7.0-1 INTRODUCTION

7.0-1.1 PURPOSE OF ALTERNATIVES ANALYSIS

As described in Chapter 1, "Program Description," the Water for the Future Program: Delaware Aqueduct Rondout-West Branch Tunnel Repair is necessary to enable DEP to continue to ensure the safe and reliable transmission of drinking water from the watershed to consumers in sufficient quantity to meet all present and future water demands. New York State Environmental Quality Review Act (SEQRA) regulations require that alternatives to a proposed project be identified and evaluated as part of the EIS process. New York's CEQR procedures, established pursuant to SEQR, therefore also require that an EIS include a discussion of alternatives to a proposed project and the comparable impacts and effects of such alternatives. According to CEQR, an EIS must include a description and evaluation of the range of reasonable alternatives that are feasible, considering the objectives and capabilities of the project sponsor. The alternatives analysis should present reasonable options for reducing or eliminating project impacts, while substantively meeting project goals and objectives; demonstrating a reasonable range of options to the proposed project; and comparing potential impacts with alternative approaches for meeting project objectives. The range of alternatives to be considered is determined by the nature, goals, and objectives of the specific action and its potential impacts, as disclosed by the technical impact assessments in Chapters 2 through 6 of this EIS. Alternatives to Project 2A are not considered in this analysis, because there is not sufficient project detail at this time for a full evaluation. The second EIS will thoroughly evaluate all Project 2A alternatives.

In general, since the alternatives analysis compares each alternative's impacts to those of the proposed project, the level of detail in the analysis depends on the alternative and the project's impacts. When limited impacts of the proposed project are disclosed, a qualitative assessment is appropriate. Where a significant impact of the proposed project has been identified, or where the alternative may disclose a significant impact in an area where the proposed project would have none, it is appropriate to provide additional detail on impacts with the alternative.

7.0-1.2 ALTERNATIVES TO BE ANALYZED

The alternatives discussed in this section are divided into two categories: alternatives to the Water for the Future Program (Projects 1, 2A, and 2B) and alternatives that are specific to Project 1, Shaft and Bypass Tunnel Construction. The various alternatives are listed below and discussed in greater detail in the remainder of this section.

ALTERNATIVES TO THE WATER FOR THE FUTURE PROGRAM

The No Action Alternative.

The No Action Alternative presents environmental conditions that would exist if the proposed Water for the Future Program (Projects 1, 2A, and 2B) were not implemented. The assessment of a No Action Alternative is required for all EISs. This alternative is discussed in section 7.0-2. The second EIS will also include an assessment of the No Action Alternative.

Tunnel Repair Alternatives

Under the Tunnel Repair Alternatives, a bypass tunnel would not be constructed. Instead, DEP would repair the existing aqueduct using one of the alternatives described below.

Surface Pressure Grouting

This alternative would involve the injection of high pressure grout from the ground surface through a series of holes drilled down to the level of the RWBT, in an attempt to seal the cracks in the Roseton and Wawarsing sections of the existing aqueduct.

Leak Stabilization

This alternative would involve the injection of lime into the water flowing through the RWBT in an attempt to reduce the leaks in Roseton and Wawarsing sections of the aqueduct. The second EIS will include a detailed analysis of the Leak Stabilization Alternative if this alternative is determined to be feasible.

Unwatering and Repair with Expanded Project 2A

This alternative would involve unwatering of the existing aqueduct so that repairs could be made in the Roseton and Wawarsing areas, as well as along its entire length. Because the shutdown period that would be required to complete these repairs would be longer than that required to complete Project 2B under the proposed program, an expanded water supply augmentation program would have to be undertaken, with additional augmentation projects beyond those included in Project 2A of the proposed program.

Modified Project 2B – Completed in Multiple Intervals

This alternative would complete Project 2B—the connection of the bypass to the RWBT and repairs in Wawarsing—over multiple intervals, corresponding to multiple shorter-term shutdowns of the existing aqueduct**.**

Wawarsing Bypass Tunnel Alternative

This alternative would involve the construction of a second bypass tunnel in Wawarsing instead of repairing the existing aqueduct in this area.

Third Aqueduct Alternative

This alternative would involve the construction of a new full-length aqueduct from Rondout Reservoir to either the West Branch or Kensico Reservoirs.

ALTERNATIVES TO PROJECT 1

Design Alternatives

Tunnel Drive Direction
Under this alternative, the TBM would be launched from the east connection site and received at the west connection site.

Alternate West Connection Site
Under this alternative, the west connection site would be placed at another location.

Three Shafts at Each Connection Site
Under this alternative, each connection site would have three shafts—a launch or reception shaft, a connection shaft, and a plug shaft—instead of the single shaft proposed at each site under Project 1. Inundation plugs would still be required at each of the connection sites.

No Reception Shaft at East Connection Site, Bury TBM
Under this alternative, the reception shaft at the east connection site would be eliminated, and the TBM would be buried instead of retrieved.

Construction Alternatives

East Connection Site – Shaft Muck Removal by Barge
Under this alternative, a wharf would be constructed on the Hudson River adjacent to the east connection site, for the purpose of removing muck excavated during the construction of Shaft 6B and the eastern connector tunnel between the bypass and the RWBT.

East Connection Site – Shaft Muck Removal by Rail
Under this alternative, a connection to the existing railroad tracks bordering the east connection site would be constructed, for the purpose of removing muck excavated during the construction of Shaft 6B and the eastern connector tunnel between the bypass and the RWBT.

Extended Work Hours and/or Work Week Alternative
Under this alternative, construction activities would take place for additional hours on weekdays and Saturdays, beyond what is anticipated under Project 1.

Impact Reduction Alternative

Under this alternative, additional design and construction measures to reduce project-related environmental impacts would be investigated.

7.0-1.3 SUMMARY COMPARISON OF ALTERNATIVES

A comparison of the alternatives to the Water for Future Program is provided in **Table 7-1**, and a comparison of the alternatives to Project 1 is provided in **Table 7-2**.

