Division 2-1 (Electric)
Asset Condition

Request:

Page 7 of the ISR Report, references projects that are necessary "due to the poor condition of infrastructure assets", provide a summary of the continuing property records by FERC account showing depreciation and net plant?

Response:

Please refer to Attachment DIV 2-1 (Electric) Asset Condition for balances.

Prepared by or under the supervision of: Jennifer L. Grimsley

Narragansett Electric Company
Distribution - Gross Plant and Reserve (EOY FY2011)

FERC Account	FERC Account Description	Depreciation Base (000's)	Ending Reserve (000's)	Net Plant (000's)
361	Structures & Improvements	7,440	5,008	2,432
362	Station Equipment	172,423	42,233	130,190
364	Poles, Towers & Fixtures	186,685	80,545	106,140
365	OH Conductor & Devices	259,431	100,635	158,796
366	Underground conduit	62,667	30,750	31,917
367	Underground conductors and devices	139,981	49,816	90,165
368	Line transformers	160,852	83,800	77,052
369	Services	77,027	37,196	39,831
370	Meters	50,907	32,683	18,224
373	Outdoor Lighting	52,486	38,502	13,984

Division 2-2 (Electric)
Asset Condition

Request:

What is the transformer capacity of the proposed Woonsocket substation? What is the initial loading of the Woonsocket station, schedule of station load shifts, and resultant loading of the other stations in the area?

Response:

The transformer at the proposed Woonsocket substation is 40MVA transformer with summer normal and emergency capacity shown in the table below. The station is expected to have an initial load of 28.6MVA, with load shifts taking place by summer 2012. This project is on going and is approximately 80% complete with an expectation to be complete by summer 2012. The transformer at West Farnum substation is a temporary transformer that was installed in response to a 345/115/13.8 kV transformer failure that occurred in November of 2001. The temporary 115/13.8kV transformer was installed to supply the two feeders that were previously supplied via the tertiary windings of this transmission transformer. This project will resupply those feeders allowing the temporary transformer to be removed and the distribution facilities at West Farnum retired. The expected resultant loading at neighboring substations is as follows:

			System Voltage (kV)		Maximum	Rating (MVA)		BEFORE WOONSOCKET		AFTER WOONSOCKET	
Study Area	Substation	Tranf. ID.	From	To	Nameplate Rating	SN	SE	MVA	% SN	MVA	% SN
Blackstone Valley North	Nasonville #127	T271	115	13.8	46.67	47.80	47.80	28.4	59%	↓ 19.4	41%
Blackstone Valley North	Riverside #108	T82	115	13.8	41.67	49.62	58.74	36.7	74%	↓ 33.2	67%
Blackstone Valley North	Riverside #108	T81	115	13.8	33.3	41.83	45.23	28.5	68%	↓ 25.0	60%
Blackstone Valley North	Staples #112	T124	115	13.8	40	47.80	47.80	35.2	74%	↓ 34.8	73%
Blackstone Valley North	West Farnum	T1	115	13.8	20	20.00	20.00	9.7	48%	↓ 0.0	0%
Blackstone Valley North	Woonsocket	T1	115	13.8	40	47.80	50.00	0.0	0%	↑ 28.6	60%

Prepared by or under the supervision of: Jennifer L. Grimsley

Division 2-3 (Electric)
Asset Condition

Request:

What has been the historical spending on UG Cable Replacements? Does the $1M UG replacement budget include any portion that would be considered as planned or is the budget item entirely reactive to unplanned failures?

Response:

This budget line item is for proactive cable replacement and is not for "unplanned failures", which would be accounted for in the Damage and Failure accounts. Historical spending in the UG Cable Replacements area has averaged approximately $1.5M over the past 5 years. The Company is looking to increase the amount of underground cable it replaces as the Company has experienced approximately 75 failures per year on underground cable that have resulted in customer interruptions. Approximately $2M has been included as specific line items in the budget, and the Company is continuing to identify additional candidates for replacement to account for the $1M in this line item; UG Cable Replacements (C31777 - OS IE UG Cable Replacement Program).

Prepared by or under the supervision of: Jennifer L. Grimsley

Division 2-4 (Electric)
Asset Condition

Request:

How many of the over 80 battery systems does the $430,000 budget item address in FY 2013? Does the expenditure include battery charger upgrades? What is the average age of the battery systems in service?

Response:

The $430,000 budgeted for battery replacement in FY2013 will cover the replacement of 6 battery systems. The expenditure does include battery charger replacements. If the battery is determined to be in poor condition or older than 20 years of age, and the charger has been in service for more than ten years, the charger will be replaced when the battery is replaced.

The average battery age in RI is 11 years with 19 units presently 20 years or older. An additional 21 units are between 15 and 19 years of age. The age of six units is undetermined.

The average battery charger age in RI is 12 years, with 21 units presently 20 years or older, and an additional 14 units between 15 and 19 years of age. The age of thirty-two is undetermined.

Prepared by or under the supervision of: Jennifer L. Grimsley

Division 2-5 (Electric)
Asset Condition

Request:

Clarify the number of metalclad switchgear in service and subject to the Substation Metalclad Switchgear Replacement Strategy and Program. Page 17 states, "There are approximately 36 metalclads in service operating at 13.2 kV and 4.16 kV voltage level. Of these, approximately 70 were installed in the 1960s and 1970s."

Response:

This was a typographical error in the ISR. Presently there are 46 metalclad switchgear in RI operating between 4kV and 23kV. Of the 46 units, 36 units were installed prior to 1979.

Prepared by or under the supervision of: Jennifer L. Grimsley

Division 2-6 (Electric)
Asset Condition

Request:

As part of the replacement budget the company has identified older technology breaker replacement. Considering many other utilities such as PEPCO, BG&E, Progess Energy and others continue to maintain this older technology, why does the company find it necessary to make these replacements at this time? Are there in fact statistics for the historical failure rate that show a dramatic increase in the rate of failure of this technology? What quantitative analysis has been completed to justify such a large expenditure?

Response:

Our approach for breaker replacement involves a condition assessment coding of 1-4 as described in the below table. Breakers are assessed using bi-monthly visual and operational inspections and annual Infrared inspections. Breakers receive mechanical inspections every 3 or 6 years depending upon the type of breaker. Based on this data, and based on the trouble calls, these breakers are coded according to the below table. We have many breakers in our system with condition codes 1, and only those breakers with condition codes 2, 3, and 4 are reviewed for replacement. In addition to condition codes, many substations have impact codes representing the relative importance of interruptions at the substation. This helps us prioritize which breakers to replace. We also target breaker families for replacement in an accelerated manner due to the age and poor reliability.

