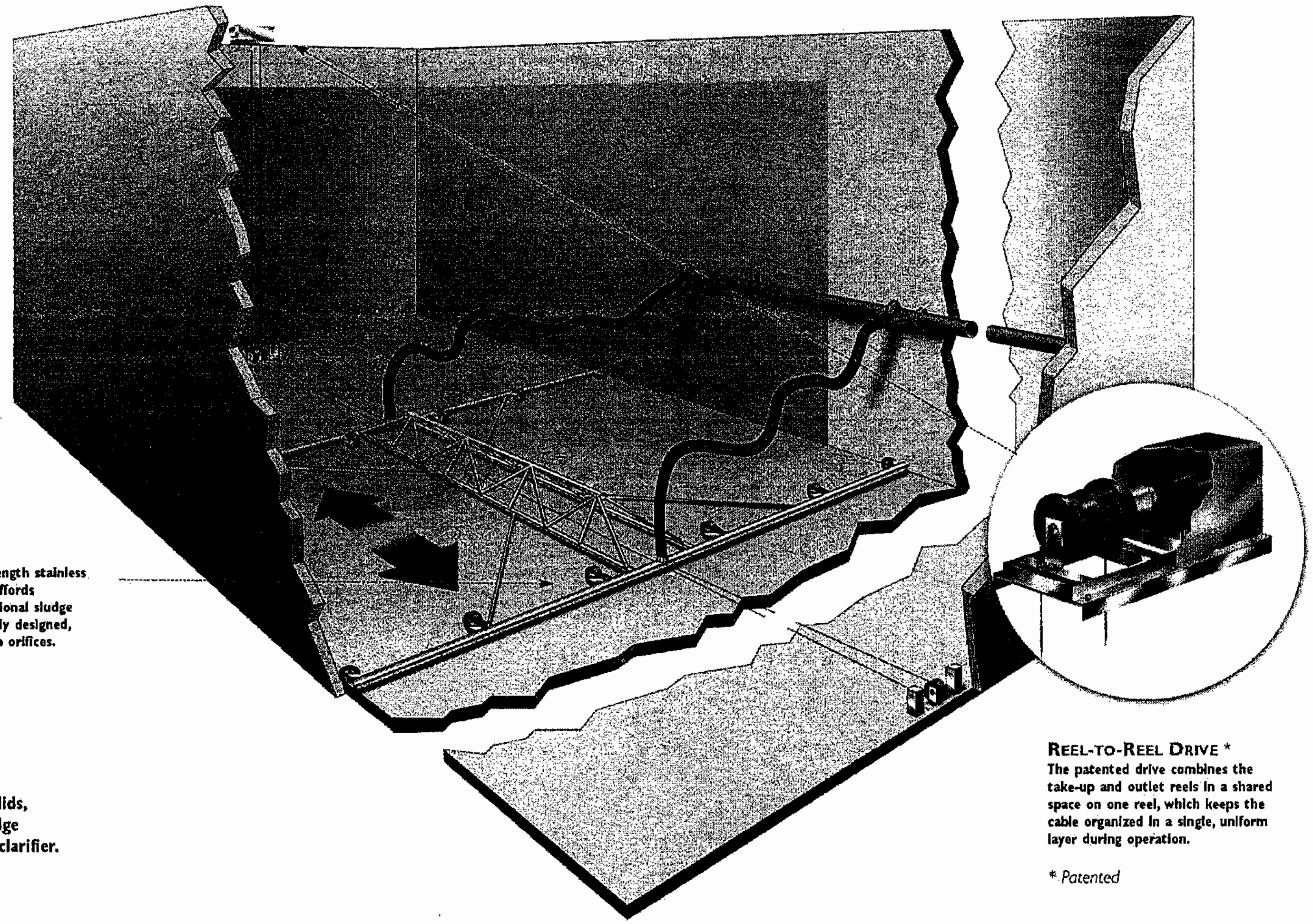
The key to the ***Cable-Vac's™*** ability to deliver proven increased solids removal is the innovative design of its tandem collector.* Unlike conventional equipment, it has two collectors instead of one, with sludge collection orifices facing forward on the side, rather than the bottom, of each collector. This allows for enhanced two-way directional sludge extraction as the assembly moves back and forth across the basin floor. Moreover, the orifices in the collectors are angled to let sludge enter tangentially, which organizes the flow (see illustration above) to pick up a greater amount of solids, as well as prevent clogs from occurring.*

MRI's ***Cable-Vac™*** operates without the use of guide rails or tracks on the basin floor, so installation is quick and easy. It can be retro-fitted to most existing clarifier basins with flat, sloping or slanted floors. Plus, the collector's all-stainless steel construction, long-life wheel bearings and low rolling resistance provide lasting, virtually maintenance-free operation—even in continuous waste water applications.

** Patented*

Uniting technology and simplicity of design.

Years of experience in producing water treatment equipment have made MRI's state-of-the-art ***Cable-Vac™*** collector system* the most reliable sludge collector on the market. Completely engineered to provide optimal solids removal, the system can be customized for new or retro-fit installations. In addition, all components are manufactured and tested in-house at MRI's facility before being shipped to the job site.



Cable-Vac™
Constructed of high-strength stainless steel, the *Cable-Vac™* affords effective two-way directional sludge removal through specially designed, forward-facing collection orifices.

Reel-to-Reel Drive *
The patented drive combines the take-up and outlet reels in a shared space on one reel, which keeps the cable organized in a single, uniform layer during operation.

** Patented*

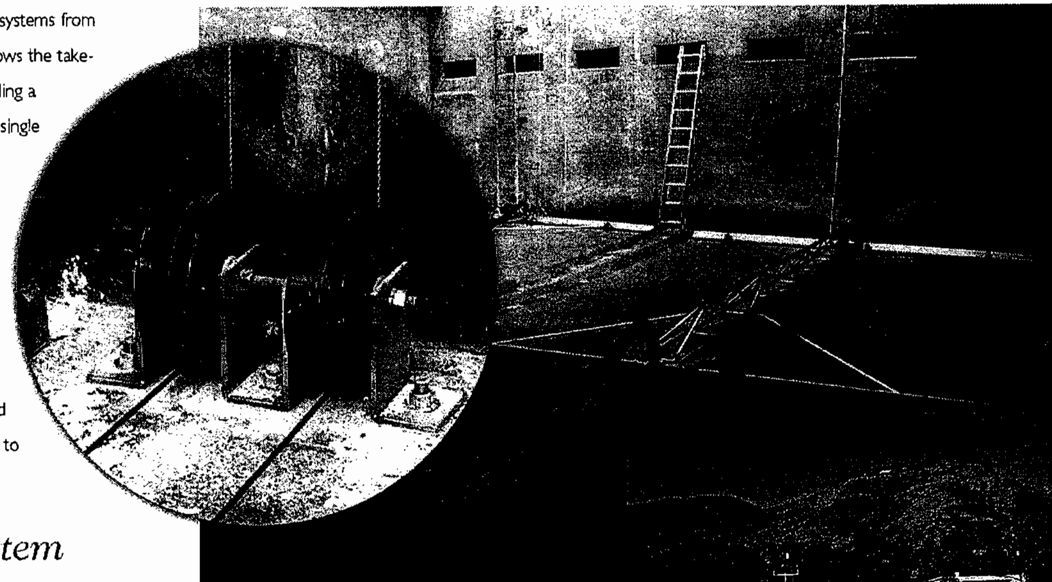
The RTR System At Work

Powered by the reel-to-reel drive (RTR), the *Cable-Vac™* travels back and forth across the sedimentation basin floor to extract settled solids, which are then discharged through flexible sludge hoses connected to fixed piping that exits the clarifier.

SLUDGE COLLECTOR

Reliably powered by the reel-to-reel drive.

The reel-to-reel drive is what makes ***Cable-Vac™*** systems from MRI so dependable. Its simple, patented design allows the take-up and outlet reels to utilize the same space, affording a compact drum length that maintains the cable in a single layer with no tensioning necessary. Capable of continuous, energy-efficient operation using DC power, the drive can withstand an indefinite stall without failing or sustaining damage. The assembly is housed in a durable safety enclosure that offers visual monitoring of the cable to indicate the tandem collector's working position in the clarifier. And because it has a minimum of moving parts and needs no lubrication, the above-water drive is easy to maintain and service.



Pictured clockwise from upper left:

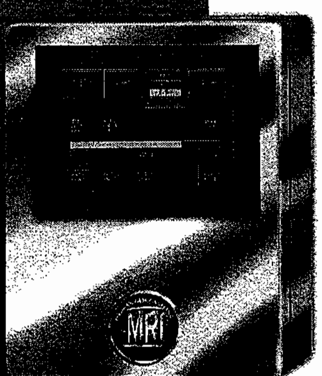
Garrett Morgan Water Treatment Plant, Cleveland, Ohio — View of cable pulleys in basin floor below MRI's patented, above-water reel-to-reel drive.

Semper Water Treatment Plant, Westminster, Colorado — Cable-Vac™ collectors were retrofitted to existing basins, as well as installed in a new basin.

City of Golden Water Treatment Plant, Colorado — Overview of two sedimentation basins, each equipped with two Cable-Vac™ collectors.