Table 7-1
Alternatives to the Proposed Program

		Alternatives to the Proposed Water for the Future Program						
			Tunnel Repair					
Issue	**Proposed Program**	**No Action**	**Surface Pressure Grouting**	**Leak Stabilization**	**Unwatering and Repair with Expanded Project 2A**	**Modified Project 2B - Completed in Multiple Intervals**	**Bypass Tunnel in Wawarsing in Addition to Roseton**	**Third Aqueduct**
Purpose and Need	Meets program goals and permanently addresses RWBT leaks and reliability	Does not meet program goals because does not address RWBT leaks and reliability	Does not meet program goals because unlikely to permanently address RWBT leaks and reliability	Does not meet program goals because not proven to permanently address RWBT leaks and reliability	Could meet program goals and permanently address RWBT leaks and reliability	Could meet program goals and permanently address RWBT leaks and reliability	Does not meet program goals because of higher cost to design and construct	Does not meet program goals because of greater time required to design and construct
Feasibility	Feasible	Not feasible	Not feasible	Under investigation	Feasible	Under investigation	Feasible	Feasible
Risk	Acceptable	Much greater than proposed program	Much greater than proposed program	Greater than proposed program	Much greater than proposed program	Under investigation	Similar to proposed program	Greater than proposed program because of additional time required to design and complete
Cost	$2.1 billion	N/A	Less than proposed program	Less than proposed program	Much greater than proposed program	Under investigation	Greater than proposed program	Much greater than proposed program
Time to Complete	8-9 years	N/A	Less than proposed program	Less than proposed program	Greater than proposed program because of longer RWBT shutdown	Under investigation	Similar to proposed program	Much greater than proposed program
Land Acquisition	Necessary for west connection site and possibly for augmentation projects	N/A	Likely less land area needs to be purchased than proposed program, but easements needed on many more properties	Less than proposed program; would not require new shaft sites	Would eliminate land acquisition associated with new shaft sites, but may introduce new land acquisition because of expanded water supply augmentation	Same as proposed program	Greater than proposed program; would require acquisition of properties for additional connection sites	Much greater than proposed program; would require acquisition of numerous shaft sites and subsurface easements
Environmental	Analyzed in first and second EISs	Possible risk to water supply provided by RWBT	Possibility of contaminating aqueduct, groundwater and surface wetlands with grout	To be analyzed in the second EIS if determined to be feasible	Would eliminate impacts associated with new shaft sites, but may introduce new impacts because of expanded water supply augmentation	To be analyzed in the second EIS if determined to be feasible	Greater than proposed program; would result in localized impacts at additional connection sites	Much broader range of impacts than proposed program; localized impacts at many new shaft sites

Table 7-2
Alternatives to Project 1

		Alternatives to Project 1							
		Design Alternatives				Construction Alternatives			Impact Reduction Alternative
Issue	**Project 1 Impacts**	**Tunnel Drive Direction**	**Alternate West Connection Site**	**Three Shafts at Each Connection Site**	**No Reception Shaft at East Connection Site, Bury TBM**	**East Connection Site - Shaft Muck Removal by Barge**	**East Connection Site - Shaft Muck Removal by Rail**	**Extended Work Hours and/or Work Week Alternative**	
Land Use	No temporary significant adverse impacts	See "Other" below	See "Other" below	See "Other" below	See "Other" below	See "Other" below	Comparable to Project 1	Comparable to Project 1	N/A
Neighborhood Character	Temporary significant adverse impacts (east connection site only)	Impacts would be of longer duration and greater intensity in the area surrounding the east connection site	See "Other" below	Would require additional workers, construction activity, and muck removal, thereby potentially intensifying the neighborhood character impact at the east connection site	See "Other" below	See "Other" below	Comparable to Project 1	See "Other" below	Reductions already achieved to maximum extent practicable through project improvements and mitigation measures
Visual Resources	No temporary significant adverse impacts	See "Other" below	See "Other" below	See "Other" below	See "Other" below	Increased visibility from the Hudson River	Increased visibility from the Hudson River	Comparable to Project 1	N/A
Historic Resources	No temporary significant adverse impacts	See "Other" below	See "Other" below	See "Other" below	See "Other" below	See "Other" below	Comparable to Project 1	Comparable to Project 1	N/A
Socioeconomic Conditions	No temporary significant adverse impacts	Comparable to Project 1	Any alternate west connection site that would require a longer bypass tunnel would result in higher costs	Would result in higher costs	Relative decrease in cost because of eliminating reception shaft; possible increase in cost because of burying TBM and greater construction complexity;	Additional costs associated with design, construction, and operation of the wharf	Additional costs associated with design, construction, and operation of the rail connection	Construction labor costs would be higher	N/A
Community Facilities	No temporary significant adverse impacts	See "Other" below	Comparable to Project 1	See "Other" below	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	See "Other" below	N/A
Natural Resources	No temporary significant adverse impacts	A greater portion of the east connection site would be required for staging and construction activities, necessitating additional clearing and grading	See "Other" below	See "Other" below	See "Other" below	See "Other" below; would introduce in-water natural resource impacts	Comparable to Project 1	Comparable to Project 1	N/A
Hazardous Materials	No temporary significant adverse impacts	Comparable to Project 1	See "Other" below	See "Other" below	See "Other" below	See "Other" below	Comparable to Project 1	Comparable to Project 1	N/A
Transportation	Temporary significant adverse impacts at several locations (west and east connection sites)	See "Other" below	See "Other" below; would result in greater traffic impacts on local roads	See "Other" below	See "Other" below	Potential reduction in truck trips from Project 1 at the east connection site (during Phase 2: Shaft Construction); however, temporary significant adverse traffic impacts would still occur	Comparable to Project 1	See "Other" below	Reductions already achieved to maximum extent practicable through project improvements and mitigation measures
Air Quality	No temporary significant adverse impacts	See "Other" below	See "Other" below	See "Other" below	See "Other" below	See "Other" below	Comparable to Project 1	See "Other" below	N/A
GHG/Energy	Consistent with PlaNYC goals	Comparable to Project 1	Any alternate west connection site that would require a longer bypass tunnel would result in higher GHG emissions	Would result in higher GHG emissions	Relative decrease in GHG emissions because of eliminating reception shaft; possible increase in GHG emissions because of burying TBM and greater construction complexity;	Higher GHG emissions because of construction and operation of the wharf	Higher GHG emissions because of construction and operation of the rail connection	Comparable to Project 1	N/A
Noise	Temporary significant adverse impacts at several locations (west and east connection sites)	See "Other" below	See "Other" below	See "Other" below; would result in greater noise impacts	See "Other" below	See "Other" below	Comparable to Project 1	See "Other" below	Reductions already achieved to maximum extent practicable through project improvements and mitigation measures
Infrastructure	No temporary significant adverse impacts	See "Other" below	See "Other" below	See "Other" below	See "Other" below	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	N/A
Solid Waste	No temporary significant adverse impacts	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	N/A
CZM	No temporary significant adverse impacts	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	Comparable to Project 1	Potential issues with compatibility of wharf with other water-related uses	Comparable to Project 1	Comparable to Project 1	N/A
Public Health	No temporary significant adverse impacts	See "Other" below	See "Other" below	See "Other" below	See "Other" below	See "Other" below	Comparable to Project 1	See "Other" below	N/A
Other	N/A	Would increase impacts and/or need for project improvements at the east connection site, and reduce impacts/need for improvements at the west connection site	Could have localized impacts or require project improvements at the alternate west connection site	Could increase impacts and/or need for project improvements at both connection sites	Would reduce but not eliminate localized impacts and/or need for project improvements in the vicinity of the east connection site -- an inundation plug would still be needed at this location; would increase impacts and/or need for project improvements at the west connection site	Would reduce but not eliminate impacts and/or need for project improvements associated with truck trips, and could introduce new impacts/need for project improvements associated with wharf	N/A	Effects and impacts from construction activities would occur over longer work hours and on Saturdays at both connection sites	N/A