Air magnetic breakers are a targeted family of breakers in which we take a proactive approach in replacing. Their design is considered obsolete due to the lack of spare parts, frequent mechanism rebuild requirements (every 8-10 years), obsolescence of air-magnetic (AM) interrupting technology, presence of asbestos in arc chutes and arc-flash problems. We have many of these in our system, but we only replace those units with condition codes 2, 3 and 4. Breakers with a condition code 2 and a high impact code are reviewed for replacement, while 3's and 4's are automatically replaced. We anticipate on replacing 15 breakers of this type in 4 substations in FY13. Since these breakers are being replaced under an on-going program, we have become very efficient in the process. These are one-for-one replacements and are being replaced with vacuum interruption technology, which requires less maintenance.

Division 2-6 (Electric) continued
Asset Condition

Condition Code	Classification/Condition	Implication
1 Proactive	• Asset expected to operate as designed for more than 10 years	Appropriate maintenance performed; regular inspections performed
2 Proactive	• Some asset deterioration or known type/design issues • Obsolescence such that spares/replacement parts are not available • System may require a different capability at asset location	Asset likely to be replaced or refurbished in five to ten years; increased resources may be required to maintain/operate asset
3 Proactive	• Asset condition is such that there is an increased risk of failure • Test and assessment identifies definite ongoing deterioration	Asset likely to be replaced or refurbished in less than five years; increased resources may be required to maintain/operate asset
4 Reactive	• Asset has sudden and unexpected change in condition that is of immediate concern • This may be detected through routine diagnostics including inspections, annual testing, maintenance or following an event	Testing and assessment required to determine if asset may be returned to service or may be allowed to continue in service Following engineering analysis the asset will be either recoded to 1-3 or removed from the system

Prepared by or under the supervision of: Jennifer L. Grimsley

Division 2-7 (Electric)
Asset Condition

Request:

Provide the transformer age, dissolved gas analysis history and condition assessment and pictures if available for the Eldred substation which is proposed to be rebuilt.

Response:

Please refer to Attachment DIV 2-7-1 (Electric) Asset Condition for the DGA Analysis and Attachment DIV 2-7-2 (Electric) Asset Condition for the Condition Assessment reports. Since the condition assessment report in 2005, hydrogen and ethylene gasses have increased and the oil quality is poor. The age of the transformer is 41 years of age. This transformer is also on the replacement list due to elevated power factors which indicates deteriorated insulation and contamination.

Prepared by or under the supervision of: Jennifer L. Grimsley

Fluid Analysis Report

Equipment	024148	*Tank*	MAIN
Serial No.	20116-A1	*Norms used*	TRN_IEEE_INC_69KV
Apparatus type	TRF	*DGA result*	4/2
Substation	Eldred 45	*Fluid condition*	2/2
Description	TRF	*Moisture code*	2/2
Manufacturer	ITE CIRCUIT BREAKER CO	*PCB result code*	2/2
In-service	1	*Oil test status*	UNREVIEWED
Spare	0		

Gas Analysis

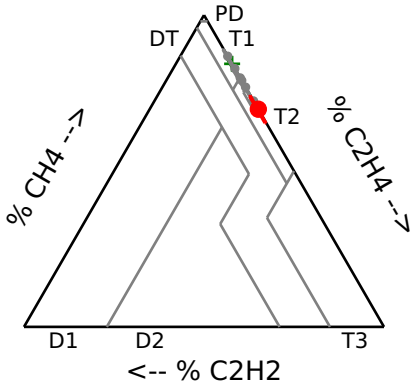
Sample date	*2010-09-15*	*2008-09-08*	*2006-10-17*	*2005-10-18*	*2004-11-29*
Fluid temp	36	40	30	30	24
Hydrogen (H2)	73	38	30	3	12
Methane (CH4)	155	214	193	237	174
Ethane (C2H6)	1500	2000	1090	1151	1151
Ethylene (C2H4)	67	54	58	36	36
Acetylene (C2H2)	0	0	0	0	0
Carbon Monoxide (CO)	188	143	92	75	73
Carbon Dioxide (CO2)	8062	9260	9520	10574	9087
Oxygen (O2)	406	50	79	808	1292
Nitrogen (N2)	72887	67100	77200	94774	28423
Total heat gas	1722	2268	1341	1424	1361
TDCG	1983	2449	1463	1502	1446
Equivalent TCG	0.501	0.475	0.270	0.170	0.520
Total partial press	79.5	72.0	86.1	105.9	34.0
Est. safe handling limit	5.1	4.7	4.9	5.0	5.0
Calculated monitor ppm	108	65	47	17	26
CO2/CO	42.883	64.755	103.478	140.987	124.479
Oxygen/Nitrogen (O2/N2)	0.006	0.001	0.001	0.009	0.045
DGA retest days	90	7	90	90	7
DGA retest date	2010-12-14	2008-09-15	2007-01-15	2006-01-16	2004-12-06
Baseline					
DGA reference days	737.0	692.0	364.0	323.0	691.0
DGA result	2	4	2	2	4
DGA diagnosis	T2	T	T2	T1	T1

Gas Analysis Remarks

One or more combustible gases have a positive long-term average rate. (H2) Several combustible gases have increased. (H2, C2H4) High level (*). Thermal fault (300 to 700 C).

Gas Analysis Summary

Diagnosis



Triangle Diagnosis: T2

Rogers Diagnosis: ?

Fluid Quality

Sample date	*2008-06-09*	*2000-05-10*	*2000-05-03*
Fluid temp	52	25	30
Dielectric breakdown D1816 (1 mm)	10.0	17.0	0.0
Dielectric breakdown D877	22.0	35.0	0.0
PF at 25 C	0.060	0.030	0.000
PF at 100 C	1.680	1.260	0.000
Interfacial tension	30.0	33.0	33.0
Oxidation inhibitor			0.000
Specific Gravity	0.890	0.880	0.000
Pour point	-40	-40	0
Color	1.5	1.0	0.0
PF100/PF25	28.000	42.000	
Fluid quality retest days			
Fluid quality retest date			
Fluid condition	2	2	2
Fluid diagnosis	CONTAMINATED	CONTAMINATED	CONTAMINATED
Inhibitor code			

Fluid Quality Analysis Remarks

Low breakdown kV. There may be polar contaminants or excessive moisture. Consider reconditioning the oil.

Fluid Quality Summary

Moisture Analysis

Sample date	*2010-09-15*	*2008-09-08*	*2008-06-09*	*2006-10-17*	*2005-10-18*
Fluid temp	36	40	52	30	30
Moisture	43	60	39	34	43
Relative saturation	40	48	20	41	51
Dew point	15	22	12	9	15
Moisture code	2	2	2	2	2
Moisture diagnosis	WET-OIL	WET-OIL	WET-OIL	HUMID-OIL	WET-OIL

Moisture Remarks

The water content of the oil may be too high. Resample to confirm this result. If confirmed, consider installing a relative saturation sensor for further investigation. If the condition persists, investigate its source and consider drying the oil.

Moisture Summary

PCB Analysis

Sample date	*2008-06-09*	*2000-05-10*
Total PCB	131.0	141.0
PCB result code	2	2

PCB Remarks

PCB contaminated (concentration at or above alert limit).