Adaptable control system provides simplified operation.

Easy to understand and simple to use, MRI's menu-driven, touch screen control system is designed to operate any number of Cable-Vac™ systems within a facility.



Combining state-of-the-art technology with versatility, the simple-to-use control system automatically displays and handles all of the sludge collector's functions. It can be programmed easily through a menu-driven, LCD touch screen to control drive variables such as duration, speed and frequency of operation to fully meet a plant's specific needs. The UL-listed system operates on 120 VAC power and is housed in an anodized aluminum enclosure. In addition, security coding is an option, and conventional button and switch controls are also available.

For effectiveness, reliability and simplicity, the fully engineered systems from MRI deliver outstanding performance—especially when used in conjunction with the company's plate and tube settler systems. From design and manufacturing through service and support, Meurer Research, Inc. is the supplier that utility operators, contractors and engineers can rely on for the very latest in sludge collection equipment.

THE HOSELESS CABLE-VAC™ SLUDGE COLLECTOR

The "Hoseless" Cable-Vac™ sludge collector was developed to operate in the restricted area below plate settlers where vertical space is limited and many overhead obstructions exist.

The "Hoseless" design eliminates the only problem with operation of a suction sludge collector under plates; the flexible hose which by design must float and can, therefore, become entangled in the plates.

The beauty of the hoseless device is that it utilizes components from the traditional Cable-VAC™ sludge collectors which have been in service in varied applications for many years.

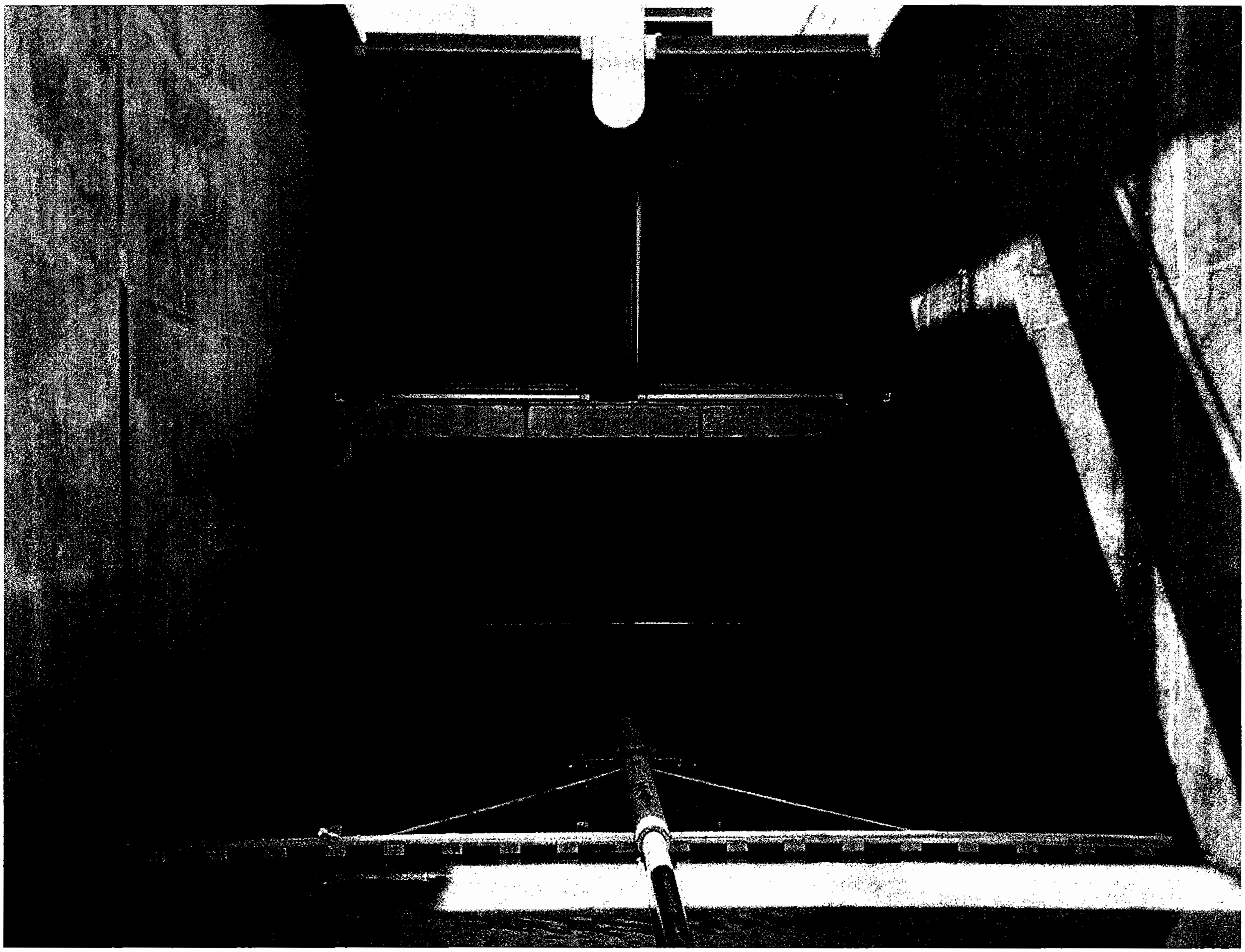
In the hoseless Cable-Vac™, the floating hose has been replaced by a horizontal telescoping pipe sludge conduit.

OPERATION OF THE HOSELESS CABLE-VAC™:

Sludge which has settled on the bottom of the sedimentation basin is collected by the traveling sludge collector which consists of two collection header pipes connected to a large center telescoping pipe. Patented directional orifices along the bottom of the collector pipes extract sludge from across the floor of the sedimentation basin and send it in a spiral pattern to the large center pipe. The flow then passes through the outer telescoping pipe to the inner telescoping pipe and to the end of the sedimentation basin and out through the wall. A sludge valve at the end of the outlet pipe controls the flow.

The unit is half of the total length of the basin; each header pipe covers half of the basin.

The low profile of our "Hoseless" Cable-Vac™ can also be used to extend under baffles to allow for cleaning areas in the flocculators or behind distribution walls. (Baffles must be the plank stainless steel baffles provided by MRI which have the rotating bottom plank designed specifically for this purpose.



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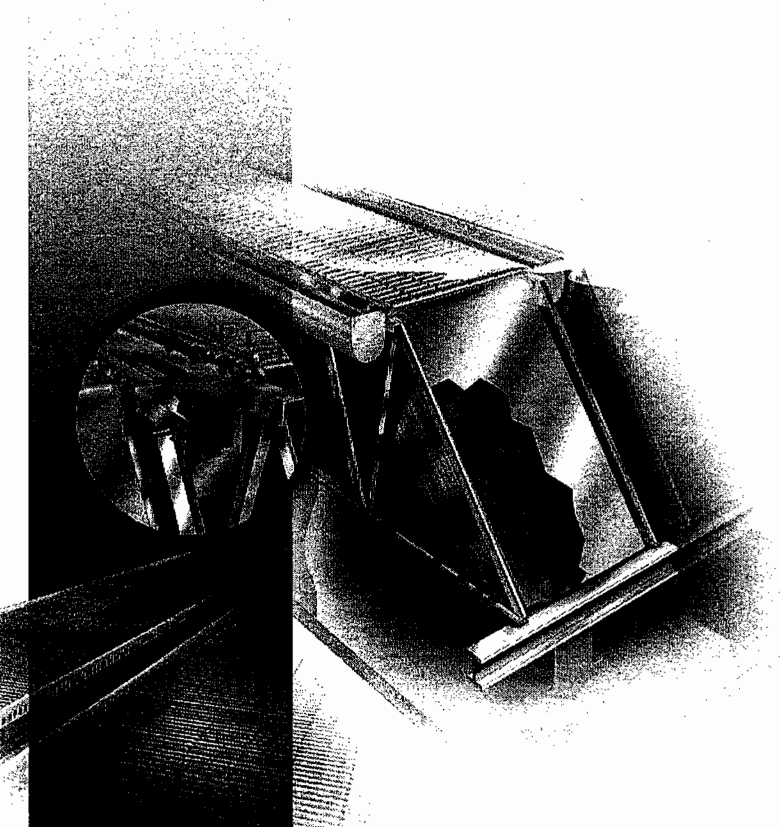
MRI PLATE SETTLERS



The High-Capacity Inclined Plate Settler System

MRI PLATE SETTLERS

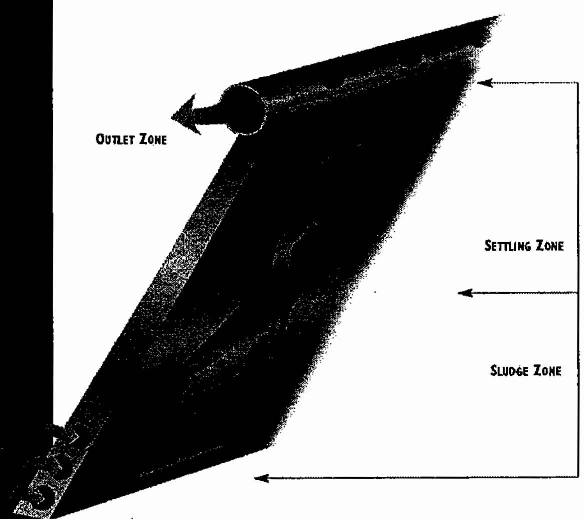
Patented solutions 25 years in the making.