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7.0-2 ALTERNATIVES TO THE WATER FOR THE FUTURE PROGRAM

7.0-2.1 NO ACTION ALTERNATIVE

DESCRIPTION OF THE NO ACTION ALTERNATIVE

Under the No Action Alternative, the Water for the Future Program: Delaware Aqueduct Rondout-West Branch Tunnel Repair would not be implemented. Specifically, Project 1, consisting of the shaft and bypass tunnel construction, Project 2A, the water supply improvement and augmentation projects, and Project 2B, the connection of the bypass tunnel and the inspection and repair of the RWBT, would not be undertaken. Therefore, there would be no construction related to any of these projects, and the RWBT would continue to function as it does currently.

Instead, DEP would continue to plan and undertake discrete projects for the emergency repair of the RWBT and to modernize and improve the reliability of its water supply system. These projects are discussed in section 1.0-2.4 of Chapter 1, "Program Description," and include tunnel and shaft rehabilitation at Shaft 6; flow metering, instrumentation and control improvements along the RWBT; the Croton Filtration Plant, the Croton Falls Pumping Station, and the Cross River Pumping Station.

ASSESSMENT OF THE NO ACTION ALTERNATIVE

The No Action Alternative would not result in any of the environmental impacts associated with the proposed program and its individual components—Project 1 temporary significant adverse impacts in the areas of traffic, noise and neighborhood character; Project 2A impacts resulting from the augmentation projects; and Project 2B construction period impacts, as well as potential long-term wetland reduction impacts associated with RWBT leak cessation.

The No Action Alternative would not address the RWBT reliability and leak issues related to the continued leakage from the tunnel, and would therefore not allow DEP to continue ensuring the safe and reliable transmission of drinking water from the watershed to consumers in sufficient quantity to meet all present and future water demands.

7.0-2.2 TUNNEL REPAIR ALTERNATIVES

DESCRIPTION OF THE TUNNEL REPAIR ALTERNATIVES

Surface Pressure Grouting

Under this alternative, high pressure grout would be injected from the ground surface through several hundred vertical and/or angled borings drilled down to the level of the RWBT, in an

attempt to seal the cracks in the Roseton and Wawarsing sections of the existing aqueduct. It is likely that the RWBT would have to be depressurized during multiple shutdown periods to allow the grouting to take place. Before and after RWBT leakage rates would be monitored to evaluate the effectiveness of the grouting program.

Leak Stabilization

Under this alternative, chemical stabilizers would be added to the water flowing within the RWBT in an attempt to reduce the rate of existing leakage, and prevent future cracking in the aqueduct. As described in Chapter 1, "Program Description," the cracking and leakage are occurring in the aqueduct where it passes through limestone, a rock more susceptible to wear and tear than the sandstone, shale, gneiss and granite that form the vast majority of the RWBT. DEP analyses indicate that the quality of the Delaware system water as it passes through the RWBT is aggressive to mortar-based materials, which include the RWBT's concrete lining and the surrounding limestone. The addition of chemical stabilizers would change the quality of the water in an attempt to reduce its tendency to further erode the cracks in the concrete lining and surrounding limestone.

Two proposed methods of treatment are being considered for application of chemicals associated with this alternative. During normal operation (Maintenance Mode), chemicals would be routinely added to water as it leaves Rondout Reservoir while the Delaware Aqueduct is in service. During shorter term operation (Repair Mode), chemical addition would be completed while the RWBT is shut down to facilitate increased chemical addition and enhance leak repair.

As described above, chemical leak stabilization would include the addition of lime and carbon dioxide at the Rondout Effluent Chamber (REC), and/or at one or more RWBT shaft locations. In addition, mineral acid (possibly sulfuric acid) or carbon dioxide would be added at the West Branch Influent Chamber to return the water's pH to a target of 8.0, and to prevent precipitation of calcium carbonate in the West Branch Reservoir.

Chemical addition facilities would involve new construction to house lime storage silos and possibly lime saturators. Sufficient land exists adjacent to the REC to accommodate new structure(s) required to house the facility. Sufficient space exists within the West Branch Influent Chamber to accommodate associated facilities; however, some additional construction may be necessary at this location.

Before implementation of this alternative, final sizing of the chemical addition facility and selection of chemicals to be used would be determined based on a series of technical studies and pilot tests. A pilot study which is currently in the planning stages would investigate chemical treatment strategies for full-scale application. Testing would evaluate different chemical combinations and chemical dosages required to optimize full-scale treatment. In addition, seasonal effects of the leak stabilization program would be monitored, and impacts to water quality, if any, would be characterized. Once collected, this information would be used to further

identify the number and size of facilities required for either Maintenance or Repair Mode and would evaluate the viability of the Leak Stabilization Alternative.

