EAST CAROLINA UNIVERSITY

Health Sciences Campus

HSC Utility Tunnel

Utility Condition Assessment

September 16, 2016

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UTILITY CONDITION ASSESSMENT

SECTION 1

OVERVIEW

OVERVIEW

Introduction

East Carolina University's Health Science Campus (ECU-HSC) utilizes a single underground utility tunnel for steam and condensate, chilled water supply and return, compressed air, nonpotable water, electrical, and, in some areas, domestic water distribution. The overall condition of the tunnel system is good, as expected with its relatively young age and the lack of a high groundwater table in the immediate area. There is adequate tunnel ventilation, egress and exit signage, and lighting.

There is approximately 880 linear feet (LF) of cast-in-place reinforced concrete box-shaped tunnel. The average cross section of the tunnel network is 10 feet wide by 10 feet tall. The first 350 feet of the tunnel system was installed in 2007 and the remaining 530 feet installed in 2010.

Costs Overview

Current Replacement Value

The current replacement value (CRV) of the utility tunnel system is approximately $9,644,420. This is an estimate of the cost in current dollars to replace the utility tunnel and installed support equipment. It is not a construction estimate or a detailed take-off but rather an estimate of replacement with like equipment.

Total Project Costs

The estimated recurring (lifecycle) needs total $31,757 and consist of the lifecycle replacement of fire alarm devices. The additional recommendation is based on the RDK Engineers Master Plan proposal to extend the utility tunnel, at a projected cost of $5,373,690.

Methodology

This document is the result of the assessment of the physical condition and estimated remaining reliable operating life of the utility tunnel system at ECU-HSC. The estimates for remaining useful life consider safety, reliability, efficiency, and sustainability as the primary operational objectives for capital renewal. These estimates are based on actual equipment age, physical inspections, performance data reviews, personnel interviews, maintenance practices, and operating history.

Visual system assessments were used as the primary inputs in this nondestructive assessment of the tunnel. The focus of this report is projected needs of the utility tunnel over the next ten years. ISES has concluded that estimates extending beyond a ten-year cycle are of questionable value for the purposes of capital investment planning for equipment replacement.

The goal was to produce a campuswide report with lifecycle, project and lifecycle renewal recommendations incorporated by ISES engineers into the individual utility system assets in the Asset Management System (AMS). The assessments and estimates are based solely on visual, nondestructive observations, review of existing drawings, previously prepared engineering reports, such as the RDK Engineers Campus Master Plan, interviews with key staff.

This methodology for assessing the physical condition of the targeted utility assets was applied to the system and equipment to arrive at recommendations for asset allocation for critical needs with regard to Deferred Renewal, Corrective Action, and Plant Adaption.

Approach to Lifecycle Calculation

Operating data was reviewed for abnormal excursions such as tunnel flooding or failures of the installed distribution systems. This data was evaluated for impact on the physical structure of the tunnel and installed equipments estimated useful life.

The realization of expected equipment useful life preserves the original capital investment strategy, while accelerated depreciation results in premature expenditure of resources. These observations point out the importance of providing adequate but not excessive resources for utility system asset preservation. Table 1 shows expected useful, reliable equipment life of typical tunnel systems and equipment.

Table 1: Typical Average Equipment Expected Useful Life

COMPONENT	TYPE	USEFUL LIFE (YEARS)
Tunnel Section	Cast-In-Place Concrete	75
Tunnel Section	Brick	75
Stanchion	Galvanized Steel	40
Stanchion	Aluminum	40
Fan	Upward Exhaust	30
Fan	Through-Wall Exhaust	25
Hatch	Hydraulic, Steel	30
Ladder	Steel	45
Lighting	Single-Lamp	25
Electrical	120/208 Volt	35
Pump	Sump, Submersible	15

Source Data: ASHRAE, BOMA, Hartford Ins. Co., ISES Database

SECTION 2

SYSTEM FINDINGS

SYSTEM FINDINGS

This assessment includes the physical tunnel as well as the secondary electrical system, including lights, tunnel ventilation equipment, and the sump pump system. All of the campuswide utility systems in the tunnel structure will be addressed in their respective infrastructure reports.