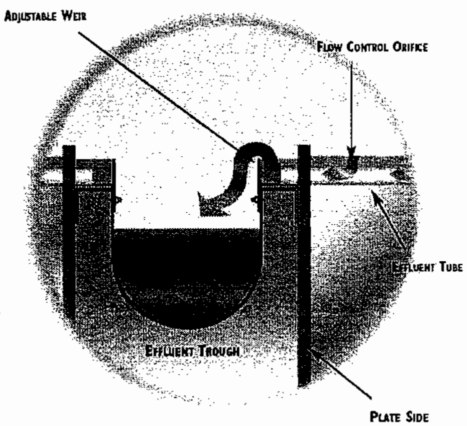
Today's water and waste water treatment facilities are always looking for ways to improve clarifier system performance with an eye to practicality, efficiency and economics. The solution? An inclined plate settler system from Meurer Research, Inc. These plates deliver the highest flow rate and solids capture available for the ultimate in clarifier function. What's more, the all-stainless steel, self-cleaning system provides long-lasting strength, is extremely cost effective and can be configured for virtually any new or existing basin.

Since 1978, utility companies, municipalities and consulting engineers have relied on MRI for the latest shallow-depth sedimentation technology. With more than 50 patents and hundreds of installations, Meurer Research continues to lead the way with innovative, high quality equipment. Furthermore, MRI is the only 100% employee-owned company in the industry that designs and manufactures all its products in-house in the U.S.

THE GOLDEN WATER TREATMENT PLANT, COLORADO—THIS FACILITY IN SCENIC GOLDEN HANDLES SEVERAL MILLION GALLONS MORE PER DAY WITHOUT ANY INCREASE IN BASIN SIZE OR LAND AREA, THANKS TO MRI PLATE SETTLERS.

CLEAR WATER PRODUCTION RATES ARE GREATLY INCREASED BECAUSE MRI INCLINED PLATE SETTLERS DRAMATICALLY SHORTEN THE DISTANCE PARTICLES MUST TRAVEL (A FEW INCHES COMPARED TO SEVERAL FEET IN CONVENTIONAL CLARIFIERS).





AS CLARIFIED WATER IS DISCHARGED FROM THE EFFLUENT TUBES AT THE TOP OF THE PLATES INTO THE EFFLUENT TROUGHS, MRI'S MICRO-ADJUSTABLE WEIR ALLOWS FOR PRECISE CONTROL OF FLOW VELOCITY AND EQUALIZATION FOR ENHANCED EFFICIENCY.

A process proven to increase solids removal.

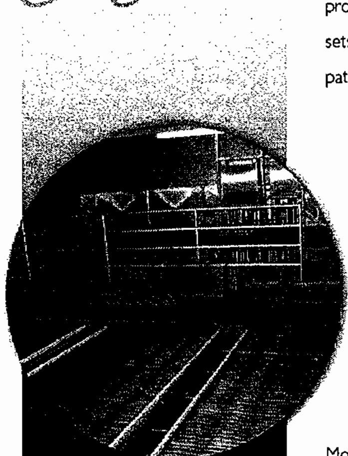
Designed around the principle that inclined plates in a basin increase the capacity of water production, the patented MRI plate settling system consists of a set of plates with a combination outlet support tube at the top of each plate edge. Supported by the tubes, the plates are installed at a 55° to 60° angle between two effluent troughs. The sides of the plates fit together to form a wall with inlet ports at the lower end of each side. A stainless steel truss structure supports the system to position the top of the system at the water line.

The plate settlers provide a fast, efficient way to remove solids from water by increasing the settling surface area while decreasing vertical settling distance. When the flow is introduced to the basin, it enters the inlet ports and rises up between each inclined plate as solids fall to the lower surface. The solids agglomerate, gain weight and slide down the plate, accumulating more particles until the sludge drops from the end of the plates to the basin floor, where it is removed by sludge collection equipment.

In the meantime, clear water is conducted upward between the plates and into six orifices in the outlet (or effluent) tubes, where it flows to the side of the plates and across a weir (which is adjustable to maintain equal flow for greater efficiency) into the effluent trough. The troughs then take the flow to the end of the basin and out.

MRI PLATE SETTLERS

Uniquely designed for efficiency and convenience.

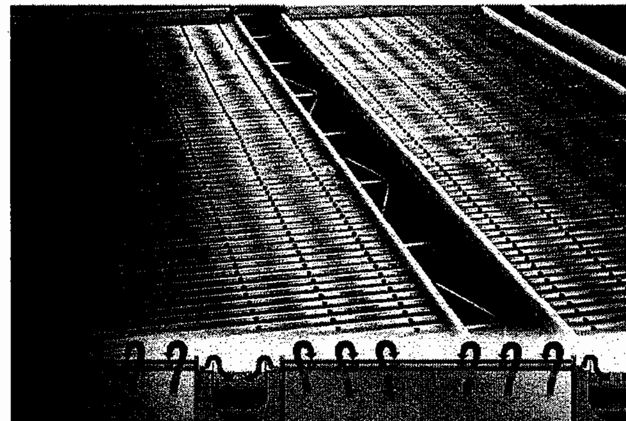


BROOMFIELD WATER TREATMENT PLANT, COLORADO—THIS CITY NEEDED TO EXPAND PLANT OPERATIONS BY 100% ON A PROPERTY THAT WAS ALMOST FULLY UTILIZED, SO ANY MODIFICATIONS HAD TO BE VERY COMPACT. INCLINED PLATE SETTLERS WERE INSTALLED IN THE FILTER BACKWASH RECLAIM SYSTEM IN AN UNDERGROUND VAULT, AND TODAY ARE TREATING 6,000 GALLONS PER MINUTE—WITHOUT CHEMICAL FEED.

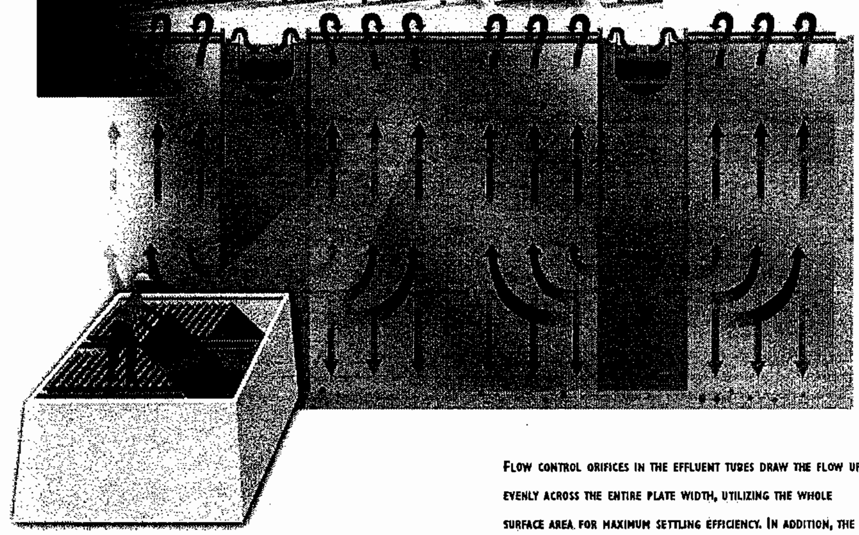
The all-stainless steel construction of MRI's plate settler system provides superior strength and durability. However, what truly sets our plates apart from other plate settling systems is the patented hydraulic flow control deck.

Meurer's flow control deck is made up of a set of stainless steel tubes which are actually the top edge of each plate settler. Each tube has a series of metering orifices that extract flow evenly from across the width of each plate for the most uniform flow distribution available. Coupled with the adjustable weir, MRI's system offers more flow control, capacity and efficiency than any other system.

Moreover, since the plates are mounted in rows at water level in an array that forms an extremely solid deck, it is strong enough to be walked on during installation, inspection or repairs. Whereas other systems have plates that are trapped under effluent troughs or permanently attached to the structure, MRI plates are easily viewed and removed from above without disassembling other components.



NO OTHER PLATE SETTLER SYSTEM OFFERS A STAINLESS STEEL FLOW CONTROL DECK THAT WILL SUPPORT A 250-POUND CONCENTRATED LOAD.