Unwatering and Repair with Expanded Project 2A

Under this alternative, the RWBT would be unwatered and repaired from within at both Wawarsing and Roseton. Augmentation projects proposed as part of Project 2A would need to be in place and functioning for a longer period of time and/or at greater capacity. In addition, other projects designed to assist DEP with meeting longer-term, potential water supply shortfalls would likely be required. It is anticipated that the RWBT shutdown under this alternative could range from 22 to 48 months, as compared to 6 to 15 months under Project 2B.

ASSESSMENT OF THE TUNNEL REPAIR ALTERNATIVES

Surface Pressure Grouting

This alternative would result in lesser environmental impacts than those associated with the proposed program and its individual components. It would likely not result in any of the temporary significant adverse construction period impacts that would occur with Project 1. However, due to the large number of borings involved—and the associated operation of the drill rigs, as well as the grading required to establish the pads where the rigs would be placed—it has the potential to result in adverse impacts on noise, natural resources and archaeological resources in the vicinity of the RWBT alignment along the length of the leakage areas in Roseton and Wawarsing. It would also pose the risk of contaminating groundwater, surface water, wetlands, and possibly the water in the RWBT itself, with grout. Project 2A impacts resulting from the augmentation projects, as well as Project 2B construction period impacts would not occur under this alternative.

Overall, based on unsuccessful results with similar programs at other tunnels, as well as the findings of a number of DEP studies conducted to date, this alternative is not considered technically feasible. It would not address the RWBT reliability and leak issues, and would therefore not allow DEP to continue ensuring the safe and reliable transmission of drinking water from the watershed to consumers in sufficient quantity to meet all present and future water demands.

Leak Stabilization

This alternative would not result in any of the temporary significant adverse construction period impacts that would occur with Project 1. Project 2A impacts resulting from the augmentation projects would not occur under the Maintenance Mode for this alternative. They would occur in some measure under the Repair Mode because the RWBT would have to be shut down for limited periods to allow higher chemical doses to be applied to the aqueduct, thus requiring some water supply augmentation. Project 2B construction period impacts would not occur under either the Maintenance or Repair modes for this alternative.

The Leak Stabilization Alternative would require construction of chemical addition facilities at the Rondout Effluent Chamber and the West Branch Influent Chamber, thus potentially resulting in construction-period and operational impacts at these locations. Finally, preliminary bench-scale results and computer modeling predict that chemical stabilization may have a minimal impact on water quality in the RWBT. Optimization of chemical additions and addition of a neutralization facility at West Branch Reservoir are anticipated to maintain acceptable water quality and minimize impacts to the West Branch Reservoir. Potential impacts in these and all other environmental areas for this alternative will be fully assessed in the second EIS if this alternative is determined to be feasible.

Unwatering and Repair with Expanded Project 2A

This alternative would not result in any of the temporary significant adverse construction period impacts that would occur with Project 1, or any of the construction period impacts that would occur under Project 2B. Long-term wetland reduction impacts associated with RWBT leak cessation would remain unchanged as compared to Project 2B. Project 2A impacts resulting from the augmentation projects would increase in duration and magnitude, and would likely occur in additional locations, because of the increased water supply augmentation that would be required.

7.0-2.3 MODIFIED PROJECT 2B ALTERNATIVE – COMPLETED IN MULTIPLE INTERVALS

DESCRIPTION OF THE MODIFIED PROJECT 2B ALTERNATIVE

Under this alternative, Project 2B—the connection of the bypass to the RWBT and repairs in Wawarsing—would be completed over multiple intervals, corresponding to multiple shorter-term shutdowns of the existing aqueduct. Instead of a single 6 to 15 month shutdown period, several 3 to 4 month shutdowns would be used. This would extend the overall time required to complete the connection, but may require less water supply augmentation.

ASSESSMENT OF THE MODIFIED PROJECT 2B ALTERNATIVE

This alternative would result in construction period impacts similar to those of Project 2B, but those impacts would extend over a longer period of time, with periods of lesser or no activity in between the short term RWBT shutdowns. Project 2B long-term wetland reduction impacts associated with RWBT leak cessation would remain unchanged under this alternative, as would the intensity of Project 1 construction period impacts. Consecutive months of activity may be shorter, but overall, more impacted months could result, because of the need to mobilize and demobilize construction activities for each shutdown period. Project 2A impacts resulting from the augmentation projects may be reduced since less water supply augmentation may be needed.

Overall, it is possible that this alternative could address the RWBT reliability and leak issues, and allow DEP to continue ensuring the safe and reliable transmission of drinking water from the

watershed to consumers in sufficient quantity to meet all present and future water demands. If it is found to be feasible, its potential environmental impacts will be fully assessed in the second EIS.

7.0-2.4 WAWARSING BYPASS TUNNEL ALTERNATIVE

DESCRIPTION OF THE WAWARSING BYPASS TUNNEL ALTERNATIVE

Under this alternative, a bypass tunnel would be constructed in Wawarsing instead of repairing the existing aqueduct in this area, and in addition to the bypass tunnel that would be constructed in Roseton. An additional construction effort similar to that described in Chapter 2 for the Roseton bypass would be required to build the connection sites, shafts and bypass tunnel.

ASSESSMENT OF THE WAWARSING BYPASS TUNNEL ALTERNATIVE

This alternative would result in construction period impacts in Wawarsing similar to the Project 1 and Project 2B impacts associated with the Roseton bypass tunnel. New properties would have to be acquired for the construction of the connection sites, and shaft and tunnel construction at these sites would result in high levels of traffic and noise for several years. Potential adverse impacts could also occur in other environmental areas such as natural resources, historic and archaeological resources, visual resources and neighborhood character. Project 2A impacts resulting from the augmentation projects would likely remain unchanged under this alternative.

This alternative would not meet the Water for the Future Program goals and objectives because it would be much more costly to design and construct than the proposed program, without providing any additional benefit in addressing the RWBT reliability and leak issues. A bypass tunnel is proposed in the Roseton area for two key reasons. It is the low point of the RWBT, and there is a hydraulic connection between the RWBT and the Hudson River at that location, both resulting in a risk of tunnel inundation if the RWBT is unwatered for repairs. These issues and the associated inundation risk are absent in Wawarsing. Therefore, this alternative would involve unnecessary additional cost and complexity, and would not increase DEP’s ability to continue ensuring the safe and reliable transmission of drinking water from the watershed to consumers in sufficient quantity to meet all present and future water demands, beyond what the Water for the Future Program would accomplish.