National Grid

Substation O&M Services

Memorandum

To: **Francis Barys**
Rich St. Andre
Copy: **O&M Services NE +NY**
Kathy Mixay
From: **Dan Falla**
John Bleyer
Date: **2/10/2005**

Subject: **Equipment Condition**
Eldred No.45

Eldred Ave.
Jamestown, RI

Introduction

The planning department is performing a study to determine system needs in the Newport area. This memo is a review by O&M services of the equipment at Eldred No. 45 substation. This station is located within the study area.

Executive Summary

Replacement Summary

- 45J2, 45J4, 4520 breakers
- 451 Transformer
- 4500-1 airbreak
- fence
- necessary equipment to go to single battery system at station
- regulators (due to clearance/configuration issues)
- retaining walls

Maintenance Considerations

- If study determines station is to remain without changes there will be some maintenance action items for fence and airbreak.

Options to be considered

- Retire Substation to avoid replacement\maintenance costs that will occur if this station remains in service for many years to come.
- Replace Substation with an alternative design that would perform the same function with significantly less equipment.

Background

The resources utilized to formulate this memo are:

- Most recent Infra-red inspection performed at station
- Trouble-reports for station and by equipment type
- Transformer power factor, DGA, and Oil Screen information
- Diagnostic Inspection records
- Site visit with Local O&M department

What follows is a summary by equipment type of what the planning department should address with replacement and what maintenance issues should be addressed by O&M during the study.

Compliance current requirements

Station Clearances at 4.16kV : 6'6" to top regulator bushings, 7'6" to top of breakers

The regulators and breakers at the station do not meet EDP-SUB- 41 part 5.0 required vertical clearances of 8'6" to bottom of porcelain bushings. There are some PT sensing transformers on the side of the structures that do not meet EDP-SUB-41 part 5.0 for clearances if you approach the structure from the retaining wall. It is recommended that these clearance issues be resolved.

The regulators also are located before the breakers in the station configuration. This arrangement does not allow regulators to be denergized utilizing the preferred method of opening the station breaker. The regulator location at this station also means a regulator failure would result in a three feeder outage instead of one. It is recommended that the equipment configuration be changed.

Structures +Foundations (includes control house)

The visual condition of the steel bus structure is good. The bus structure and all the equipment in service sits on one big concrete slab that appears to be in good condition. The control house is in good condition visually. There are foundations that are no longer utilized that have become tripping hazards in the yard. It is recommended that these hazards be removed. The yard also has areas where retaining walls are failing. It is recommended that they be replaced or the yard be revamped in order to remove them.

Abandoned foundations

Retaining Wall

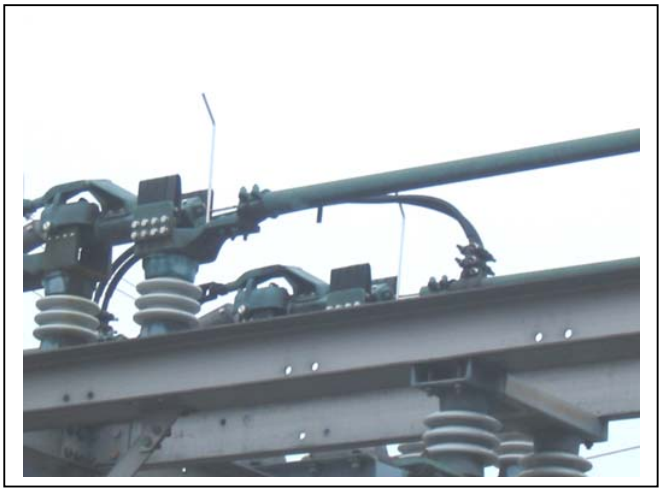
Fence

The fence height is less than 6 feet on two sides.

Battery & Charger

There is both a 120 volt and a 48volt battery system in the station. There are no condition issues with either installation. It is recommended that changes be considered that would allow such a small station to need only one battery system.

Switches



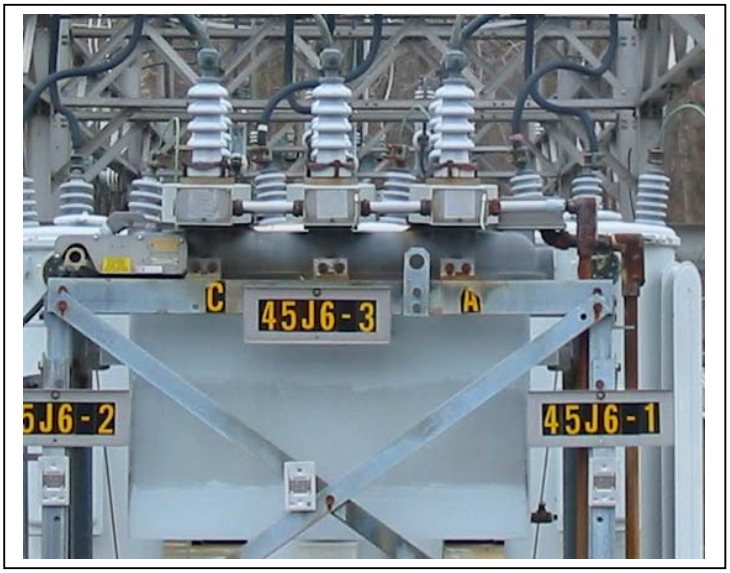
4500-1 – out of service middle phase jumpered

The switch is out of service. It is recommended that it be replaced or removed.

Station Breakers

45J2, 45J4 – Westinghouse PR-560 Manf. 1973

There are 11 Westinghouse PR type station reclosers in the NGRID NE system. The maintenance department in this area would perform internal inspections of this equipment after only a few breaker operations. The oil quality was known to quickly deteriorate. These breakers have control cabinets that are in poor condition due to the location of the station near the ocean. It is recommended that the breakers be replaced.



45J6 Mcgraw Edsion – WE 560 amp

There are hundreds of these type reclosers in the NGRID NE system. All but ten of these type reclosers are installed on lines. The trouble history for this family has been good and there are no noted problems with this installation.

4520 Allis Chalmers OZ-210 23kV 600 amp Manf. 1952

There are 45 A-C OZ-210 type OCBs in the system. The OZ family of breakers under 23kV generates about two equipment related trouble reports a year due to moisture ingress into tank or mechanism problems. Confirmation was obtained from Siemens

(Larry Sudbeck) and High Voltage Supply Website (only moving/stationary contact) that parts and support are not readily available. There are currently only 5 replacement bushings in stock for this family of breakers. Replacement bushings can not be located on the ABB website that are compatible with the 9.5" 4 hole bolt circle of these bushings. If more replacements are needed an adapter plate would have to be fabricated. It is recommended that the breaker be considered for replacement.

Regulators

45J2R – GE ML32 Manf. 1973 operations 400k 235k, 241k
45J6R - GE ML32 Manf. 1970 operations 240k, 390k, 280k

There is no reason to believe that the regulators would not be able to continue in service for many years to come. The GE published minimum number of operations is 1.5 million for this size and type regulator. The oil dielectric test values in 2000 were good.