The tunnel sections are well constructed, with much room for future growth, and are overall in good condition. The professional staff at ECU has identified areas for upgrade and has been diligent in maintaining the tunnel. Structurally, there are no areas of major concern. However, there is minor evidence of groundwater and/or possibly irrigation water penetration through the tunnel construction joints and around some pipe penetrations through the concrete wall. To avoid having to excavate the tunnel walls and ceilings to apply sealant, an epoxy injection is recommended in the joints and porous areas to halt the water infiltration. Due to the limited extent of observed infiltration, this is assumed to be a relatively low-cost, routine maintenance item.

Secondary electrical distribution provides power to outlets, lighting, and additional equipment. The tunnel is well lit with energy-efficient fluorescent lights. Strategically placed sump pumps remove any water that may enter the tunnel. Ventilation is good, with exhaust fans and air intakes located throughout. All of these systems are connected to the emergency generator at the Central Utility Plant (CUP). Emergency exits from the tunnel are identified with exit signs. The electrical distribution, lighting, and pump systems are in good condition and should outlast the scope of this report.

The tunnel is connected to a central fire alarm system at the CUP. The components of this system include egress lighting, horn strobes, visual annunciators, and exit signage. These unitary components are in proper working, and most will outlast the scope of this assessment. However, it will be necessary to update the fire alarm devices near the end of the next ten years.

Based on discussions with campus staff and a review of the Master Plan prepared by RDK Engineers, the utility tunnel is proposed for expansion as part of the future plans for campus utility upgrades. The new tunnel section would tie the existing utility system to the proposed new central plant, which is part of the overall Master Plan recommendations.

SECTION 3

CONDITION ASSESSMENT DEFINITIONS

CONDITION ASSESSMENT DEFINITIONS

The following information is a clarification of the Asset Report using example definitions.

Material and Labor Cost Factors and Additional Markups

The database contains an R. S. Means City Cost Index for material and labor cost factors to adjust the project costs from the national averages to reflect conditions in Greenville. The percentage adjustment of the national average is shown below. Typical general contractor fees (which could include profit, overhead, bonds, and insurance) and professional fees (architect or engineer design fees and in-house design costs) are also included. However, most of the project costs were provided by University personnel, so no mark-ups have been applied.

GLOBAL MARKUP	%
Local Labor Index	51.3
Local Materials Index	100.7
General Contractor Markup	20.0
Professional Fees	16.0

Recurring and Nonrecurring Renewal Costs

Renewal costs are divided into two main categories – recurring and nonrecurring. Recurring costs are cyclical and consist primarily of major repairs to or replacement/rebuilding of systems and components. The tool for projecting the recurring renewal costs is the Lifecycle Component Inventory, which is explained in detail below. Nonrecurring costs typically consist of modifications or repairs necessary to comply with code requirements or to address isolated, nonrecurring deficiencies that could negatively affect the systems and components. For these nonrecurring costs, projects have been developed and include estimated material and labor costs.

Recurring Costs

Asset Component Inventory and Cost Projections

The Asset Component Inventory is a list of major systems and components and is based on industry standard lifecycle expectancies. Each indicated component has the following associated information:

CATEGORY	DEFINITION
Uniformat Code	The standard Uniformat Code that applies to the component
Component Description	This line item describes the individual component
Identifier	Unique identifying information entered for a component as necessary
Quantity	The quantity of the listed component
Units	The unit of measure associated with the quantity
Unit Cost	The cost to replace each individual component unit (this cost is in today's dollars)
Complexity Adjustment	A factor utilize to adjust component replacement costs accordingly when it is anticipated that the actual cost will deviate from the average for that component
Total Cost	Unit cost multiplied by quantity, in today's dollars. Note that this is a one-time renewal/replacement cost
Install Date	Year that the component was or is estimated to have been installed. When this data is not available, it defaults to the year the asset was constructed
Life Expectancy	Average life expectancy for each individual component
Life Expectancy Adjustment	Utilized to adjust the first lifecycle of the component and to express when the next replacement should occur

The component listing forms the basis of the Recurring Component Renewal Schedule, which provides a year-by-year list of projected recurring renewal costs over the next ten years. Each individual component is assigned a replacement year based on lifecycles, and the costs for each item are in future year dollars. For items that are already past the end of their lifecycle, the replacement year is shown as Deferred Renewal.