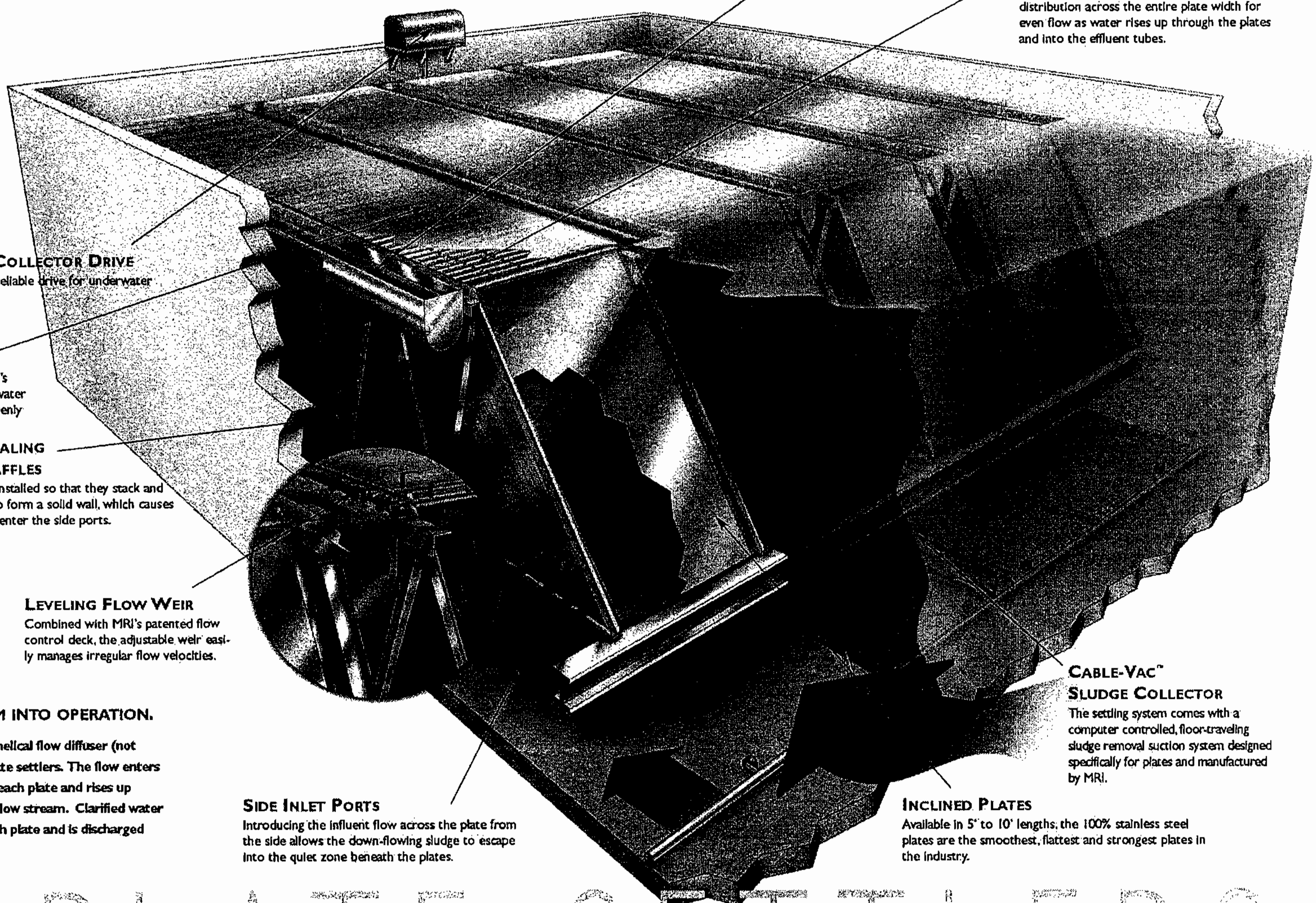


PLATES CAN BE EASILY INSPECTED AND REMOVED INDIVIDUALLY FOR CLEANING, MAINTENANCE OR REPAIR—
ALL WITHOUT DRAINING THE BASIN TO GAIN ACCESS.

FLOW CONTROL ORIFICES IN THE EFFLUENT TUBES DRAW THE FLOW UP EVENLY ACROSS THE ENTIRE PLATE WIDTH, UTILIZING THE WHOLE SURFACE AREA FOR MAXIMUM SETTLING EFFICIENCY. IN ADDITION, THE INFLUENT FLOW IS INTRODUCED ACROSS THE PLATE FROM THE LOWER SIDE, RATHER THAN STRAIGHT UP FROM THE BOTTOM, ENSURING MINIMUM INTERFERENCE WITH DOWN-FLOWING SLUDGE.

For ultimate performance, the choice is clear.

Engineered for simple precision, MRI's state-of-the-art plate settler system* allows for more water flow and settling area to greatly enhance clarification effectiveness and productivity. NSF-61 approved plates, troughs and support structures are manufactured using solid stainless steel for longevity.



PUTTING THE PLATE SETTLER SYSTEM INTO OPERATION.

The influent enters the clarifier basin through the helical flow diffuser (not shown), which creates a quiet zone beneath the plate settlers. The flow enters the plates through feed ports in the lower sides of each plate and rises up between the plates as solids are settled out of the flow stream. Clarified water emerges through the outlet pipes at the top of each plate and is discharged into the collection troughs.

*Patented

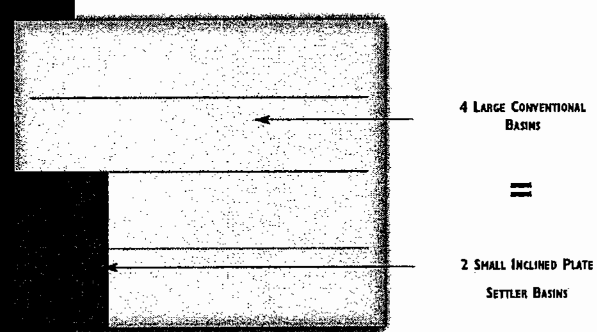
MRI PLATE SETTLERS

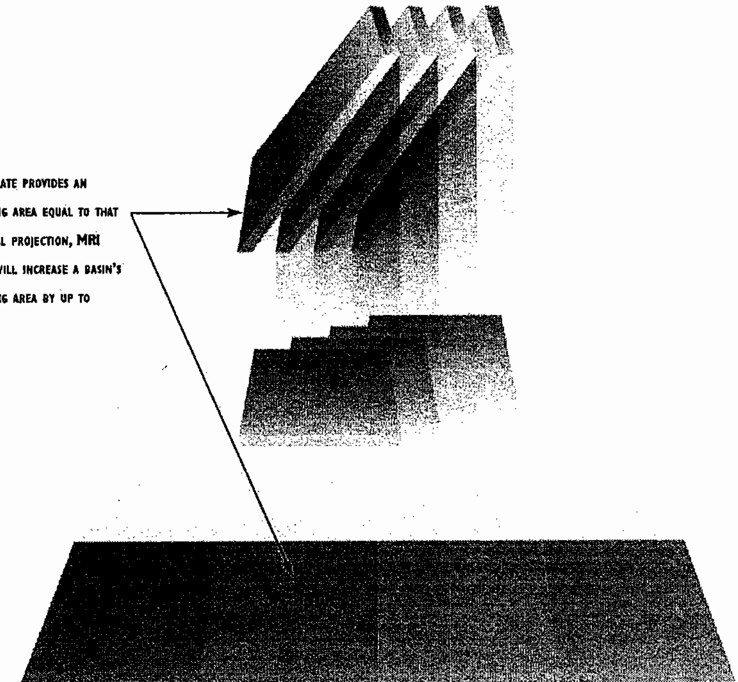
Improved clarifier capacity. Improved cost savings.

In the sedimentation process, a clarifier's capacity is proportional to the surface area of the basin. Using the MRI plate settling system, surface area for solids settling is provided by rows of inclined plates installed at 55° to 60°, in effect compressing the capacity of a large conventional clarifier into a significantly smaller footprint. As more plates are utilized, productivity increases proportionally, along with the cost-effectiveness of clarifying operations.

In fact, MRI systems are far more economical compared to the costs of a medium or large clarifier with no sedimentation enhancement. Whether building a new facility or expanding an existing one, plate settlers provide maximum flow using minimum space—which adds up to dramatic savings in land and construction costs. Additionally, plate settlers produce a consistently higher quality effluent, resulting in typical chemical cost savings of 30%. Further costs can be saved by using plate settlers in reclaiming filter backwash waste water and in treating membrane reject water.

BY INSTALLING MRI PLATES AT A 55° TO 60° ANGLE, MORE SETTLING SURFACE AREA CAN BE ACCOMMODATED IN LESS SPACE, PROVIDING FOR INCREASED EFFICIENCY AND COST SAVINGS.





BECAUSE EACH PLATE PROVIDES AN EFFECTIVE SETTLING AREA EQUAL TO THAT OF ITS HORIZONTAL PROJECTION, MRI PLATE SETTLERS WILL INCREASE A BASIN'S EFFECTIVE SETTLING AREA BY UP TO EIGHT TIMES.

Adaptable to meet specific requirements.

The Meurer Research plate settling system effectively enhances clarification in a wide variety of applications, including treatment of potable water, primary, secondary and tertiary domestic waste water, and various industrial waste products. The plates can also be specifically configured to fit any basin—even those of unusual shape or size.

In addition, MRI ships equipment in two different forms depending on a facility's unique installation and design needs or limitations. The cartridge form combines the plates, effluent troughs, truss frame and flow control deck in a preassembled module, or "plate pack" that can be placed in the basin by a crane, minimizing field labor. The component form is shipped as individual elements that are placed in the basin item by item, allowing the system to be installed inside or beneath a facility.

