

Utility Distribution Tunnel Maintenance Repair Study  
University of Wisconsin Parkside  
Kenosha, Wisconsin

Division Project No. 09G3Q

December 21, 2009

FOR  
THE STATE OF WISCONSIN  
DEPARTMENT OF ADMINISTRATION  
DIVISION OF STATE FACILITIES  
STATE OF WISCONSIN ADMINISTRATION BUILDING - 7TH FLOOR  
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By

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## **Purpose**

The purpose of this study is to evaluate the current condition of the utility tunnel piping systems, areas of water infiltration in the tunnel and overall structural condition of the entire tunnel. Construction and engineering costs will then be applied to each area reviewed for future repair and upgrade to utility tunnel system.

The following are the areas of analysis:

1. Tunnel water infiltration.
2. Tunnel structural deterioration.
3. Steam/Condensate support integrity.
4. Steam/Condensate insulation condition.
5. Chilled water pipe support integrity.
6. Chilled water insulation condition.
7. Air pipe exterior corrosion.
8. Miscellaneous structural and mechanical repairs.



## **Utility Tunnel Survey**

Visual walk-thru and examination was performed with UW Parkside Plant Supervisor Dale Lovejoy to review piping systems, locations of water infiltration and overall structural integrity of tunnel. The existing utility tunnel conditions table within illustrates the varying conditions and quantities that are present thru-out the tunnel. See Appendix A for tunnel map. Questionable conditions were deemed to require upgrade.





## Detailed Description

Item:

1. Tunnel Leaks - Ground water leaking into utility tunnel through cracks has damaged piping, supports and insulation on steam and chilled water systems. These leaking areas are recommended to be filled with a waterproofing compound.

Existing duct banks are constructed directly on top of utility tunnel making tunnel roof repair extremely difficult. Areas shown to have large quantities of tunnel leaks are recommended to be excavated and exterior of tunnel waterproofed.

2. Tunnel Spalling - Locations where concrete has begun to separate from the wall and reinforcing exposed from tunnel leaks should have damaged concrete removed and surface prepared for a masonry mortar patch repair.

Major Tunnel Reconstruction – One location within tunnel has severe roof and wall deterioration present from areas of major surface water leaking. Area will require major reconstruction of tunnel structure to correct problem.

Tunnel construction joints show severe water penetration. Areas will require exterior tunnel excavation to externally waterproof the tunnel.

3. Steam Supports – Support bases and wall connections have corroded over time due to tunnel leaking.

Existing support bases shall be removed and replaced with new stainless steel base.

Several anchors and supports have surface corrosion. Locations shall be wire brushed and repainted.

4. Steam Insulation - Insulation has been damaged at various locations thru-out tunnel from water leaks and system maintenance. Insulation shall be removed and replaced.

Metal Jacket - Areas where piping is abused, a metal jacketing shall be applied for protection of insulation.

Exterior guide steel within tunnel is un-insulated and exposed to the tunnel aisle. Insulate exterior of guide steel.

5. Chilled Water Supports – Existing chilled water piping was installed directly on steel support; no true vapor barrier is present. Physical plant has currently filled openings around support and pipe with Styrofoam insulation. Remove existing chilled water supports and replace with support that will allow for a complete vapor barrier to be installed around pipe.

Existing chilled water piping was installed using victaulic connections. No leaks were observed at pipe connections. Gasket life is expected to be consistent with the life of piping.

6. Chilled Water Insulation – Entire insulation system has been compromised and damaged. Insulation and jacketing has been damaged from tunnel leaks and system maintenance.

Recommended that all chilled water pipe insulation and jacketing be removed and replaced with new insulation and jacket.

7. Air Pipe Coating – Locations of pipe corrosion have occurred where tunnel was leaking directly on air pipe. Wire brush and epoxy coat existing air pipe.

8. Leaking Tunnel Entrances – Brick ledge at tunnel entrances is below grade allowing surface water to leak in to tunnel. Remove existing concrete top and brick around entrance. Extend concrete walls above grade level and install new aluminum entrance hatch. Safety posts shall be installed on ladders.