7.0-2.5 THIRD AQUEDUCT ALTERNATIVE

DESCRIPTION OF THE THIRD AQUEDUCT ALTERNATIVE

Under this alternative, a new full-length aqueduct would be constructed from Rondout Reservoir to either the West Branch or Kensico Reservoirs. It is anticipated that this new aqueduct would be at least 45 miles in length, with new influent and effluent chambers, and shafts located at intervals of approximately five miles. The construction effort associated with this alternative

would be similar in nature to that described in Chapter 2 for the Roseton bypass, but would be much more extensive because it would involve a much longer tunnel and the construction of many more shafts. Since the RWBT would remain fully operational during construction of the new aqueduct, water supply augmentation projects would not have to be constructed under Project 2A. The RWBT could be shut down for repair after activation of the new aqueduct or it could be deactivated if the third aqueduct is designed to replace the RWBT.

ASSESSMENT OF THE THIRD AQUEDUCT ALTERNATIVE

This alternative would result in construction impacts similar to those for the bypass tunnel under Project 1, but over a much longer period of time and at many more locations. Properties would have to be acquired for the new shafts, and construction activities could result in adverse impacts in a number of environmental areas at different locations along the route of the new aqueduct. Project 2A impacts resulting from the augmentation projects and Project 2B construction period impacts would not result under this alternative, since the RWBT would not need to be shut down prior to completion and activation of the new aqueduct. Long-term wetland reduction impacts associated with RWBT leak cessation would remain unchanged under this alternative.

This alternative would not meet Water for the Future Program goals and objectives because it would be much more costly and time consuming to design and construct than the proposed program. While it would enable DEP to continue ensuring the safe and reliable transmission of drinking water from the watershed to consumers in sufficient quantity to meet all present and future water demands, it would do so at an unnecessarily high cost and would not be completed quickly enough to address the current RWBT reliability and leak issues.

7.0-3 ALTERNATIVES TO PROJECT 1

7.0-3.1 DESIGN ALTERNATIVES

DESCRIPTION OF THE DESIGN ALTERNATIVES

Tunnel Drive Direction

As described and assessed throughout Chapter 2, “Probable Impacts of Project 1, Shaft and Bypass Tunnel Construction,” the TBM would be launched from the west connection site in the Town of Newburgh and retrieved at the east connection site in the Town of Wappinger. In the Tunnel Drive Direction Alternative, the reverse would occur: the TBM would be launched from the east connection site and retrieved at the west connection site. The construction effort for this alternative would be similar to that described in Chapter 2, but with construction activities associated with TBM launch occurring at the east connection site—such as TBM delivery and assembly, storage of pre-cast concrete segments for the bypass tunnel, removal of muck

excavated from the tunnel, and production of concrete for the tunnel, and TBM retrieval, disassembly and removal occurring at the west connection site.

Because the east connection site would be used to launch the TBM, additional space would have to be provided for TBM delivery and assembly, storage of pre-cast concrete segments and other lining materials for the bypass tunnel, as well as storage of muck excavated from the tunnel. In addition, a grout and concrete batch plant would be required at the site in order to produce grout needed during the placement of the pre-cast concrete segments in the bypass tunnel by the TBM, and concrete for the final bypass tunnel lining, connector tunnels, and other project elements. In order to accommodate these construction activities associated with launching the TBM at the east connection site, additional parcels contiguous to the Shaft 6 property owned by DEP would have to be acquired.

In addition, there would be an overall increase in the duration and intensity of construction activity at the east connection site, as compared to Project 1. During shaft and tunnel construction, lasting approximately 6 years, construction would occur 24 hours/day, 5 days/week. Additional workers would be required and there would be no restrictions on trucking during the third construction shift (11 PM to 7 AM).

Conversely, there would be a decrease in the extent of site development, and construction intensity and duration on the west connection site, as compared to Project 1.

Alternate West Connection Site

As part of project planning, DEP considered a number of alternate west connection sites for the bypass tunnel. The main criteria for evaluating these sites included: the minimum length of tunnel required to bypass the leaking Roseton segment of the RWBT; the additional time and cost associated with constructing a bypass longer than this minimum length; the size and topography of the parcels, as well as their location relative to the RWBT alignment and to major roadways; the cost of property acquisition and development of the connection site; and the willingness of property owners to sell.

Of all the alternate sites considered, the proposed west connection site best satisfied the above criteria. The bypass tunnel connecting to the proposed site is very close to the minimum length required to bypass the leaking Roseton segment of the RWBT; the site provides adequate size and topography that can be modified to accommodate project construction activities; it is located adjacent to Route 9W, a major arterial roadway; and it has willing sellers and acceptable property acquisition and site development costs. The two other west connection sites that were given the most consideration based on the above criteria were the existing RWBT Shaft 5A, which is owned by DEP and is located approximately 4,000 feet northwest of the proposed west connection site, and a privately owned property located approximately 1,000 feet southeast of Shaft 5A. Potential environmental impacts associated with these two alternate sites are discussed below.

Three Shafts at Each Connection Site

Under this alternative, each connection site would have three shafts—launch or reception shaft, a connection shaft, and a plug shaft—instead of the single shaft at each site under Project 1.The connection shafts would provide vertical access to construct the connection chambers at the junctions of the bypass tunnel with the RWBT, instead of the lateral access through the connector tunnels that would be used to construct the connection chambers under Project 2B. The plug shafts would provide vertical access to construct the bulkheads that would permanently seal off the leaking segment of the RWBT, instead of the lateral access through the connector tunnels that would be used to construct the bulkheads as part of the connection chambers under Project 2B. The plug shafts would not replace the inundation plugs, which would still be required at each of the connection sites.

This alternative would significantly increase the duration and intensity of construction activity associated with shaft construction at both connection sites, as compared to Project 1. Simultaneous construction of the three shafts would likely be required at each site, resulting in additional workers and construction activities 24 hours/day, 5 days/week. At the east connection site, it would not be feasible to restrict trucking during the third construction shift (11 PM to 7 AM).