Recurring Cost Classifications

- **Deferred Renewal**
  Recurring repairs, generated by the Lifecycle Component Inventory, that are past due for completion but have not yet been accomplished as part of normal maintenance or capital repair efforts. Further deferral of such renewal could impair the proper functioning of the system. Costs estimated for Deferred Renewal should include compliance with applicable codes, even if such compliance requires expenditures beyond those essential to effect the needed repairs.

- **Recurring Component Replacement**
  Recurring renewal efforts, generated by the Lifecycle Component Inventory, that will be due within

the scope of the assessment. These costs represent regular or normal facility maintenance, repair, or renovation that should be planned in the near future.

Nonrecurring Costs

As previously mentioned, modifications or repairs necessary to comply with code requirements and those that address isolated, nonrecurring deficiencies that could negatively affect the systems and components are not included in the Lifecycle Component Inventory. For each such deficiency, a project with an estimated cost to rectify said deficiency is recommended. These projects each have a unique number and are categorized by system type, priority, and classification, which are defined below. The costs in these projects are also indexed to local conditions and markups applied as the situation dictates.

Project Number

Each project has a unique number consisting of three elements, the asset identification number, system code, and a sequential number assigned by the FCA software. For example, the fourth electrical project identified for asset 0001 would have a project number of 0001EL04:

Example: Project Number 0001EL04		
0001	-	Asset Identification Number
EL	-	System Code (EL represents Electrical)
04	-	The next sequential number for an Electrical project

Project Classification

- Plant Adaption
  Nonrecurring expenditures required to adapt the physical plant to the evolving needs of the institution and to changing codes or standards. These are expenditures beyond normal maintenance. Examples include compliance with changing codes and improvements occasioned by the adoption of modern technology (e.g., the use of personal computer networks).

- Corrective Action
  Nonrecurring expenditures for repairs needed to correct random and unpredictable deficiencies. Such projects are not related to aligning a building with codes or standards. Deficiencies classified as Corrective Action could have an effect on utility safety, or usability.

Priority Class

- Immediate

  Projects in this category require immediate action to:

  a. correct a cited safety hazard
  b. stop accelerated deterioration
  c. and/or return a facility to normal operation

- Critical

  Projects in this category include actions that must be addressed in the short-term:

  a. repairs to prevent further deterioration
  b. improvements to facilities associated with critical accessibility needs
  c. potential safety hazards

- Noncritical

  Projects in this category include:

  a. improvements to facilities associated with noncritical accessibility needs
  b. actions to bring a facility into compliance with current building codes
  c. actions to improve the usability of a facility following an occupancy or use change

Category Code

CATEGORY CODE*	SYSTEM DESCRIPTION
EL1A – EL8A	ELECTRICAL
HV1A – HV8B	HVAC
PL1A – PL5A	PLUMBING

**Refer to the Category Code Report starting on the following page.*

Example: Category Code = EL5A	
EL	System Description
5	Component Description
A	Element Description

Priority Sequence

A Priority Sequence number is automatically assigned to each project to rank the projects in order of relative criticality and show the recommended execution order. This number is calculated based on the Priority Class and identified system of each project.