Existing tunnel vent hatch openings are below grade allowing surface water to leak into tunnel. Remove existing unused tunnel vents and cap opening at tunnel roof.

Existing primary and signal vault roofs are exposed above grade and show extensive damage. Remove existing damaged vault roof, replace concrete roof and casting.

Relocate existing ladder blocking tunnel aisle.

9. Asbestos Abatement – Abate existing high pressure steam pipe insulated with asbestos from Point E to Point H. Re-insulate existing abated steam piping.

**University of Wisconsin - Parkside (DSF NO. 09G3Q)**

**Existing Utility Tunnel Conditions**

Item	Description	TUNNEL LEG						
		A-B	B-C	C-D	D-E	E-F	F-G	G-H
1	<b>Exterior Waterproofing</b>	None	200' Exterior Tunnel Waterproofing	200' Exterior Tunnel Waterproofing	350' Exterior Tunnel Waterproofing	350' Exterior Tunnel Waterproofing	320' Exterior Tunnel Waterproofing	None
2	<b>Tunnel Leaks</b>	(6) Leak Repair Locations	(75) Leak Repair Locations	(60) Leak Repair Locations	(85) Leak Repair Locations	(75) Leak Repair Locations	(55) Leak Repair Locations	(2) Leak Repair Locations
3	<b>Tunnel Spalling</b>	(3) Spall Locations	(3) Spall Locations	(2) Spall Locations	(5) Spall Locations	(6) Spall Locations, (1) 15' Section Bad Tunnel Roof	(2) Spall Locations	(1) Spall Locations
4	<b>Steam/Cond. Supports</b>	(6) Support Modifications	(13) Support Modifications (2) Anchor Steel Repairs	(4) Support Modifications (6) Paint Support Locations	(19) Support Modifications (2) Paint Support Locations	(19) Support Modifications	(16) Support Modifications	(2) Support Modifications
5	<b>Steam/Cond. Insulation</b>	(2) 20' Replacement with Metal Jacket	(2) 20' Replacement with Metal Jacket	(2) 20' Replacement with Metal Jacket	(4) 20' Replacement with Metal Jacket	(6) 20' Replacement with Metal Jacket. Remove asbestos on existing steam pipe and re-insulate.	(2) 20' Replacement with Metal Jacket. Remove asbestos on existing steam pipe and re-insulate.	Remove asbestos on existing steam pipe and re-insulate.
6	<b>CW Supports</b>	(26) Supports	(38) Supports	(25) Supports	(44) Supports	(42) Supports	(28) Supports	(26) Supports
7	<b>CW Insulation</b>	(2) 280' Replacement, (2) 20' Metal Jacket	(2) 350' Replacement, (2) 20' Metal Jacket	(2) 260' Replacement, (2) 20' Metal Jacket	(2) 490' Replacement, (4) 20' Metal Jacket	(2) 440' Replacement, (6) 20' Metal Jacket	(2) 350' Replacement, (2) 20' Metal Jacket	(2) 220' Replacement
8	<b>Air Piping</b>	(2) Pipe Locations, 20' Epoxy Coating	(2) Pipe Locations, 20' Epoxy Coating	(4) Pipe Locations, 20' Epoxy Coating	(3) Pipe Locations, 20' Epoxy Coating	(2) Pipe Locations, 20' Epoxy Coating	(2) Pipe Locations, 20' Epoxy Coating	None
9	<b>Miscellaneous Repair</b>	Replace (1) steam tunnel, primary vault and signal vault entrances. Remove (1) tunnel elevated vent.	Replace (1) steam tunnel, primary vault and signal vault entrances. Remove (1) tunnel elevated vent.	Replace (1) steam tunnel, primary vault and signal vault entrances. Remove (1) tunnel elevated vent. Relocate ladder block aisle.	Replace (2) steam tunnel, primary vault and signal vault entrances. Remove (2) tunnel elevated vent. Relocate ladder block aisle.	Replace (3) steam tunnel, primary vault and signal vault entrances. Remove (2) tunnel elevated vent. Relocate ladder block aisle.	Replace (1) steam tunnel, primary vault and signal vault entrances. Remove (1) tunnel elevated vent. (1) Under slab drain pipe modifications.	None