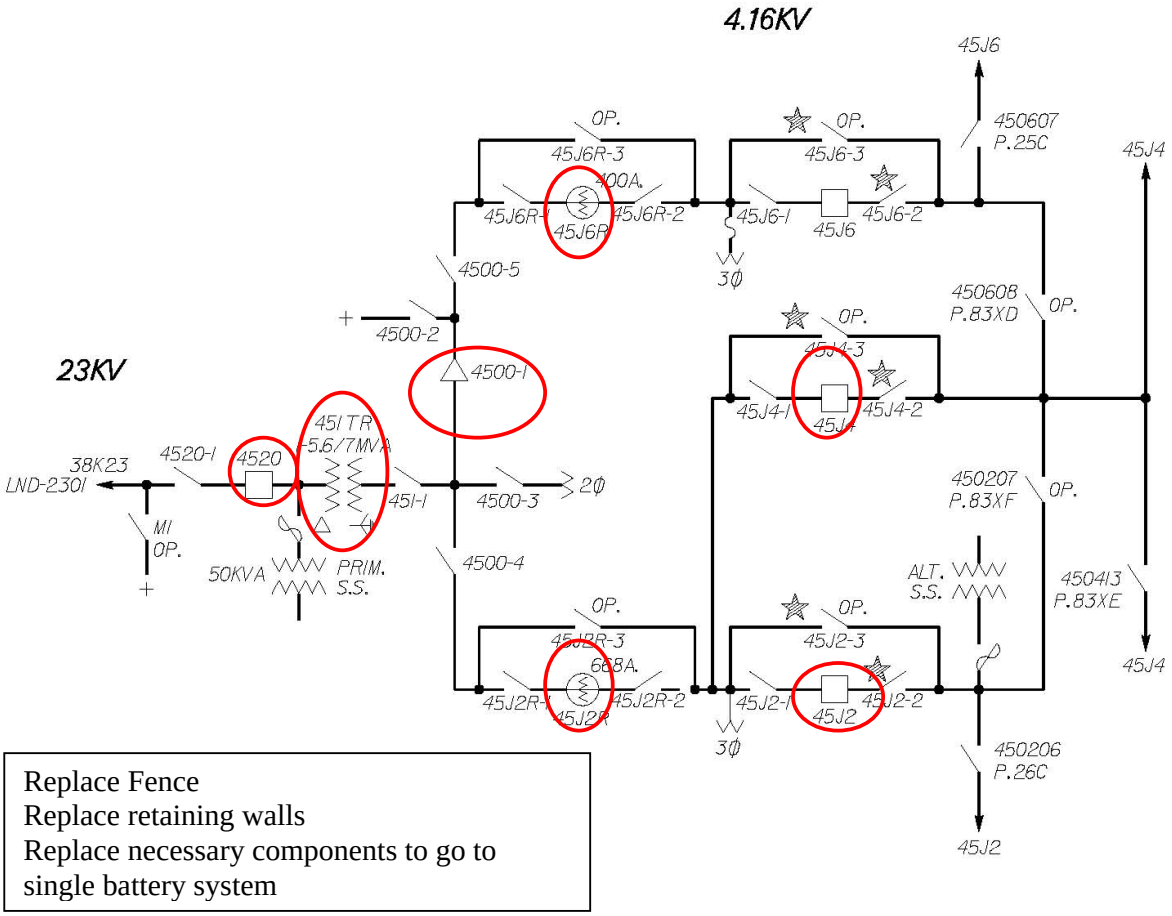
Transformer

NO. 2 REF# 023185– Westinghouse Manf. 1970

ITE Serial # 20116-A1 - 5.6\ 7 MVA ONAN\ONAF Manf. 1970
22.9kV delta/ 4.16kV wye

a)	Gas in Oil	Combustible gas values are fair for this unit. Ethane level tripled on 11/04 DGA
b)	Oil Quality	Oil quality values are good.
c)	Power Factor	The insulation power factor results are poor for a test done in 1998. (Ch-2.26%, Cl 6.68%, Chl-8.64%) The bushings all tested good. The value for Cl in 1998 is double the value of a prior test (Cl -3.66%).
d)	Infra – red	No issues.
e)	Site Inspection	The paint is in good condition. There are no leaks on the unit. All gauges are in working order. There are no alarms at the station. There are fans controlled by liquid temperature gauge (no winding temperature gauge). There is no fault pressure relaying protection on the unit.

Diagnostic testing indicates there are insulation issues with the transformer windings. It is recommended that it be replaced.



Replace Fence
Replace retaining walls
Replace necessary components to go to single battery system

= Replace

★ DEMARCATION LINE OF AUTHORITY
\+ MOBILE SUB CONN

11-14-03

ELDRED NO. 45
OCEAN STATE DIVISION

OS5704

Division 2-8 (Electric)
Asset Condition

Request:

Discuss and provide additional information for the following line budget line items:

a. C14326 I&M- OS D-Line UG Work From Insp $250,000
b. C25815 OS ARP Insul, SensDev, Surge Arrest $ 405,000
c. C26058 OS ARP Spare Substation Transformer $350,000
d. C20297 03740 Sac AB Repl Prog Phase 7 NEC DxT $400,000
e. PPM 13247 13247 102W51_Carriage Drive_Rplc Direct buried cable URD $489,000

Response:

a. C14326 is a project utilized to repair underground equipment issues found during routine inspections of underground structures such as manholes, vaults and ductbanks.

b. C25815 is a project for the replacement of insulators, sensing devices, and surge arresters which may pose a threat to the safety and reliability of substation performance. Insulators are replaced if they are damaged or broken. Cap-pin insulators are known throughout the industry as problematic and are targeted for replacement. Replacement of this equipment is scheduled to coincide with planned maintenance or during outages arranged for other projects. The cap-pin insulators at our Waterman and Arctic substations are planned for replacement in FY13.

c. C26058 is a project to purchase a spare transformer that would be readily available in case of an unexpected transformer failure. A review of the transformer population and inventory of mobile and spare units was completed, and it identified the need for additional spare units. The Company plans to purchase one spare transformer per year to address identified gaps, and we are in the process of purchasing a spare transformer that will cover 9 transformers in service in RI.

d. C20297 is a project for the replacement of sacrificial airbreaks (SAC AB) as part of a strategy that proactively replaces sacrificial airbreaks across our system. Sacrificial airbreak schemes were applied predominantly in the 60's and 70's as an economic low cost solution for the protection of large power transformers. In this scheme, an airbreak switch on the high side of a substation transformer is relayed to open under fault

Division 2-8 (Electric) continued
Asset Condition

conditions. The resultant arc will cause a fault at the airbreak location, which is detected and cleared by the remote terminal protection systems.