Example:			
Priority Class	**Category Code**	**Project Number**	**Priority Sequence**
1	HV2C	0001HV04	01
2	PL1D	0001PL02	02
2	EL4C	0001EL03	03

CATEGORY CODE REPORT

ELECTRICAL			
CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
EL1A	Incoming Service	Transformer	Main building service transformer.
EL1B	Incoming Service	Disconnects	Main building disconnect and switchgear.
EL1C	Incoming Service	Feeders	Incoming service feeders. Complete incoming service upgrades, including transformers, feeders, and main distribution panels are catalogued here.
EL1D	Incoming Service	Metering	Installation of meters to record consumption and/or demand.
EL2A	Main Distribution Panels	Condition Upgrade	Main distribution upgrade due to deficiencies in condition.
EL2B	Main Distribution Panels	Capacity Upgrade	Main distribution upgrades due to inadequate capacity.
EL3A	Secondary Distribution	Step-Down Transformers	Secondary distribution step-down and isolation transformers.
EL3B	Secondary Distribution	Distribution Network	Includes conduit, conductors, sub-distribution panels, switches, outlets, etc. Complete interior rewiring of a facility is catalogued here.
EL3C	Secondary Distribution	Motor Controllers	Mechanical equipment motor starters and control centers.
EL4A	Devices and Fixtures	Exterior Lighting	Exterior building lighting fixtures, including supply conductors and conduit.
EL4B	Devices and Fixtures	Interior Lighting	Interior lighting fixtures (also system wide emergency lighting), including supply conductors and conduits.
EL4C	Devices and Fixtures	Lighting Controllers	Motion sensors, photocell controllers, lighting contactors, etc.
EL4D	Devices and Fixtures	GFCI Protection	Ground fault protection, including GFCI receptacles and breakers.
EL4E	Devices and Fixtures	Lightning Protection	Lightning arrestation systems including air terminals and grounding conductors.
EL5A	Emergency Power System	Generation/ Distribution	Includes generators, central battery banks, transfer switches, emergency power grid, etc.
EL6A	Systems	UPS/DC Power Supply	Uninterruptible power supply systems and DC motor-generator sets and distribution systems.
EL7A	Infrastructure	Above Ground Transmission	Includes poles, towers, conductors, insulators, fuses, disconnects, etc.
EL7B	Infrastructure	Underground Transmission	Includes direct-buried feeders, duct banks, conduit, manholes, feeders, switches, disconnects, etc.
EL7C	Infrastructure	Substations	Includes incoming feeders, breakers, buses, switchgear, meters, CTs, PTs, battery systems, capacitor banks, and all associated auxiliary equipment.
EL7D	Infrastructure	Distribution Switchgear	Stand-alone sectionalizing switches, distribution switchboards, etc.
EL7F	Infrastructure	Area and Street Lighting	Area and street lighting systems, including stanchions, fixtures, feeders, etc.
EL8A	General	Other	Electrical system components not catalogued elsewhere.

HVAC			
CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
HV1A	Heating	Boilers/Stacks/ Controls	Boilers for heating purposes, including their related stacks, flues, and controls.
HV1B	Heating	Radiators/ Convectors	Including cast-iron radiators, fin tube radiators, baseboard radiators, etc.
HV1C	Heating	Furnace	Furnaces and their related controls, flues, etc.

CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
HV1D	Heating	Fuel Supply/Storage	Storage and/or distribution of fuel for heating purposes, including tanks and piping networks and related leak detection/monitoring.
HV2A	Cooling	Chillers/ Controls	Chiller units for production of chilled water for cooling purposes, related controls (not including mods for CFC compliance).
HV2B	Cooling	Heat Rejection	Repair/replacement of cooling towers, dry coolers, air-cooling, and heat rejection. Includes connection of once-through system to cooling tower.
HV3A	Heating/Cooling	System Retrofit/ Replace	Replacement or major retrofit of HVAC systems.
HV3B	Heating/Cooling	Water Treatment	Treatment of hot water, chilled water, steam, condenser water, etc.
HV3C	Heating/Cooling	Package/Self-Contained Units	Repair/replacement of self-contained/package type units, including stand-up units, rooftop units, window units, etc; both air conditioners and heat pumps.
HV3D	Heating/Cooling	Conventional Split Systems	Repair, installation, or replacement of conventional split systems, both air conditioners and heat pumps, including independent component replacements of compressors and condensers.
HV4A	Air Moving/ Ventilation	Air Handlers/ Fan Units	Includes air handlers and coils, fan coil units, unit ventilators, filtration upgrades, etc., not including package/self-contained units, split systems, or other specifically categorized systems.
HV4B	Air Moving/ Ventilation	Exhaust Fans	Exhaust fan systems, including fans, range and fume hoods, controls, and related ductwork.
HV4C	Air Moving/ Ventilation	Other Fans	Supply, return, or any other fans not incorporated into a component categorized elsewhere.
HV4D	Air Moving/ Ventilation	Air Distribution Network	Repair, replacement, or cleaning of air distribution network, including ductwork, terminal reheat/cool, VAV units, induction units, power induction units, insulation, dampers, linkages, etc.
HV5A	Steam/Hydronic Distribution	Piping Network	Repair/replacement of piping networks for heating and cooling systems, including pipe, fittings, insulation, related components, etc.
HV5B	Steam/Hydronic Distribution	Pumps	Repair or replacement of pumps used in heating and cooling systems, related control components, etc.
HV5C	Steam/Hydronic Distribution	Heat Exchangers	Including shell-and-tube heat exchangers and plate heat exchangers for heating and cooling.
HV6A	Controls	Complete System Upgrade	Replacement of HVAC control systems.
HV6B	Controls	Modifications/ Repairs	Repair or modification of HVAC control system.
HV6C	Controls	Air Compressors/ Dryers	Repair or modification of control air compressors and dryers.
HV7A	Infrastructure	Steam/Hot Water Generation	Generation of central steam and/or hot water, including boilers and related components.
HV7B	Infrastructure	Steam/Hot Water Distribution	Distribution system for central hot water and/or steam.
HV7C	Infrastructure	Chilled Water Generation	Generation of central chilled water, including chillers and related components.
HV7D	Infrastructure	Chilled Water Distribution	Distribution system for central chilled water.
HV7E	Infrastructure	Tunnels/ Manholes/ Trenches	Repairs, installation, or replacement of utility system access chambers.
HV7F	Infrastructure	Other	HVAC infrastructure issues not specifically categorized elsewhere.
HV8A	General	CFC Compliance	Chiller conversions/replacements for CFC regulatory compliance, monitoring, etc.
HV8B	General	Other	HVAC issues not catalogued elsewhere.

PLUMBING

CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
PL1A	Domestic Water	Piping Network	Repair or replacement of domestic water supply piping network, insulation, hangers, etc.

CODE	COMPONENT DESCRIPTION	ELEMENT DESCRIPTION	DEFINITION
PL1B	Domestic Water	Pumps	Domestic water booster pumps, circulating pumps, related controls, etc.
PL1C	Domestic Water	Storage/ Treatment	Equipment or vessels for storage or treatment of domestic water.
PL1D	Domestic Water	Metering	Installation, repair, or replacement of water meters.
PL1E	Domestic Water	Heating	Domestic water heaters, including gas, oil, and electric water heaters, shell-and-tube heat exchangers, tank type, and instantaneous.
PL1F	Domestic Water	Cooling	Central systems for cooling and distributing drinking water.
PL1G	Domestic Water	Fixtures	Plumbing fixtures, including sinks, drinking fountains, water closets, urinals, etc.
PL1H	Domestic Water	Conservation	Alternations made to the water distribution system to conserve water.
PL1I	Domestic Water	Backflow Protection	Backflow protection devices, including backflow preventers, vacuum breakers, etc.
PL2A	Wastewater	Piping Network	Repair or replacement of building wastewater piping network.
PL2B	Wastewater	Pumps	Pump systems used to lift wastewater, including sewage ejectors and other sump systems.
PL3A	Special Systems	Process Gas/Fluids	Generation and/or distribution of process steam, compressed air, natural and LP gas, process water, vacuum, etc.
PL4A	Infrastructure	Potable Water Storage/ Treatment	Storage and treatment of potable water for distribution.
PL4B	Infrastructure	Industrial Water Distribution/ Treatment	Storage and treatment of industrial water for distribution.
PL4C	Infrastructure	Sanitary Water Collection	Sanitary water collection systems and sanitary sewer systems, including combined systems.
PL4D	Infrastructure	Stormwater Collection	Stormwater collection systems and storm sewer systems; storm water only.
PL4E	Infrastructure	Potable Water Distribution	Potable water distribution network.
PL4F	Infrastructure	Wastewater Treatment	Wastewater treatment plants, associated equipment, etc.
PL5A	General	Other	Plumbing issues not categorized elsewhere.