**Estimate of Probable Construction Costs**

Item	Description	Quantity	Unit Cost	Total Cost
1.	Exterior Waterproofing	1400 Feet	\$750	\$1,050,000
2.	Tunnel Repair	Major: 1 Location	\$20,000	\$20,000
2.	Tunnel Spalling	Minor: 18 Locations	\$2,500	\$45,000
3.	Steam Support	90 Supports	\$500	\$45,000
4.	Steam Insulation	1260 Feet	\$100	\$126,000
5.	Chilled Water Support	229 Supports	\$450	\$103,050
6.	Chilled Water Insulation	4800 Feet	\$80	\$384,000
7.	Air Pipe Coating	15 Locations	\$200	\$3000
8.	Tunnel and Vault Entrance Modification	9 Locations	\$15,000	\$135,000
8.	Tunnel Vent Removal	8 Locations	\$7,500	\$60,000
9.	Asbestos Abatement	Point E to H		\$25,000

Total:	\$1,996,050
AE Design Fee	\$110,000
DSF Fee	\$75,000
Contingency 10%	\$200,000
<b>Total:</b>	<b>\$2,381,050</b>



## **Executive Summary**

The main existing utility “umbilical” serving the campus is approximately 40 years old. In order to extend the tunnel life another 40 years and avoid major replacement projects and/or miscellaneous ongoing repairs the tunnel leaks need to be addressed.

Without proper waterproofing of the tunnel pipe, pipe insulation and pipe supports will require ongoing repairs and/or replacement.

This report identifies items that:

- Prevent further rapid deterioration of piping, supports and structure.
- Address the upgrade of all known maintenance and repair items at one time.

Total tunnel repairs are estimated at approximately \$920/ft. A replacement tunnel is estimated to cost \$5,000 to \$7,000 per foot in today’s dollars.