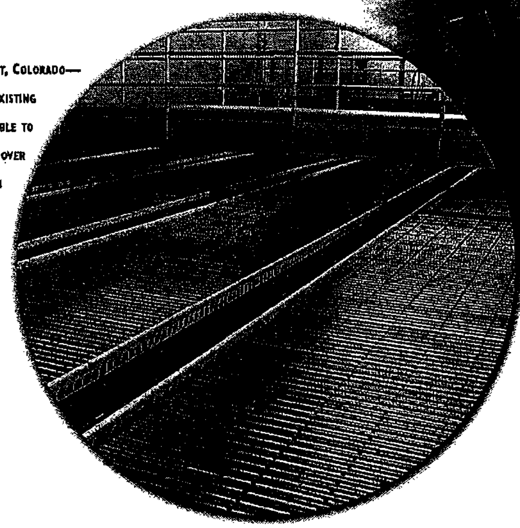
MRI PLATE SETTLERS

MRI PLATE SETTLERS

On-site success: The inclined plate settler system in action.

Trust MRI for innovation that sets the trend.

Experience, reliability, creativity and know-how. These are the qualities that have allowed Meurer Research to become a leader in the field of sedimentation technology for more than a quarter of a century. That is also why customers have come to trust MRI as their complete source for all settleable solids removal products, including troughs, baffles, diffusers, supports and sludge collectors. Count on Meurer Research to continue its commitment to serving the industry's needs, from design, engineering and production to installation, education and after-market customer service.



City of Arvada Water Treatment Plant, Colorado—By adding MRI plate settlers to its existing direct filtration plant, the City was able to decrease basin size by a factor of 10 over non-plate designs, allowing the system to be housed in a new building. The project was completed in less than a year, including the new building.

Belleville Water Treatment Plant, Ontario, Canada—The MRI plate settling system is being used in both main clarifiers, as well as in treatment units for backwash waste, sludge from traveling suction sludge removal units and scum from DAF units. MRI was involved in the design process and analysis, and manufactured the entire system within three months.

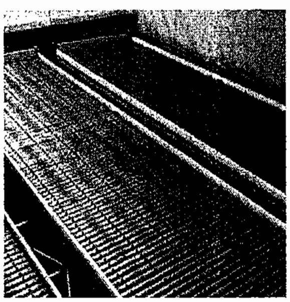
Home Up

Plate Settlers

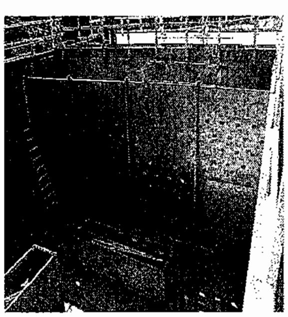
Photo Gallery

Illustration Gallery

Plate Settlers



Baffles



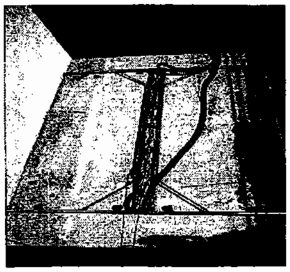
Sludge Collectors

Plate settlers have been in existence since the turn of the century. Only recently has the technology advanced to the point that allows plate settlers to be cost effective. As more engineers and plant personal realize the cost savings associated with plate settlers they are becoming more and more popular. Plate settlers can decrease the footprint of the settling basin by as much as 90% over an open basin or as much as 50% over a basin with tube settlers which results in real estate and concrete cost savings. There are design issues that must be considered for plate settlers to function properly. Since settling enhancement has been our expertise for over 25 years and we design, patent, and manufacture our own plate settlers, all of these issues have been addressed and we offer the most efficient and easy to maintain plate settler on the market today.

The advantages of MRI plate settlers are:

- **INFLUENT DISTRIBUTION** – MRI's Helical Flow Inlet Diffuser* is a compact way to introduce flow into the basin evenly. introduces the flow evenly into the basin to blend , which maintains floc structure, and allows flow to travel evenly down the side channels without short circuiting.

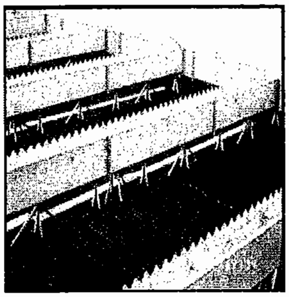
- **SMOOTH PLATE SURFACE** – The surface of MRI plates are completely smooth. They have nothing that would interfere with the



distribution across the plate or the movement of solids down the plate, i.e. textures, ribs, corrugations or stampings either vertical or horizontal.

- **EFFLUENT DISTRIBUTION** – MRI has incorporated two very important features which guarantee even distribution through each plate and over the entire basin.

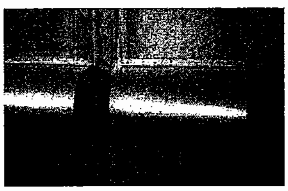
Tube Settlers



Top Tube* - As the flow reaches the top of the MRI plate settler it is distributed evenly across the entire width of the plate by the orifices spaced across the top tube. This functions as the effluent weir and assures use of the entire plate.

Effluent Weir - The water then flows over the adjustable effluent weir which establishes equal distribution between each plate pack.

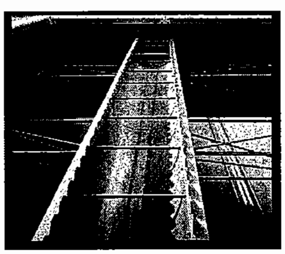
Inlet Diffusers



* Indicates items either patented or patent pending

Flow Description

Troughs



Flow is introduced to the basin through the helical flow diffuser (not shown) which blends the incoming water with the water already in the basin without shearing floc particles. The flow is then channeled between the plate packs and enters the plates via the openings located in the sides of the plates at the bottom. (See the green arrows in Fig. 1, in the illustration gallery) The flow then travels up the plate while the settled solids travel downward (see the red arrows in Fig. 1, in the illustration gallery) and drop to the basin floor where they are removed by the sludge collector.

As the flow travels upward over the plate, (green arrow Fig. 2, in the illustration gallery) it spreads out over the entire width of the plate due to the orifices spaced evenly across the top tube. This even distribution eliminates short circuiting and allows for even settling. As the solids settle onto the plate settler (see red arrow Fig 2, in the illustration gallery) they are allowed to slide down the 55^0 angle and off of the bottom of the plate to the basin floor. It is very important that there are no ribs, textures, corrugations or indentions (sometimes used for strength) to interfere with the settled solids. Any slight obstruction will accumulate solids and block off the plate.

The flow enters the top tube via the orifices and travels through the tube and over the weir into the effluent trough. (See the green arrows in Fig. 2, in the illustration gallery).

Manufacturing:

_MRI has designed, patented and manufactured its own products since our inception in 1975.

Our 25,000 square foot production facility is located in Colorado, which is centrally located for shipping to the east coast or the west coast. Our production techniques have been years in the making and are custom designed to fit our requirements. MRI's plate production utilizes the most modern, up to date machinery available today. Our employees are trained in the manufacturing of plate settlers. Stringent quality control measures are implemented to insure a quality product. When the plate settler module is completed and checked it is loaded onto a truck and delivered directly to the jobsite.

Another important advantage to making our own plates is that should the contractor have any questions he can talk directly to the person in charge of manufacturing. This has been extremely important should the contractor have special requests i.e. last minute changes due to unforeseen situations.

Installation:

The plates are shipped in a "module or plate pack" which consists of a row of plates installed into a truss type structure. This module is assembled at the MRI manufacturing facility in Colorado. They are then loaded onto a flat bed trailer and shipped to the jobsite. Usually 2 modules are loaded onto a truck. Once at the jobsite, the modules can be lifted off by a crane directly into the basin or placed in a safe place for later installation.

This reduces the installation time by a considerable amount compared to installing the individual components.

Inside the basin the modules are supported at each end by a support beam. This beam can be provided by MRI in stainless steel or the contractor can pour them out of concrete. After the modules are set in place the troughs are installed. The modules are spaced the right distance apart to allow the troughs to be dropped into place and bolted. The installation is now complete. The effluent weirs are leveled to insure even distribution. This task is made simple as the plates can be walked on for easy access to the weirs.