SECTION 4

COST SUMMARIES AND TOTALS

RENEWAL COSTS MATRIX

All dollars shown as Present Value

CATEGORY	NON-RECURRING PROJECT NEEDS			RECURRING COMPONENT REPLACEMENT NEEDS											
	Immediate	Critical	Non-Critical	Deferred Renewal	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	TOTAL
ACCESSIBILITY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
EXTERIOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
INTERIOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
PLUMBING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
HVAC	0	0	5,373,690	0	0	0	0	0	0	0	0	0	0	0	$5,373,690
FIRE/LIFE SAFETY	0	0	0	0	0	0	0	0	0	0	0	0	0	31,757	$31,757
ELECTRICAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
SITE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
VERT. TRANS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
HEALTH/EQUIP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$0
SUBTOTAL	$0	$0	$5,373,690	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$31,757	$5,405,446
TOTAL NON-RECURRING PROJECT NEEDS			$5,373,690	TOTAL RECURRING COMPONENT REPLACEMENT NEEDS										$31,757	

CURRENT REPLACEMENT VALUE	$9,644,420
FACILITY CONDITION NEEDS INDEX	0.56
FACILITY CONDITION INDEX	0.00

GSF	TOTAL 10-YEAR FACILITY RENEWAL NEEDS	10-YEAR NEEDS/SF
8,800	$5,405,446	$614.26

ISES CORPORATION

FACILITIES RENEWAL PLAN

NON-RECURRING PROJECT COST

All costs shown as Present Value

PROJECT NUMBER	PROJECT TITLE	UNI-FORMAT	PRIORITY CLASS	PROJECT CLASSIFICATION	PROJECT COST
UTUNHV01	FUTURE UTILITY TUNNEL EXPANSION		3	Plant Adaption	5,373,690
				TOTAL	**$5,373,690**

FACILITIES RENEWAL PLAN

RECURRING COMPONENT REPLACEMENT COSTS

All costs shown as Present Value

ASSET CODE COMP CODE	COMPONENT	IDENTIFIER	UNI-FORMAT	REPLACEMENT YEAR	REPLACEMENT COST
UTUN FA02	FIRE ALARM SYSTEM - DEVICES	SECTION 0+00 TO 3+50	D4030	2025	12,631
UTUN FA02	FIRE ALARM SYSTEM - DEVICES	SECTION 3+50 TO 8+80	D4030	2025	19,126
				TOTAL	**$31,757**

SECTION 5

PROJECT DETAILS

All costs shown as Present Value

FUTURE UTILITY TUNNEL EXPANSION

Project Number:	UTUNHV01	**Category Code:**	HV7E
Priority Sequence:	1		
Priority Class:	Non-Critical	**System:**	HVAC
Project Class:	Plant Adaption	**Component:**	INFRASTRUCTURE
Date Basis:	9/1/2016	**Element:**	TUNNELS/MANHOLES/TRENCHES

Code Application:	**Subclass/Savings:**	**Project Location:**
Not Applicable	Not Applicable	Undefined: Floor(s) S

Description

Based on discussions with campus staff and a review of the Master Plan prepared by RDK Engineers, the utility tunnel is proposed for expansion as part of the future plans for campus utility upgrades. The new tunnel section would tie the existing utility system to the proposed new central plant, which is part of the overall Master Plan recommendations.