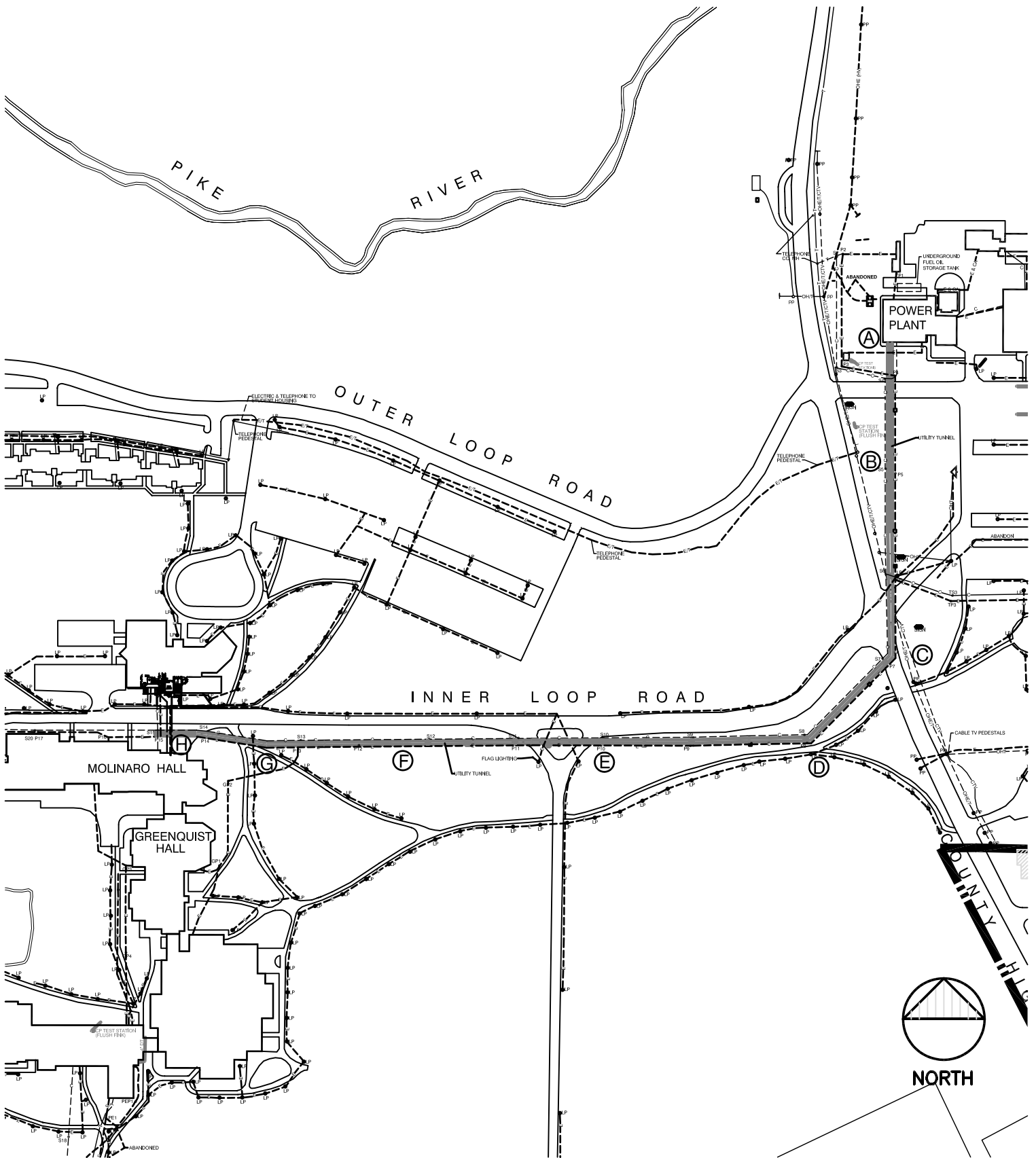





**Appendix**

- A. Utility Distribution Tunnel Map**
- B. Tunnel Section**

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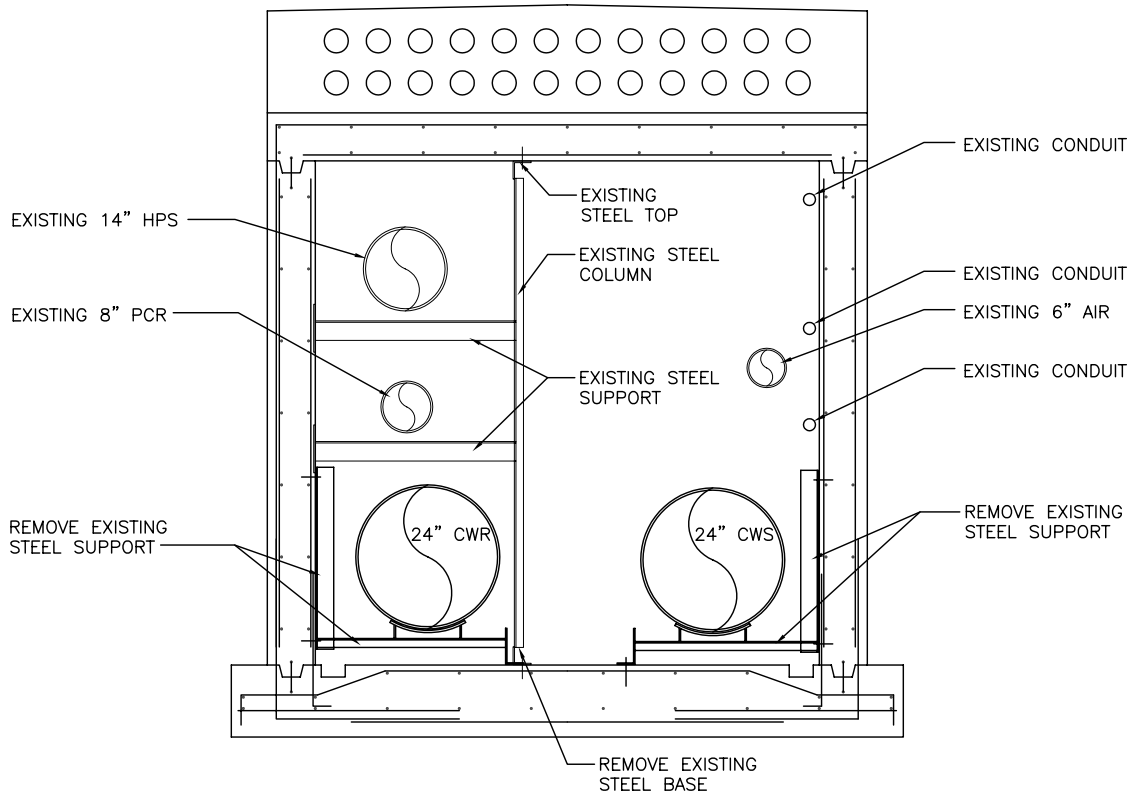