In 1992, an internal study concluded that the slow clearing time of sacrificial airbreaks was resulting in extensive collateral equipment damage during a substation fault. The study looked at historical data relative to the operation of sacrificial airbreaks schemes and found that 65% of those studied were slow, taking estimated times of 2.5 to 3 seconds to clear a fault. This extended clearance time often resulted in extensive damage to the equipment involved and in the local vicinity, and the possible destruction of the airbreak switch itself. It was determined that a circuit switcher is a more suitable protective device.

Presently, there are two substations in RI that still have sacrificial airbreak schemes, each with two sacrificial airbreaks. These stations are Wood River and West Cranston and this project will be utilized to replace them with circuit switchers. Depending upon the complexity, two or four SAC AB's will be completed in FY13.

e. PPM 13247 is a project to rebuild an existing underground residential development. The 102W51 Carriage Drive cable has had three failures since 2009 and five since 2006. The number of splices in this cable makes cable rejuvenation repairs impractical and expensive. This project consists of replacing 4,000 linear ft of 15 kV, 1/0 Al, direct buried cable, with 15 kV, # 2 Al, XLPE cable in a duct and manhole system along Carriage Drive, Wagon Wheel Road and Iron Forge Road in Lincoln, RI. In addition the project will replace eight submersible transformers with padmount transformers.

Prepared by or under the supervision of: Jennifer L. Grimsley

Division 2-9 (Electric)
(Asset Condition)

Request:

Provide a copy of the present flood mitigation study which was to have been completed as part of the last ISR plan budget. When will this study be completed? What has created a delay in its completion from what was presented in the last ISR Plan budget? When will the construction projects necessary to mitigate the future impacts of flooding in these stations be scheduled and completed?

Response:

The dollars budgeted in the FY12 ISR for the flood study was to study the flood potential, to evaluate solution alternatives for those substations that were impacted by the flooding in Rhode Island in 2010, as well as to begin to progress any mitigation work that resulted from these engineering reviews. The attachments to this response illustrate the progress to date.

Please refer to Attachment 1-DIV 2-9 (Asset), which is the flood mitigation study where National Grid conducted a broad substation flood risk assessment based upon recent and past events within the National Grid service territory. This assessment included RI substations. One of the next steps from the flood study was to determine yard elevations. Coneco surveyed the yards of the RI substations which had previous incidents of flooding. Please refer to Attachment 2-DIV 2-9 (Asset) for the results of those surveys.

Action plan alternatives for the previously affected substations were identified and are provided in Attachment 3-DIV 2-9 (Asset). These alternatives range from O&M measures such as raising of equipment and controls to full substation retirements that are in line with future system capacity and reliability projects. Individual projects for each substation are then developed and justified.

To date plans have been finalized and are being approved for Westerly and Warwick Mall. The alternatives for Pontiac have been estimated and project justification documents are being prepared. The alternatives for Sockanosett are currently in engineering for estimates. The engineering review of alternatives for Pawtuxet, Hunt River and Hope substations are still pending. At Riverside, the elevation of equipment is expected to take place without the need for any capital additions.

Division 2-9 (Electric) continued
(Asset Condition)

The table below summarizes the proposed, or most likely, resolution for each substation:

Station	**Proposed Option**	**Completion**
Sockanosett	Relocation of 23kV switchyard within existing substation to elevated 23kV metalclad arrangement.	FY15
Westerly	Build out proposed new Hopkinton Substation to allow additional capacity for Westerly load	FY16
Pawtuxet	Remove and retire substation by moving load to existing Lakewood Substation	FY15
Pontiac	Elevate to at risk substation equipment. Example: Replace three Bay C vacuum breakers with VSA reclosers mounted with the control cabinets 66 inches above grade or as high as possible without raising the foundations.	FY15
Warwick Mall	Elevate at risk substation equipment. Example: Replace existing reclosers 28F1 and 28F2 with VSA reclosers and Form 6 controls. Raise the 28F2 regulator control cabinet to 63 inches above grade.	FY14
Hunt River	Remove and retire substation by moving load to existing Division St Substation	FY15
Hope Sub	Elevate the Substation Equipment at risk: Replace the control house with a elevated control house with all relays and controls installed and wired.	FY15
Riverside	Elevate the substation equipment at risk:	FY14

During discussions between the Division and the Company on December 2, 2011 the Company was requested to provide a forecast of capital expenditures for the next five years. Please refer to Attachment 4-DIV 2-9(Asset) which provides an Excel file containing two worksheets which represent the most recent five year budget proposals. It should be noted that the budget for the Warwick Mall substation is for a complete replacement of that substation. After further review the Company believes it can reduce the scope significantly. Additionally, the increased spending in the future years assumes that the substation work in the proposed plans progresses according to plan. However, necessary permissions regarding the siting of these facilities has historically been difficult. Significant work on permitting and licensing is underway and requests to review additional alternatives for West Warwick and Hopkinton have been received and are being processed. The Company desires to move all of these projects forward as expeditiously as possible, however it would not be unexpected that some spending may be slowed and the change in spending would be smoothed over additional years.

Prepared by or under the supervision of: Jennifer L. Grimsley

Substation Flood Risk Assessment Study (June 2010)

nationalgrid
The power of action.

Introduction

- **Flooding incidents in Spring 2010 with service outages at eight substations in Rhode Island and concerns over climate change have highlighted the potential vulnerability of substations to major flood incidents.**

- **T&D Management directed that a study team be established to:**
  - **conduct a broad substation flood risk assessment**
  - **recommend a strategy outline to address flood threats to substations**

Study Team

- Sponsors: Patrick Hogan/Donald Angell
- Study Team:
  - Richard Costa
  - Jeffrey Goldberg
  - Venkatesh Minisandram (Lead)
  - Phillip Prout
  - Albert Weikart

Study Team Tasks

- Establish methodology to assess flood risks and threat level
- Identify flood risk monitoring resources
- Identify currently known risk levels at substations
- Develop Strategy Outline for:
  - Flood risk database & updates
  - Flood risk monitoring
  - Flood risk mitigation based on flood level and vulnerable substation equipment
  - Responsibility matrix for monitoring and dealing with anticipated flood events
- Present the study outcome to sponsors and key stakeholders for comments
- Generate an engineering document for "Substation Flood Risk Assessment, Monitoring & Mitigation"

Flood Types

- **Coastal or Tidal or Ocean Flooding: Flooding from the sea.**
- **Fluvial or River Flooding: Flooding from a river or water course**
- **Ground Water Flooding: Water level rise above natural ground surface**
- **Pluvial of Flash Flooding: Water level rise when the level of rainfall exceeds the capacity of drainage**

Risk

I	Risk $= f\{\text{Hazard, Exposure, Vulnerability}\}$

where the three elements can be expressed as follows–*hazard*: the extent, severity and probability of the hazard being considered; *exposure*: the extent and value of land or buildings that would be affected were the hazard to occur; and *vulnerability*: the susceptibility of the land or buildings to the hazard, were it to occur.