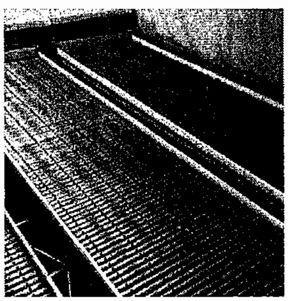
For further information on the Meurer Research plate settler line of products, contact us at:

Meurer Research Inc. Email- sales@meurerresearch.com

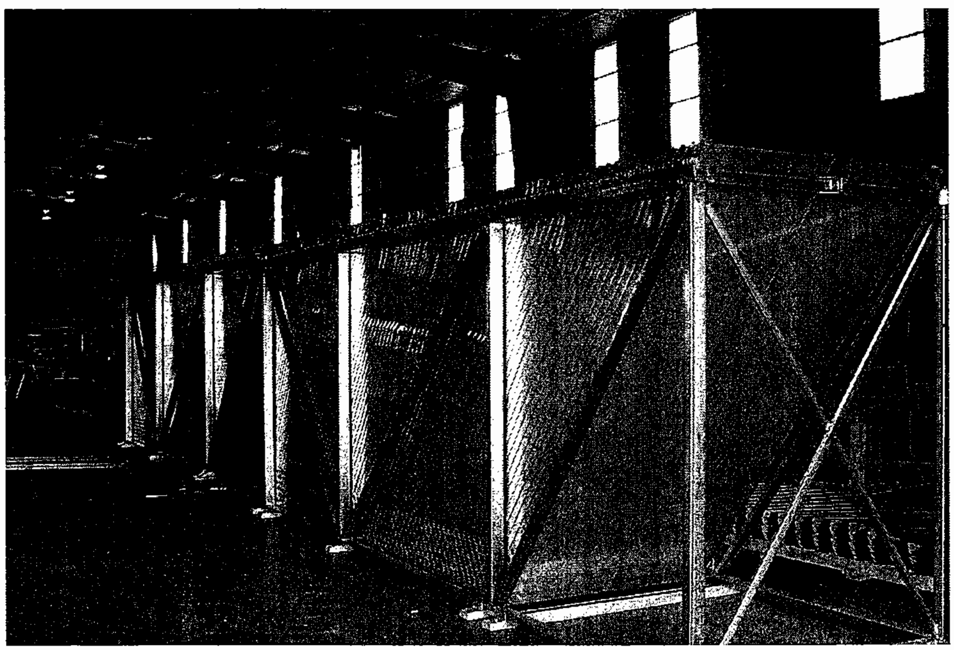
Home Up

Photo Gallery

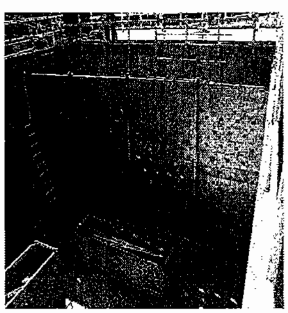
Plate Settlers



Manufacturing

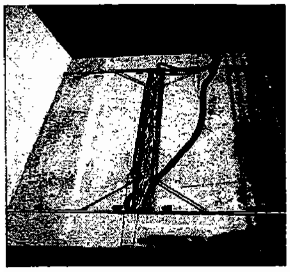


Baffles

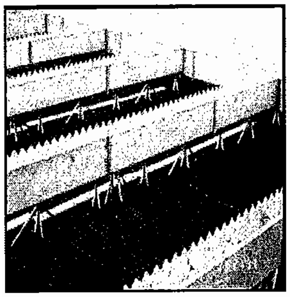


Shipping

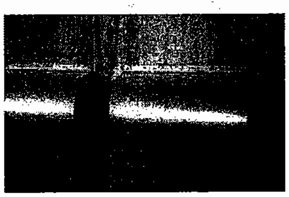
Sludge Collectors



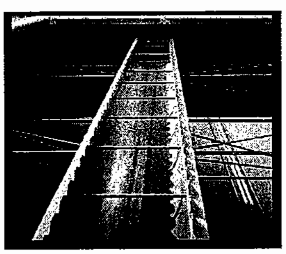
Tube Settlers



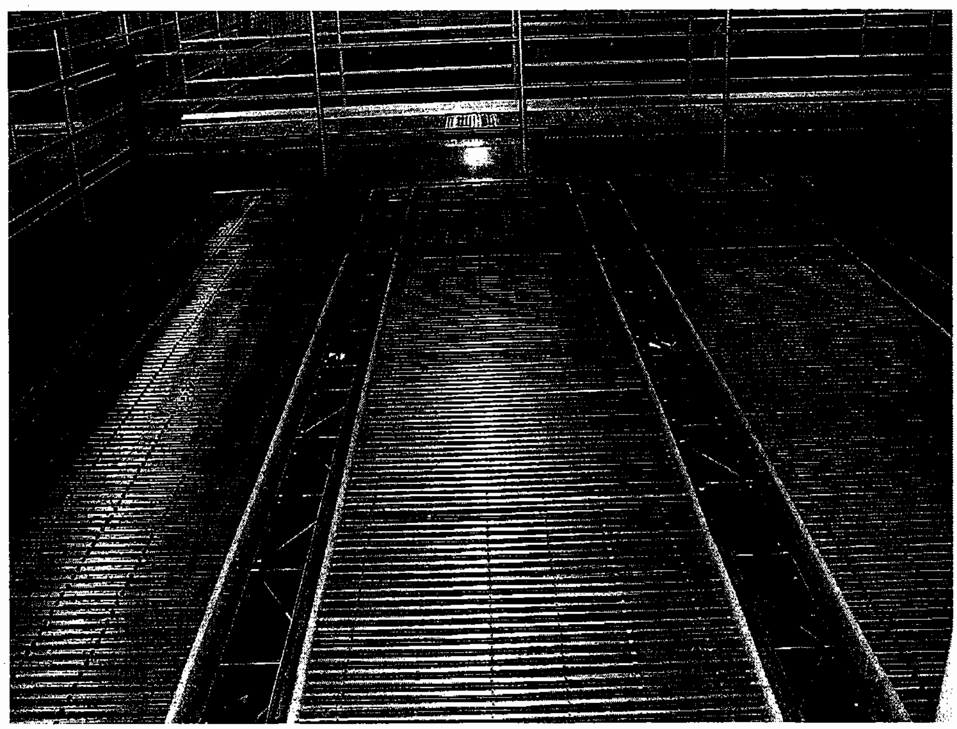
Inlet Diffusers



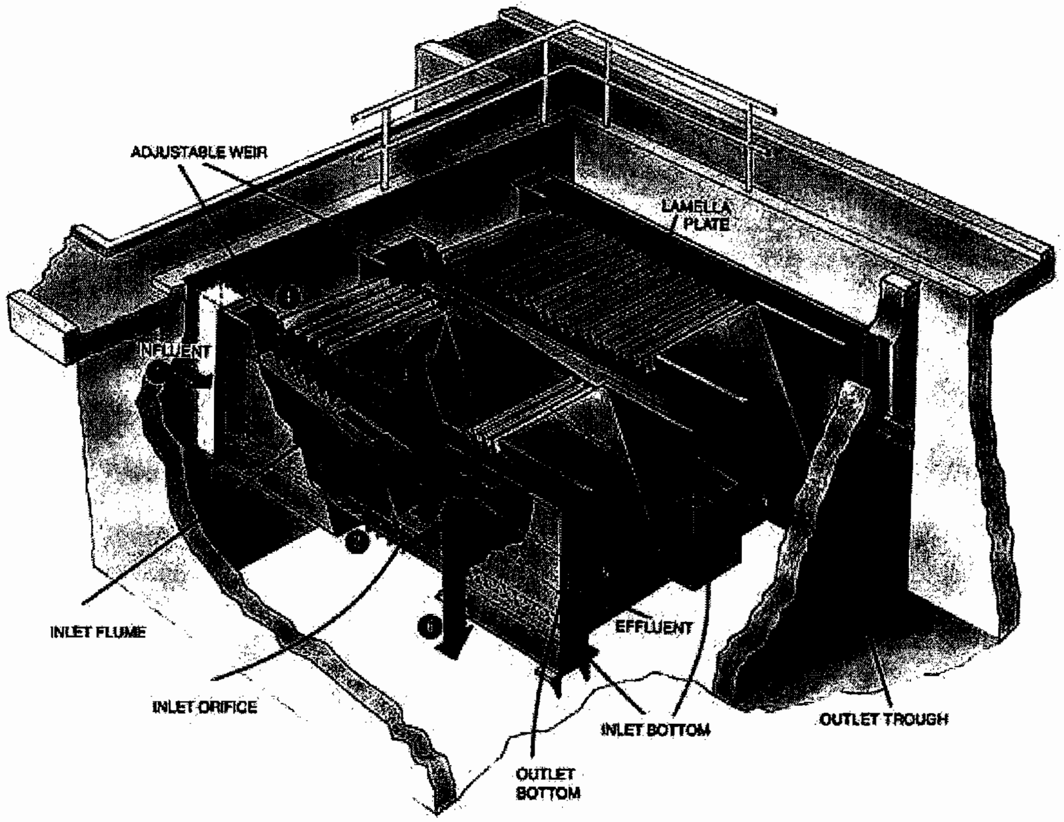
Troughs



Finished Product



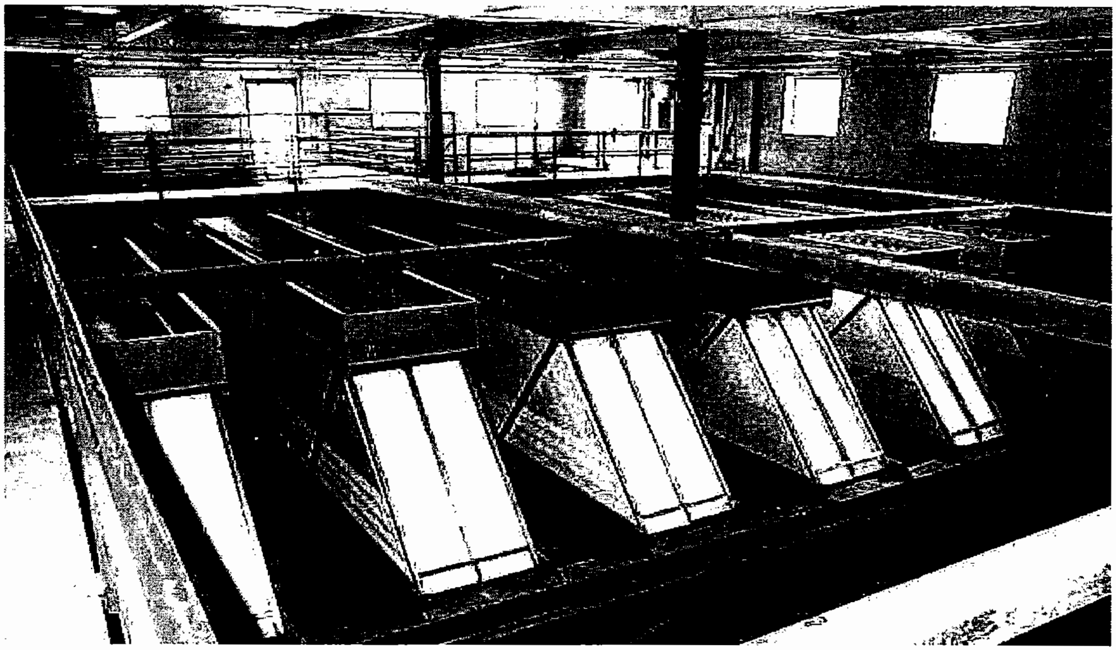
Photograph of Parallel Plate Packs inside a Clarifier.