**State of Wisconsin**  
**Department of Administration**  
**Division of State Facilities**  
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**Project Title:**  
**UTILITY DISTRIBUTION TUNNEL**  
**MAINTENANCE STUDY**  
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**RACINE, WISCONSIN**  
**Sheet Title:**  
 UTILITY DISTRIBUTION TUNNEL MAP

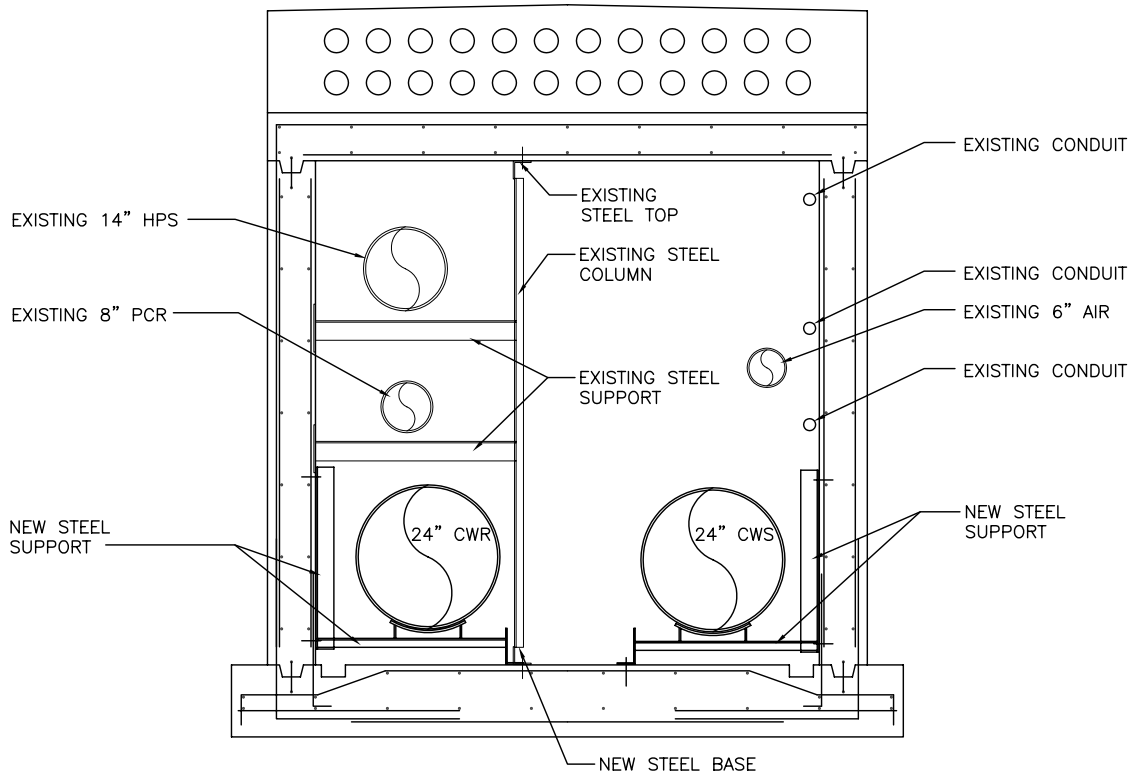
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## EXISTING TUNNEL SECTION

NO SCALE



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NO SCALE



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**Department of Administration**  
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**APPENDIX B**