All costs shown as Present Value

Project Cost Estimate

Task Description	Unit	Qnty	Material Unit Cost	Total Material Cost	Labor Unit Cost	Total Labor Cost	Total Cost
Construct new reinforced concrete utility tunnel	LF	500	$4,110	$2,055,110	$5,024	$2,511,800	$4,566,910
Base Material/Labor Costs				**$2,055,110**		**$2,511,800**	
Indexed Material/Labor Costs				**$2,069,496**		**$1,790,913**	**$3,860,409**
General Contractor Mark Up at 20.0%							**$772,082**
Original Construction Cost							**$4,632,491**
Date of Original Estimate: 9/1/2016 — **Inflation**							**$0**
Current Year Construction Cost							**$4,632,491**
Professional Fees at 16.0%							**$741,199**
TOTAL PROJECT COST							**$5,373,690**

SECTION 6

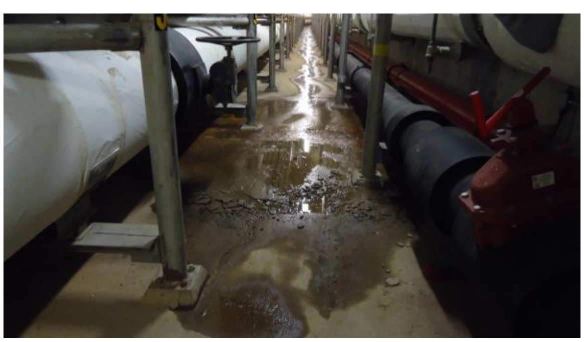
SYSTEM PHOTOLOGS

UTUN001e 4/21/2016
Poured-in-place reinforced concrete utility tunnel
Beginning of tunnel by plant

UTUN002e 4/21/2016
Previously repaired floor joint
Interior of tunnel

UTUN003e 4/21/2016
Previously repaired floor joint
Interior of tunnel

UTUN004e 4/21/2016
Moisture seeping up from floor joint
Interior of tunnel



UTUN005e 4/21/2016
Accumulation of water on concrete floor of tunnel
Interior of tunnel

UTUN006e 4/21/2016
Evidence of past water infiltration through tunnel wall
Interior of tunnel

UTUN007e 4/21/2016
Evidence of past water infiltration through tunnel wall
Interior of tunnel

UTUN008e 4/21/2016
Accumulation of water on concrete floor of tunnel
Interior of tunnel

UTUN009e 4/21/2016
Moisture seeping up from floor joint
Interior of tunnel

UTUN010e 4/21/2016
Moisture seeping up from floor joint
Interior of tunnel

UTUN011e 4/21/2016
Previously repaired floor joint
Interior of tunnel

UTUN012e 4/21/2016
Evidence of past water infiltration around a pipe penetration through tunnel wall
Interior of tunnel

UTUN013e 4/21/2016
Evidence of past water infiltration around a pipe penetration through tunnel wall
Interior of tunnel

UTUN014e 4/21/2016
Evidence of past water infiltration around a pipe penetration through tunnel wall
Interior of tunnel

UTUN015e 4/21/2016
End of existing tunnel with emergency egress ladder
Interior of tunnel

UTUN016e 4/21/2016
Emergency egress ladder and hatch
Interior of tunnel

UTUN017e 4/21/2016
Metal grate over sump for collecting infiltration water and evacuating from tunnel
Interior of tunnel

UTUN018e 4/21/2016
Stubbed out steam and chilled water lines for future expansion
Interior of tunnel

UTUN019e 4/21/2016
Evidence of past water infiltration around a pipe penetration through tunnel wall
Interior of tunnel

UTUN020e 4/21/2016
Evidence of past water infiltration around a pipe penetration through tunnel wall
Interior of tunnel

UTUN021e 4/21/2016
Evidence of past water infiltration around a pipe penetration through tunnel wall
Interior of tunnel