No Reception Shaft at East Connection Site, Bury TBM

Under this alternative, the reception shaft at the east connection site would be eliminated and the TBM would be buried instead of retrieved. Some construction activities that would take place at the east connection site under Projects 1 and 2B—such as support for construction of the eastern connection between the bypass tunnel and the RWBT, as well as installing a portion of the bypass tunnel's final concrete liner—would instead take place at the west connection site. This would increase construction activity at the west connection site relative to Project 1. Other construction activities that would take place at the east connection site under Projects 1 and 2B—such as inundation plug installation—would still take place there, but overall construction activity at the site would be reduced as compared to Project 1. This alternative would increase Project 1 construction duration, risk and complexity because the eastern connector tunnel and connection chamber between the bypass and the RWBT would have to be constructed without the nearby access that the TBM reception shaft at the east connection site would provide. Instead, the only access would be from the TBM launch shaft at the west connection site over two miles away.

ASSESSMENT OF THE DESIGN ALTERNATIVES

Tunnel Drive Direction

This alternative would generally result in greater impacts at the east connection site and lesser impacts at the west connection site, as compared to Project 1. Launching the TBM from the east connection site would result in a larger number of worker trips at the site and on surrounding

roadways as compared to Project 1, as well as the need for additional on-site and likely new off-site parking areas. Because tunnel muck would be removed from the TBM launch shaft, the number of truck trips generated at the east connection site would increase relative to Project 1, resulting in increased transportation impacts. Finally, additional noise impacts associated with increased work hours at the east connection site would also be anticipated to occur since shaft and tunnel excavation itself would take place 24 hours/day, 5 days/week.

The temporary significant adverse traffic, noise and neighborhood character impacts predicted at the east connection site under Project 1 would increase substantially in intensity and duration under this alternative, and impacts may emerge in other environmental areas relative to Project 1 as a result of the additional construction activities described above. Overall, this alternative was not selected because of the greater constraints present at the east connection site in terms of space availability, the need to acquire additional land, and the lack of direct access to a major roadway.

Alternate West Connection Site

In general, the construction period impacts that would occur at either of the alternate west connection sites—Shaft 5A or the privately owned property located approximately 1,000 feet southeast of Shaft 5A—would be similar to those at the west connection site under Project 1. However, the bypass tunnel that would be constructed between Shaft 5A and the east connection site would be approximately 4,000 feet longer than the tunnel under Project 1, resulting in additional cost, longer duration and greater number of construction period impacts, and higher GHG emissions. In addition, the Shaft 5A property is not large enough to accommodate all of the construction activities and space requirements associated with the TBM launch site, and additional contiguous properties would have to be purchased. Finally, Shaft 5A is bordered by two local roadways—Lattintown Road and Bingham Road. Traffic and noise impacts associated with construction worker vehicles and trucks could occur in the vicinity of these local roadways. Unlike Route 9W, these roadways are not designed to support extensive truck traffic.

The privately owned property located approximately 1,000 feet southeast of Shaft 5A is large enough to serve as the TBM launch site. However, it is also bordered by Lattintown Road and could therefore also result in traffic and noise impacts in the vicinity of this roadway. The bypass tunnel that would be constructed between this property and the east connection site would be approximately 2,000 feet longer than the tunnel under Project 1, resulting in additional cost, longer duration of construction period impacts, and higher GHG emissions.

The temporary significant adverse traffic and noise impacts predicted at the west connection site under Project 1 would likely also occur at the two alternate connection sites under this alternative. In addition, the duration of other construction period impacts would be longer, as would GHG emissions, both due to the longer bypass tunnel which would be constructed. Overall, the alternate connection sites considered under this alternative were not selected because of the deficiencies described above relative to the proposed west connection site.

Three Shafts at Each Connection Site

This alternative would generally result in greater impacts and longer work hours at both connection sites, because of the increased construction activity required to build three shafts instead of one at each site. For example, the larger number of workers needed at each site would result in more vehicular trips on surrounding roadways as compared to Project 1, as well as the need for additional parking areas. Similarly, the larger quantity of muck excavated from the additional shafts would generate more truck trips. Noise and air pollutant levels would increase at each connection site relative to Project 1 due to the more intense construction activity required to build the three shafts. Finally, GHG emissions would increase due to greater construction activity and use of construction materials such as concrete and steel.

The temporary significant adverse traffic and noise impacts predicted at the west connection site, and the temporary significant adverse traffic, noise and neighborhood character impacts predicted at the east connection site under Project 1 would increase in intensity and duration under this alternative, and impacts may emerge in other environmental areas as a result of the construction activities associated with the additional shafts. Overall, this alternative was not selected because based on the current design, the additional shafts are not necessary to meet the objectives of Projects 1 and 2B, and would result in greater costs and environmental impacts.

No Reception Shaft at East Connection Site, Bury TBM

This alternative would generally result in greater impacts at the west connection site and lesser impacts at the east connection site, as compared to Projects 1 and 2B. Traffic, noise and other impacts in the vicinity of the west connection site would increase relative to Projects 1 and 2B, due to the addition of construction activities that would take place at the east connection site under Projects 1 and 2B. As mentioned above, these activities include support for constructing the eastern connection between the bypass tunnel and the RWBT, as well as installing a portion of the bypass tunnel's final concrete liner. Conversely, traffic, noise and other impacts in the vicinity of the east connection site under Project 1 would decrease under this alternative, because of the elimination of the activities mentioned above. Other construction activities, such as inundation plug installation, would still take place at the east connection site.

The temporary significant adverse traffic and noise impacts predicted at the west connection site under Projects 1 and 2B would likely increase under this alternative, and impacts may emerge in other environmental areas as a result of the additional construction activities described above. The temporary significant adverse traffic, noise and neighborhood character impacts predicted under Projects 1 and 2B would decrease at the east connection site under this alternative, due to the elimination of the construction activities described above.

Overall, this alternative was not selected because it would unacceptably increase construction duration, risk and complexity for Projects 1 and 2B. The eastern connector tunnel and connection chamber between the bypass and the RWBT would have to be constructed without the nearby access that the TBM reception shaft at the east connection site would provide. Instead, the only

access would be from the TBM launch shaft at the west connection site over two miles away. This alternative would also unacceptably increase construction duration for Project 1 by requiring that the final concrete liner for the bypass tunnel be installed entirely from the west connection site.