Schematic Diagram for Inclined Plate Settlers

Plate Assembly
Inlet Openings

Photograph of Plate Assembly showing the Inlet Openings.



Photograph of Plate Packs with a V-notch Effluent Collection Channels.

Alternative Feasibility—Transporting Liquid Residual by Barge from Washington Aqueduct to Blue Plains on the Potomac River

PREPARED FOR: Ms. Jennifer Wilson, E.I.T./WDC, Mr. Ed Fleischer, P.E./WDC, Mr. Jamie Maughan, Ph.D./BOS

PREPARED BY: Ms. Sandra Rice, P.E./CCG

COPIES:

DATE: March 19, 2004

INTRODUCTION

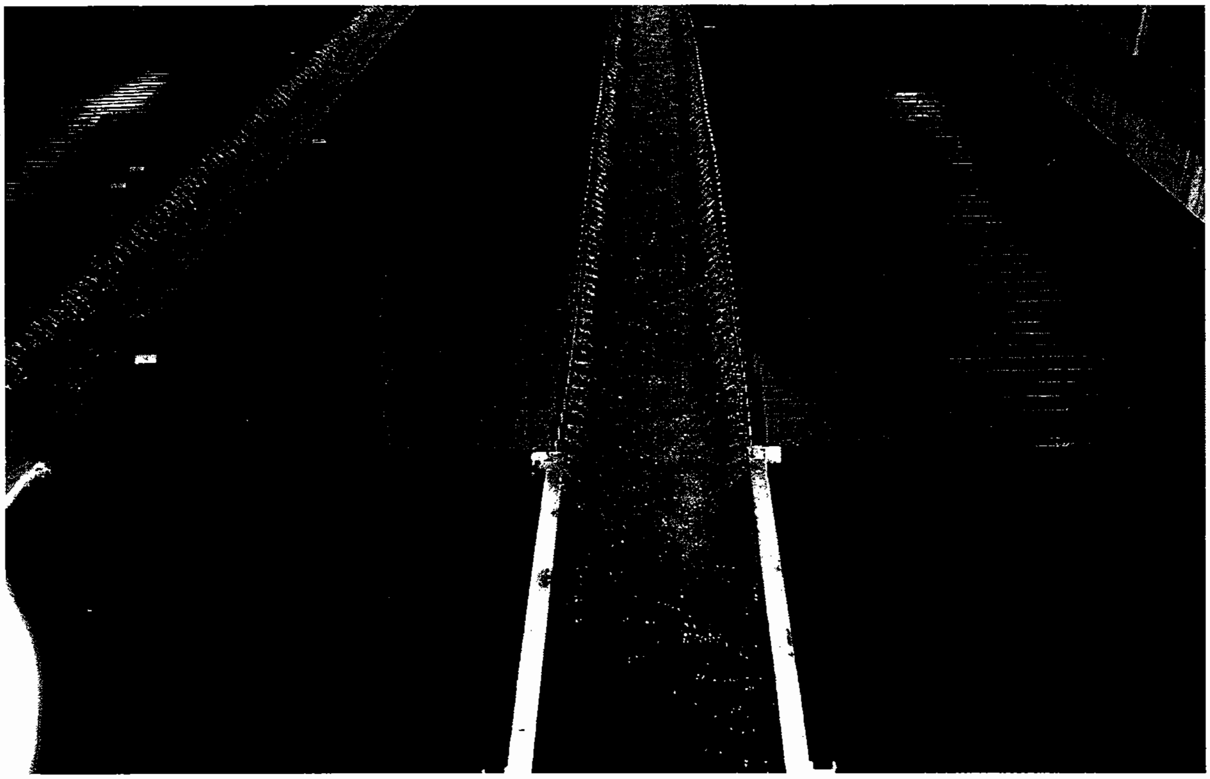
Currently, liquid residual waste from the Washington Aqueduct Water Treatment Plant is discharged into the Potomac River. As it is necessary to discontinue this practice, the feasibility of transporting the liquid residual by barge via Georgetown Channel, an approximate distance of 9.7 nm (nautical miles) on the Potomac River from the Washington Aqueduct Water Treatment Plant to the Blue Plains Wastewater Treatment Plant has been investigated. The analysis of this method of handling the liquid residual required the review of a current NOAA navigational chart and the U.S. Coast Pilot for this portion of the Potomac River as well as discussions with various regulatory agencies and marine contractors regarding the operation. Specifically, personnel from the Corps of Engineers, Baltimore District, the Coast Guard 5th District Waterways Management Office, Norfolk Dredging Company, and Precon Marine Company were contacted. This report and associated drawings describe several key factors affecting the technical and economical feasibility of this operation. Those factors include determination of limiting water depths, horizontal and vertical bridge clearances, and bottom conditions along the route as well as adverse weather conditions and facility constraints at each end of the route that will certainly impact the viability of this operation.

LIQUID RESIDUAL TRANSPORT REQUIREMENT

The volume of liquid residual to transport was given at 885,000 gallons per day, occurring on the five work days of each week. This is a volume of 118,325 cf or 7.46 million lbs of residual (3,730 tons or 3,330 long tons) based on a weight density of 63 pcf. It was estimated that the loading and unloading from two or more barges at each end of the route could be accomplished at a rate of 9,000 gpm.

TRANSPORT BARGE OPERATIONAL SCENARIOS

Two barge operation scenarios were investigated. The first concept involved specifying a standard size barge for a two-barge operation that would be large enough to handle each day’s volume of liquid residual, permitting loading and unloading operations at the up-river and down-river locations simultaneously. The second concept evaluated how many barges were required to handle the daily volume of residual liquid considering the navigational constraints of the Potomac River over a 6.5 nm stretch from the Francis Scott Key Bridge (referred to subsequently as Key Bridge) and Marbury Pt., the location of the Blue Plains plant.



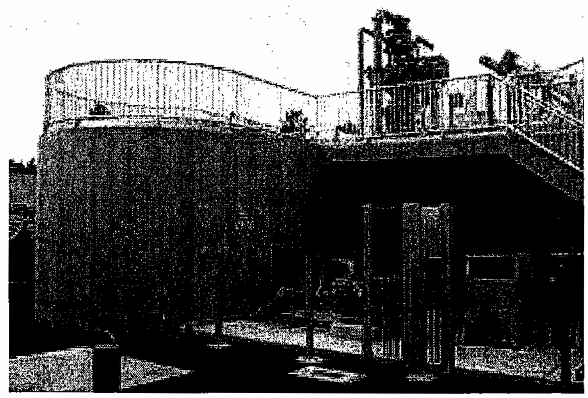
Photograph of GEWE Inclined Plate System with Collection Channels between Plate Raws.

EUTEK SYSTEMS
Solids Spinoffs for Water Reclamation and Reuse

Application Bulletin: HEADCELL™ Headworks

APPLICATION PARAMETERS

- 1 – 46 mgd per HEADCELL™
- 75 to 200 micron standard designs are available.
- Custom designs available at request.
- Headloss less than 12 inches at peak flow.
- Screening prior to the HEADCELL™ is required in wastewater applications.



Headworks Application

The flexible HEADCELL™ design provides optimum grit capture with a space-efficient configuration that uses no moving parts. The primary application of the HEADCELL™ is to remove grit as small as 50 microns (S. G. 2.65) from screened sewage in the headworks of wastewater treatment plants. Historically, grit removal has usually been installed in the headworks of the plant. It is an important part of design to prevent grit deposits in pipelines, channels, and in anaerobic digesters, thickening tanks, digestion tanks, and aeration basins. Headworks grit removal protects primary sludge pumps, centrifuges, digestion systems, solids handling equipment, high-pressure progressing cavity and diaphragm pumps, and other mechanical equipment by reducing abrasive wear.

Vital design and application considerations for choosing grit removal equipment include: headloss requirements, space requirements, removal efficiency, organic content, life-cycle costs, and characteristics of the native grit. Plant grit load should be investigated to quantify the impacts of sugar sand or light grit. When all of these are considered, the HEADCELL™ is often the most cost effective grit removal solution.