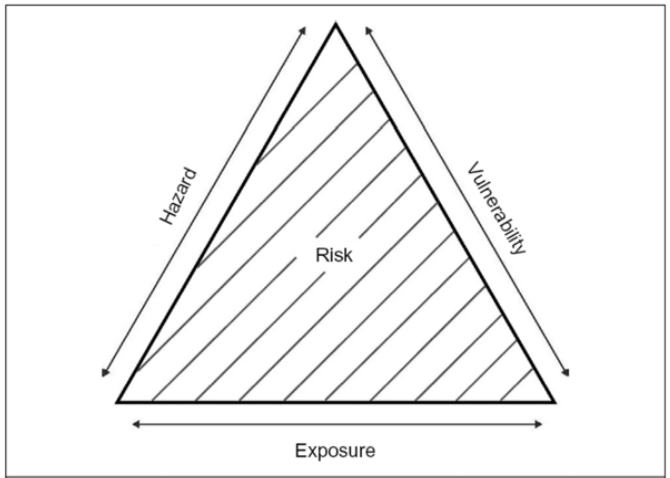


Fig. 1. Crichton's risk triangle[6]

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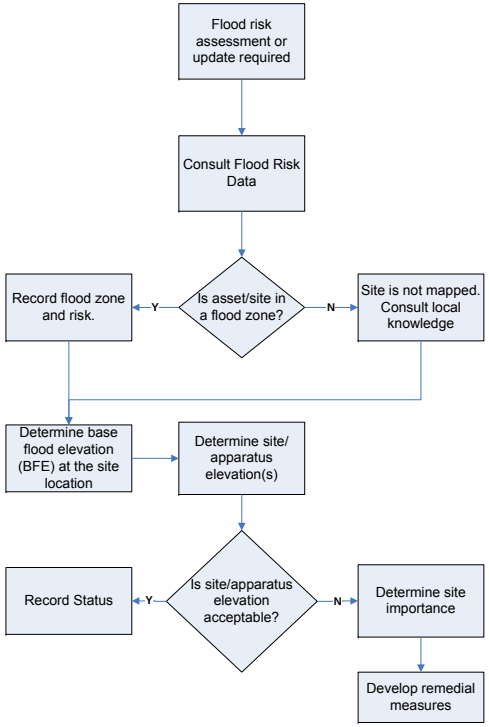
Risk Assessment Methodology

Substation Flood Assessment Methodology



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Flood Risk Assessment

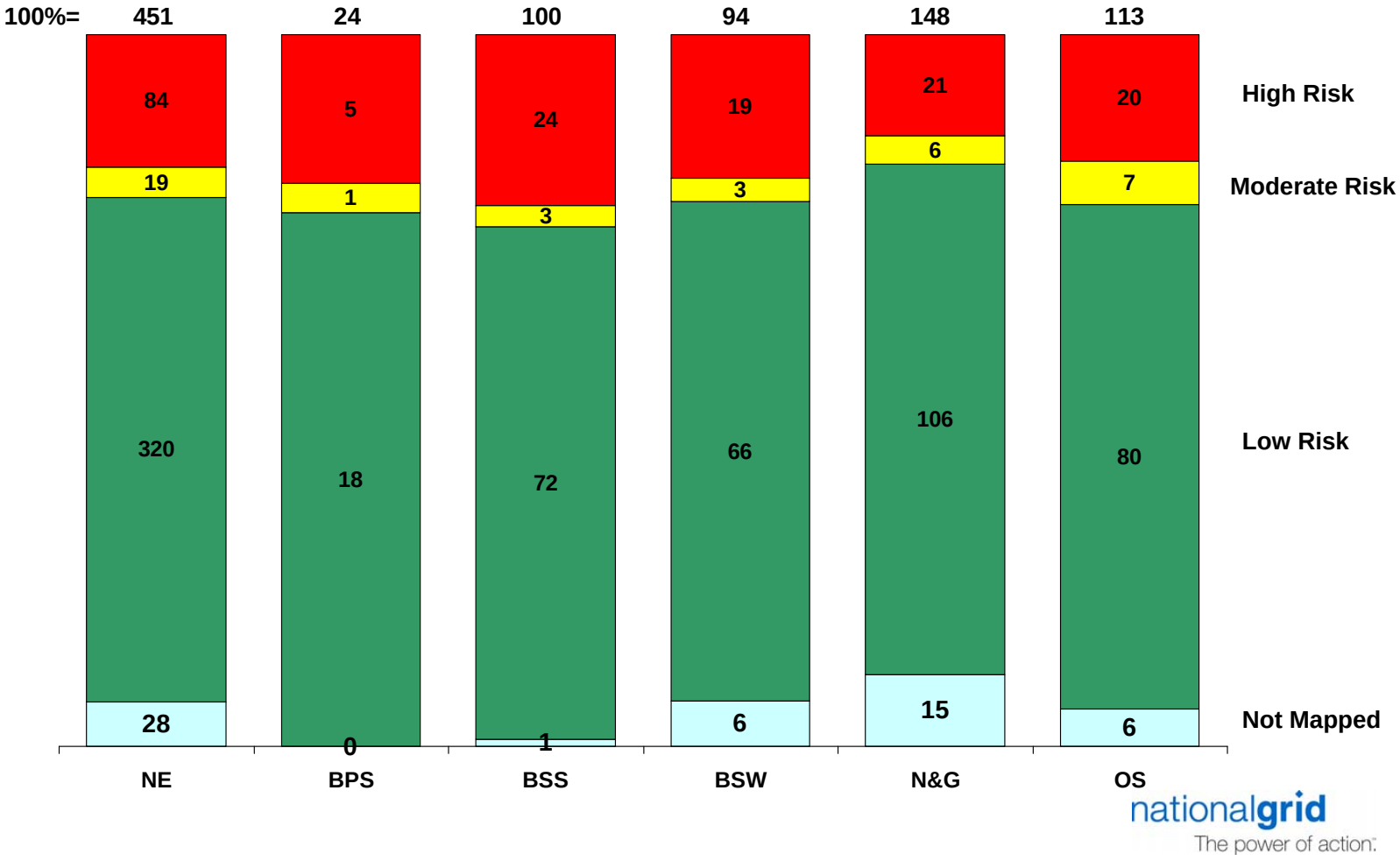
- Federal Emergency Management Administration (FEMA) identifies and maps flood hazard areas on its Flood Insurance Rate Maps (FIRMs).
- National Flood Insurance Act of 1968 mandated establishment of flood zones and FIRM maps first printed in 1973 became the official data to reference.
- FEMA Flood Zones (ANI-not mapped)

FEMA Risk Level	Description	Zone
Low	Areas outside 0.2% annual chance flood (500-year floodplain)	X
Moderate	Between 0.2 & 1% annual chance flood (between 100 & 500 year floodplain)	X500
High	Area having 1% chance flood (100-year floodplain)	A,AE,VE, AI, AH, A0