7.0-3.2 CONSTRUCTION ALTERNATIVES

DESCRIPTION OF THE CONSTRUCTION ALTERNATIVES

East Connection Site – Shaft Muck Removal by Barge

Under this alternative, a wharf would be constructed on the Hudson River adjacent to the east connection site, for the purpose of removing muck excavated during the construction of Shaft 6B and the eastern connector tunnel between the bypass and the RWBT, thereby reducing overall truck trips to and from the site. The wharf would be placed approximately 300 feet off-shore, in order to provide adequate water depth for fully loaded barges and minimize the need for dredging. To convey muck from Shaft 6B to the wharf, a pile-supported elevated conveyor system would be constructed, starting at the shaft and continuing west across the east connection site, over the MTA Metro-North rail line, and then over the water to the wharf. There would also be a walkway adjacent to the elevated conveyor, but no vehicular access between the shaft and the wharf would be provided. The conveyor would be loaded by front-end loaders in the vicinity of the shaft.

The primary construction activities associated with building the wharf would be pile driving, which would be performed in the water using a jack-up barge. Since there is no access across the railroad tracks located between the east connection site and the river, all construction activity would be supported by marine transport from a nearby marina. On land, the construction of the conveyor support system would also require pile driving, as well as steel framework construction involving cranes, mobile work platforms and welding. All work occurring in the vicinity of the railroad tracks would require extensive coordination with MTA and railroad landowners.

Removal of muck by barge would be restricted for approximately 4 months each winter due to ice on the Hudson River. During this winter work window, all muck would be removed by truck.

As compared to Project 1, additional permits and approvals to construct the wharf would be required from the following entities:

- New York State Department of Environmental Conservation (NYSDEC)
- United States Army Corp of Engineers (USACE)
- New York State Office of General Services (NYSOGS)
- Metro-North Railroad, CSX, and/or Midtown Trackage Ventures

Because the railroad carries a high volume of existing commuter and freight rail traffic, the placement of an elevated muck conveyor system over the tracks would pose significant technical

and regulatory challenges, and would have to be designed in coordination with, and according to the design standards established by Metro-North Railroad and/or CSX.

East Connection Site – Shaft Muck Removal by Rail

Under this alternative, a connection to the existing railroad tracks bordering the east connection site would be constructed, for the purpose of removing muck excavated during the construction of Shaft 6B and the eastern connector tunnel between the bypass and the RWBT. The rail connection, or "siding," would require extensive excavation, grading, and installation of retaining walls on the east connection site adjacent to the railroad tracks, and would be designed in coordination with and according to the design standards established by Metro-North Railroad and/or CSX. Excavation, grading and installation of retaining walls in this area of the east connection site would generate a similar number of truck trips as those required for muck removal under Project 1. A pile-supported ground-level conveyor system would also be constructed to transport the muck from the shaft to the rail siding, where it would be loaded onto rail cars.

The primary construction activities associated with building the rail siding would be excavation and grading, installation of retaining walls, pile driving, and steel framework construction involving cranes, mobile work platforms and welding.

Permits and approvals to construct the rail siding would be required from:

- Metro-North Railroad, CSX, and/or Midtown Trackage Ventures
- New York State Department of State (NYSDOS)
- New York State Office of Parks, Recreation and Historic Preservation

The railroad-related approvals would require extensive coordination with MTA and/or CSX to ensure that operation of the rail siding would not adversely affect the high volume of existing commuter and freight traffic served by the railroad.

Extended Work Hours and/or Work Week Alternative

Under this alternative, construction activities would take place for additional hours on weekdays and Saturdays, beyond what would occur under Project 1. In the case of site preparation and tunnel excavation at the west connection site, construction activities would already occur on Saturdays under Project 1, but the work hours may be extended under this alternative. All other construction activities at the east and west connection sites—which would take place on weekdays under Project 1—may have extended work hours and/or take place on Saturdays. Overall, this alternative may be employed on an as-needed basis to prevent delays in the completion of Project 1 and the overall Water for the Future Program.

ASSESSMENT OF THE CONSTRUCTION ALTERNATIVES

East Connection Site – Shaft Muck Removal by Barge

This alternative would reduce truck traffic associated with muck removal at the east connection site relative to Project 1 during warm months, but would also increase noise levels in the vicinity of the site due to the construction and operation of the muck conveyor system. No reduction of truck traffic would be observed during the winter months when the Hudson River is not navigable due to ice. In addition, construction and operation of the wharf would result in natural resource impacts in the Hudson River, as well as potential issues regarding the compatibility of the wharf with other nearby water-related uses, and increased visibility of the east connection site from the river. Additional information on the anticipated reduction in truck trips under this alternative is provided below.

Under Project 1, the estimated total number of truck trips at the east connection site for removal of muck from construction of Shaft 6B and the eastern connector tunnel between the bypass and the RWBT would be approximately 11,000. The estimated total number of truck trips for all purposes, including muck removal and delivery of construction supplies is approximately 32,000. Accordingly, muck removal accounts for approximately one third of the total truck trips.

If barge transportation is implemented, it is assumed that barges would replace trucks for muck removal during eight months of the year, with Hudson River traffic shut down for four months during winter due to ice and weather conditions. On this basis, barge transportation would eliminate approximately 6,500 truck trips associated with muck removal, or approximately 20 percent of the total number of truck trips at the east connection site. Because muck would still have to be removed by truck during the winter, truck trips during the winter would remain unchanged. There would also be an increase in the number of truck trips during site preparation at the east connection site, corresponding to the construction of the muck conveyor system between Shaft 6B and the wharf. Finally, all of the muck-related truck trips that would be eliminated from the vicinity of the east connection site would reappear at some other location, i.e., where the barges would unload the muck onto trucks for transport to the final disposal destination.

Based on the modest reduction in truck trips anticipated under this alternative, and the fact that worker trips at the east connection site would remain unchanged, the temporary significant adverse traffic, noise and neighborhood character impacts that would occur under Project 1 would remain. In addition, new impacts associated with natural resources, visual resources, and coastal zone consistency would occur in the vicinity of the east connection site, along with potential off-site traffic impacts associated with unloading of the barges and truck transport of muck to its final destination.