HEADCELL™ Description

The HEADCELL™ offers a low headloss option to removing fine grit and abrasives as small as 50 microns (S.G. 2.65). The HEADCELL™ is a non-mechanical, forced vortex grit removal unit using stacked tray clarification. Grit is removed by utilizing large amounts of surface area, short settling distances, and the boundary layer effect. When combined, these allow the HEADCELL™ to remove grit as small as 50 microns.

Application benefits:

- Small Footprint.
- Low headloss.
- No moving parts to wear out.
- High efficiency fine grit removal.
- High added value to plant through reduced O&M costs.
- All Hydraulic design.
- Simple maintenance.

HEADCELL™ Selection Criteria

The HEADCELL™ is typically sized for 95% removal of 75 to 200 micron material (S.G. 2.65), and larger, with headloss of 12 inches at its peak design flow. Capacity of a single unit can be as high as 46 mgd. Multiple units can be used for higher flows. Flow to the unit can be pumped or flow by gravity. Flow is introduced to the HEADCELL™ via an inlet channel and exits over a weir. The HEADCELL™ offers design flexibility by allowing multiple inlet and outlet orientations. These varied configurations allow the HEADCELL™ to be integrated into virtually any hydraulic profile and plant layout.

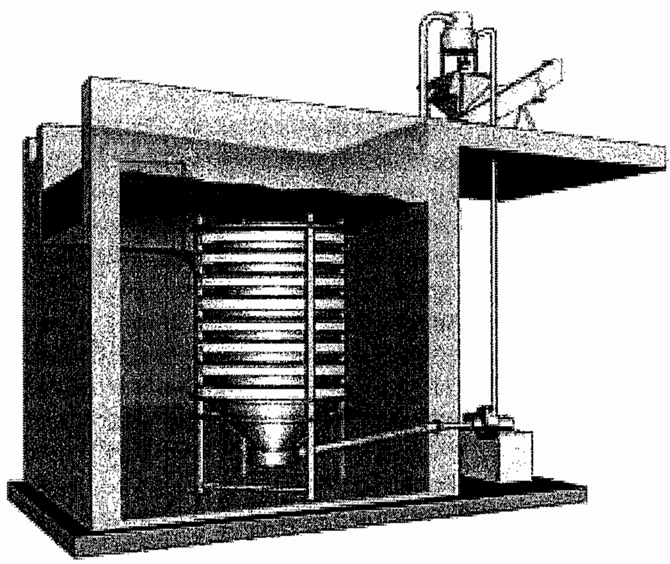
The HEADCELL™ is a non-mechanical forced vortex grit removal unit. Therefore, removal efficiency increases with decreasing flow. Because the greatest quantity of grit enters the plant during the highest flow, the HEADCELL™ is sized for peak day flows. At peak day flow, the HEADCELL™ will remove 95% of the specified particle. At lower flows, removal efficiency is increased.

When combined with SLURRYCUP™ and GRIT SNAIL™ grit washing system the HEADCELL™ can remove up to 95% of the total grit load and discharges clean, dry grit with less than 20% organic solids and at least 60% total solids.

HEADCELL™ Requirements

The HEADCELL™ can be operated in a start-stop scheme or continuous flow as necessary. Screening is required prior to the HEADCELL™ in the process stream. Acceptable screen opening is ¾". ½" or finer is recommended.

Refer to EUTEK® SYSTEMS™, INC. TEACUP™ and SLURRYCUP™ bulletins for other grit removal options.



EUTEK® SYSTEMS™, INC.
1055 NE 25th Avenue, Suite N, Hillsboro, OR 97124
Tel: (503) 615-8130 , Fax: (503) 615-2906
E-mail: sales@eutek.com

HEADCELL™ is a proprietary design - patent pending.

EUTEK SYSTEMS™

Grit Facts

Why should grit be removed from water and wastewater?

First, grit is abrasive and wears out equipment. The extent of this wear depends on the type of process used at the wastewater treatment plant. Equipment with moving parts will have higher maintenance costs resulting from this abrasive wear.

Secondly, grit accumulates in the bottom of channels, tanks and pipes. When the liquid velocity in a channel, tank or pipe falls below the transport velocity required to move grit forward, the grit settles to the bottom. Re-suspending this settled grit requires a higher energy input, so it often collects until physically removed during periodic cleaning. Prior to cleaning, the performance of the treatment process deteriorates, increasing maintenance costs and potentially jeopardizing compliance permits. This cleaning more often involves expensive "Confined Space" procedures, increasing the cost of clean-up.

Effective grit removal means comparing the capital cost of an effective grit removal system with the long-term operating costs resulting from abrasive wear, periodic cleaning and reduced process performance.

Why Remove Grit?
Abrasive Issues - Wears out Equipment

- Collector Chains, Flights and Buckets
- Clarifier Rakes
- Pumps
- Pipes
- Centrifuges

What is Grit? (Conventional Definition)

- >300μ (50 mesh)
- 1 to 5 ppm Load

Traditionally, grit is defined as high density, inorganic solids greater than 300 microns (50 mesh) in size. These solids will consist of not only sand and gravel, but also seeds, ash, cigarette filters, corn kernels, melon rinds and other inorganic solids. Traditionally, most specifications require removing 50 mesh, 300 micron sand that has a specific gravity of 2.65.

The common misconception is that abrasives, referred to as grit, are predominantly larger than 200 micron (70 mesh) sand. Through multiple pilot studies and grit analysis performed within North America by EUTEK® SYSTEMS™, a more accurate definition for grit has been developed.

Grit is more accurately defined as high density inorganic solids or abrasives as small as 50 micron (270 mesh) with specific gravity 2.65. Regardless of geographic location, to remove 99% of the abrasives, it is necessary to remove all sand larger than 40-45 microns (325 mesh) in size.

As much as 95% of the grit entering a wastewater treatment plant is smaller than 300 microns (50 mesh) in size. Thus, conventional grit control systems designed to remove 100% of sand larger than 300 microns can at best remove as little as 5 to 10% of the total abrasives load during peak flow events, when grit loads are at their highest.

Grit or abrasives are rarely well defined materials in water and wastewater treatment plants. They are most usually found with attached greases and oils which modify their settling and transport characteristics significantly from that of the inorganic grit "kernel". Attached greases and oils can reduce the specific gravity of the fine abrasives to less than that of water, often making them floatable. The condition can remain until subsequent processes remove the grease layer. Then the inorganic grit "kernels" settle rapidly in downstream processes accounting for nuisance solids deposits.

Another misconception is the amount or concentration of abrasives entering wastewater treatment plants. The average is about five parts per million during dry weather conditions and up to 40 times that amount during peak wet weather events.

Grit More Accurately Defined

- $>50\mu$ (270 mesh)
- 2.65 Specific Gravity
- 5 to 240 ppm Load

Looking at a treatment plant with a 4:1 peaking factor and a combined storm/sewer system (Table 2), 50 pounds of fixed solids per million gallons enter the treatment plant during the average daily 95 MGD flow, 359 days per year, for a total annual load of 1.7 million pounds. In contrast, during the 6 peak wet weather days experienced each year, the 380 MGD flow carries 2000 pounds of fixed solids per million gallons for a total annual load for 4.6 million pounds deposited each year of the total load of 6.3 million pounds. Almost 3/4 of the total annual load enters the treatment plant during six (6) days per year. During these six days, higher performance grit removal is essential to prevent subsequent problems.

A plant with a more typical 3:1 peaking factor will result in 10 to 20 peak events per year with less grit entering during each event. However, the total annual load ratio does not significantly change, with 2/3 of the annual grit load entering under these smaller but more numerous peak events.

Grit size distribution varies significantly depending on native soil characteristics and plant location (Table 1).

Larger treatment plants should invest in a grit study to determine actual grit size distribution. Knowledge of the grit size distribution will help determine actual grit removal system performance requirements.

Table 1: Grit Size Distribution			
Mesh	**Micron**	**Coastal Areas**	**Inland Areas**
50	300	3 - 5%	5 - 40%
70	210	5 - 10%	10 - 60%
100	150	10 - 40%	10 - 75%
150	100	10 - 75%	10 - 95%
200	75	10 - 85%	10 - 98%

Table 2: Grit Load Example				
Flow (MGD)	**Grit Load (lbs. fixed solids per million gallons)**	**Days Per Year**	**Annual Load (lbs. fixed solids)**	**% of Total Annual Grit Load**
95 MGD, ADWF	50	359	1,705,000 #FS	27.20%
380 MGD, PWWF	2000	6	4,560,000 #FS	72.80%
	TOTAL	**365**	**6,265,000 #FS**	**100.00%**

* For additional application information, please view our application datasheets.

MGD = Million Gallons per Day (1 MGD = 3785 M^3 per Day)
FS = Fixed Solids
ADWF = Average Dry Weather Flow
PWWF = Peak Wet Weather Flow

Grit can be removed at various process locations. Most commonly, it is removed at the headworks, thus removing the grit before it enters the treatment processes. Another common practice is to remove the grit from dilute sludge (0.5 to 1%) prior to thickening. Grit removal at other stages in the treatment process is common and may be better for some treatment plants.