Additional Resources

- Contacted Consultants and Utilities to obtain feedback on design criteria for floods
- UKBP/TP213 : Substation Flood Risk Assessment and Flood Risk Monitoring
- Obtained feedback from Long Island on the work done for LIPA
- Contacted Local NE/NY O&M Personnel to obtain feedback on past substation flood events
- Obtained feedback on recent flood events in Rhode Island
- Substation Flood Risk Assessment Study by DTA dated Oct 10, 2008
- FEMA bulletins
- Flood Proofing EP 1165-2-314 , U.S. Army Corps of Engineers
- ASCE Standard 24-05: Flood Resistant Design and Construction

New England



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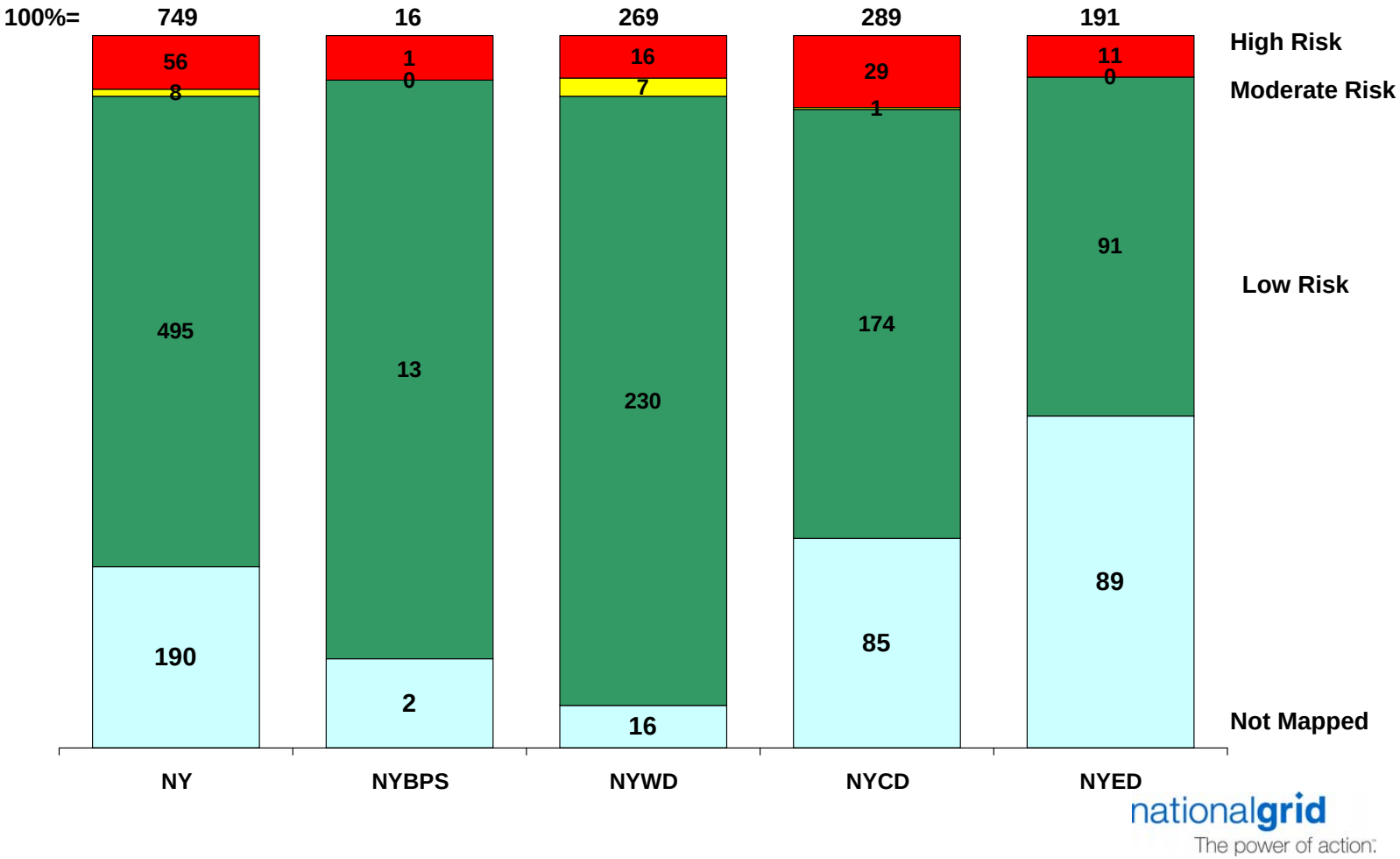
New York



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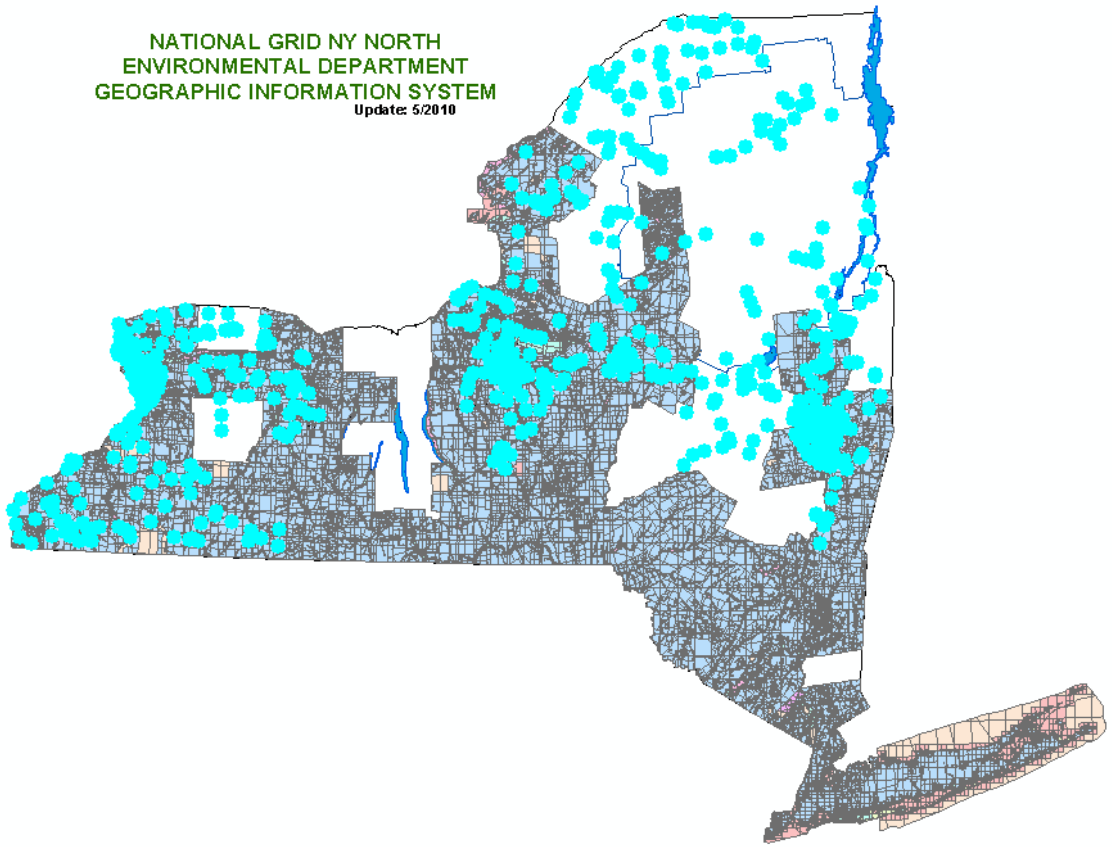
NY FIRM Coverage