Overall, this alternative was not selected because it would provide only marginal benefits in the vicinity of the east connection site without eliminating any of the temporary significant adverse impacts that would occur under Project 1. It would also introduce new environmental impacts in

several other areas, substantially increase Project 1 costs and the intensity of construction activities at the east connection site, and could adversely impact the Project 1 schedule. Moreover, as described above, the design and operation of an elevated muck conveyor system over the existing railroad tracks adjacent to the east connection site would pose significant challenges, and would require extensive coordination with and approval from Metro-North Railroad and/or CSX to ensure that the high volume of existing commuter and freight traffic served by the railroad would not be adversely affected.

East Connection Site – Shaft Muck Removal by Rail

This alternative would not reduce overall truck traffic at the east connection site relative to Project 1. Noise levels may increase in the vicinity of the site due to the construction and operation of the muck conveyor system, and to a larger extent because of the extensive excavation, grading and installation of retaining walls that would be required adjacent to the railroad tracks. Construction and operation of the rail siding would also increase visibility of the east connection site from the Hudson River, as well as GHG emissions, relative to Project 1.

In contrast to the barge alternative discussed above, it is assumed that rail cars would replace trucks for muck removal for all 12 months of the year. This would eliminate truck trips associated with muck removal at the east connection site relative to Project 1. However, this reduction would be offset by the additional truck trips associated with the extensive excavation, grading, and installation of the retaining walls required to construct the rail siding. Therefore, there would be no net benefit or reduction in truck traffic at the east connection site, and the duration of noise impacts would likely increase as a result of rail siding construction. Finally, as with the barge alternative, all of the muck removed from the site by rail would reappear at some other location, i.e., where the rail cars would unload the muck onto trucks for transport to the final disposal destination.

The temporary significant adverse traffic, noise and neighborhood character impacts that would occur under Project 1 would likely remain under this alternative. In addition, it would introduce potential new impacts or issues with respect to visual resources, increased GHG emissions, and off-site traffic associated with unloading of the rail cars and truck transport of muck to its final destination.

Overall, this alternative was not selected because it would not provide benefits in the vicinity of the east connection site, would substantially increase Project 1 costs and the intensity of construction activities at the east connection site, and could adversely impact the Project 1 schedule. Moreover, as described above, the design and operation of a rail siding adjacent to the existing railroad tracks bordering the east connection site would pose significant challenges, and would require extensive coordination with and approval from Metro-North Railroad and/or CSX to ensure that the high volume of existing commuter and freight traffic served by the railroad would not be adversely affected.

Extended Work Hours and/or Work Week Alternative

While the intensity of Project 1 impacts would likely be similar under this alternative, the temporary significant adverse traffic and noise impacts predicted at the west connection site, and the temporary significant adverse traffic, noise and neighborhood character impacts predicted at the east connection site would increase in duration, as a result of work hours and/or the work week being extended. In addition, the continuation of construction activities on Saturdays, and the lack of a full two-day respite from construction noise and other impacts on weekends, would increase nuisance and disruption for nearby residents.

7.0-3.3 IMPACT REDUCTION ALTERNATIVE

Under this alternative, additional design and construction measures to reduce Project 1 environmental impacts may be investigated as project design and construction advance, and implemented if determined to be practicable.

A wide range of impact-reduction measures have already been identified and incorporated into the Project 1 design, substantially reducing the potential for additional temporary significant adverse impacts resulting from the construction of Project 1. These measures include: the decision to employ inundation plugs at both connection sites instead of constructing plug shafts; limiting work hours at the east connection site for phases of work that would not delay completion of Project 1; limiting truck traffic to and from the east connection site between 11 PM and 7 AM; committing to tree clearing at both connection sites during seasonal periods that would not disturb potential Indiana bat populations; and utilizing connection sites already under DEP ownership or sold to DEP by willing sellers.

7.0-4 OTHER ALTERNATIVES

7.0-4.1 CONCRETE BATCH PLANT ON EAST CONNECTION SITE

Under this alternative, a concrete batch plant would be constructed at the east connection site to provide concrete for three project elements—the lining of shaft 6B, a portion of the bypass tunnel final lining that would be installed from the east connection site, and the lining of the eastern connector tunnel between the bypass tunnel and the RWBT. This would be done instead of delivering concrete for these purposes by truck. Construction and operation of the batch plant may require the acquisition of additional parcels contiguous to the Shaft 6 property owned by DEP.

This alternative would not reduce overall truck traffic at the east connection site relative to Project 1. While it would reduce truck traffic associated with concrete delivery to the site, this benefit would be offset by the additional worker and truck trips necessary to construct the batch plant, as well as by the new truck trips necessary to deliver cement, aggregate and other concrete ingredients during operation of the plant. In addition, air and noise emissions, as well as visibility

of the east connection site would all increase as a result of the construction and operation of the batch plant.

The temporary significant adverse traffic impacts that would occur in the vicinity of the east connection site under Project 1 would remain under this alternative. In addition, Project 1 temporary significant adverse noise and neighborhood character impacts would intensify, and new impacts with respect to visual resources and other environmental areas may emerge as a result of the construction and operation of the batch plant.

Overall, this alternative was not selected because it would increase environmental impacts in the vicinity of the east connection site, and substantially increase Project 1 costs. Moreover, because the concrete batch plant would have to be built before construction of Shaft 6B could begin, this alternative would unacceptably increase construction duration for Project 1.

7.0-4.2 TUNNEL ALIGNMENT ALTERNATIVES

As part of project planning, DEP considered a number of alternative alignments for the bypass tunnel. These included alignments at varying distances from the RWBT; horizontal alignments to the south of the RWBT instead of to the north; and vertical alignments above or below the RWBT instead of at the same elevation. The main criteria for evaluating these alternatives included: the minimum distance required between the bypass tunnel and the RWBT to minimize adverse effects from the leaking RWBT Roseton segment on bypass construction; geologic conditions along possible bypass alignments, such as rock quality and the presence and orientation of known geologic faults; the minimum turning radius required by the TBM that would excavate the bypass; and hydraulic flow and future access considerations associated with elevation differences between the bypass and the RWBT. Of all the alternative alignments considered, the proposed bypass best satisfied the above criteria.

The construction period impacts associated with the various tunnel alignment alternatives would be comparable to those predicted for the proposed bypass tunnel. The intensity of impacts would be similar to the proposed bypass, and the duration would generally correspond to the length of the bypass tunnel under a given alignment alternative, with longer tunnels resulting in more lengthy construction periods and associated impacts. ✷