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Base Flood and Substation Elevation

(North and Granite)

Substation	BFE	Yard	State
Amesbury No. 5	22	-	MA
Barron Avenue No. 10	113	-	NH
Beverly No. 12	10	-	MA
Boulevard No. 77	101	-	MA
Bridge St Boot Mill	66	-	MA
Concord Road No. 24	-	-	MA
East Bradford No. 65	22	-	MA
Lynn No. 21	10	11	MA
Meadowbrook No. 16	104	-	MA
Melrose No. 2	-	-	MA
Melrose No. 25	-	-	MA
Nahant No. 79	10	-	MA
Newburyport No. 36	9	-	MA
North Andover No. 7	-	-	MA
North River No. 30	10	-	MA
Revere Beach No. 35	13	-	MA
Riverdale No. 52	10	-	MA

Substation	BFE	Yard	State
Salem No. 1	10	-	MA
Tewksbury No. 14	115	-	MA
Topsfield No. 26	44	-	MA
West Methuen No. 63	111	-	MA

Base Flood and Substation Elevation

(Bay State South)

Substation	BFE	Yard	State
Ames Street No. 911	-	-	MA
Belmont No. 98	-	-	MA
Blackstone No. 329	301	-	MA
Brayton Point No. 15	14	-	MA
Bridgewater No. 16	-	-	MA
Candle Street No. 6	8	-	MA
Clara Street No. 6	77	-	MA
Depot Street No. 335	249	-	MA
E. Bridgewater No. 797	-	-	MA
Easton No. 92	121	-	MA
Field Street No. 1	11	-	MA
Hathaway No. 106	20	-	MA
Houghs Neck No. 6	11	-	MA
Mink Street No. 7	9	-	MA
North Scituate Unit 65	27	-	MA
North Weymouth No. 6	12	-	MA
Phillips Lane No. 95	76	-	MA

Substation	BFE	Yard	State
Plainville No. 3451	192	-	MA
Pleasant Street No. 8	-	-	MA
Read Street No. 9	-	-	MA
Rockland No. 72	-	-	MA
Uxbridge No. 321	227	228	MA
West Quincy No. 3	49	-	MA
West Street No. 1	123	-	MA

Base Flood and Substation Elevation

(Bay State West)

Substation	BFE	Yard	State
Adams No. 21	723	-	MA
Ayer No. 21	-	-	MA
Brooks Street No. 13	-	-	MA
Brown Street No. 1	680	-	MA
Dunstable No. 210	-	-	MA
Florence No. 2	69	-	MA
Groton Street No. 226	183	-	MA
Harriman No. 8	-	-	VT
Little Rest Rd No. 516	249	-	MA
Meadow Street No. 12	634	-	MA
Millbury No. 5	343	-	MA
Risingdale No. 9	694	-	MA
Royalston No. 701	-	-	MA
Searsburg No. 9	1518	-	VT
Webster Street No. 6	474	-	MA
West Street No. 901	133	-	MA

Substation	BFE	Yard	State
West Street No. 901	133	-	MA
Williamstown No. 3	615	-	MA
Winfield Street No. 10	-	-	MA

Base Flood and Substation Elevation

(Ocean State)

Substation	BFE	Yard	State
Anthony No. 64	220	-	RI
Farnum Sub No. 105	-	-	RI
Front Street No. 24	38	-	RI
Gate II No. 38	13	-	RI
Hope Valley No. 41	83	-	RI
Hunt River No. 40	-	-	RI
Kent County No. 22	-	-	RI
Pawtucket 1 No. 107	16	-	RI
Pawtucket 2 No. 148	33	-	RI
Pawtuxet No. 31	16	-	RI
Pontiac No. 31	26	-	RI
Quonset No. 83	13	-	RI
Riverside No. 8	128	-	RI
Sockanosset No. 24	23	-	RI
S. Aquidneck No. 122	13	-	RI
Warren No. 5	13	-	RI

Substation	BFE	Yard	State
Warwick Mall No. 28	35	-	RI
West Howard No. 154	11	-	RI
Westerly No. 16	11	-	RI
Woonsocket No. 26	229	-	RI

NY High Risk Stations*

NYWD

Station ID	Station Name	Flood Risk Zone
NY07-0090	Andover Station 09	AE
NY07-0240	Batavia Station 01	AE
NY07-0590	Corfu Station 22	A
NY07-1020	Franklinville Station 24	AE
NY07-1610	Livingston Correctional Station 130	AE
NY07-1720	Middleport Station 77	AE
NY07-2940	Seneca Terminal Station	AE
NY07-3080	South East Batavia Station	AE
NY07-3430	Station 043	AE

* BFE data is not available for the revised flood zone mapping. Station elevations must be measured by Survey.

NY High Risk Stations*

NYCD

Station ID	Station Name	Flood Risk Zone
NY08-0620	Buckbee Mears Station 300	AE
NY08-0700	Butternut Station 255	AE
NY08-0770	Camillus Station 10	AE
NY08-0810	Carr Street Station 3877	AE
NY08-0850	Carthage Station 717	AE
NY08-0880	Cazenovia Station 220	AE
NY08-1500	Dewitt Station 241	AE
NY08-1630	East Conklin Terminal Station 314	A
NY08-1640	East Fulton Station 100	AE
NY08-2110	Frankfort Station 677	AE
NY08-2520	Headson Station 146	AE
NY08-2540	Herrings Station 743	AE
NY08-2680	Homer Station 129	AE
NY08-2960	Labrador Station 230	A
NY08-3070	Leray Station 813	A
NY08-3082	Lewis Road Station 572	AE
NY08-3200	Lorings Station 276	AE
NY08-3430	Mexico Station 43	AE
NY08-3490	Miller Street Station 117	AE
NY08-4690	Peterboro Station 514	AE
NY08-4720	Phoenix Station 51	AE
NY08-5090	Rock City Station 623	AE
NY08-5560	Sherman Station 333	AE
NY08-5920	Sunday Creek Station 876	A
NY08-6110	Terminal Station 651	AE
NY08-6210	Truxton Station 74	A
NY08-6380	Varick Station 207	AE
NY08-6580	West Monroe Station 274	AE
NY08-6670	Whitesboro Station 632	AE

* BFE data is not available for the revised flood zone mapping. Station elevations must be measured by Survey.

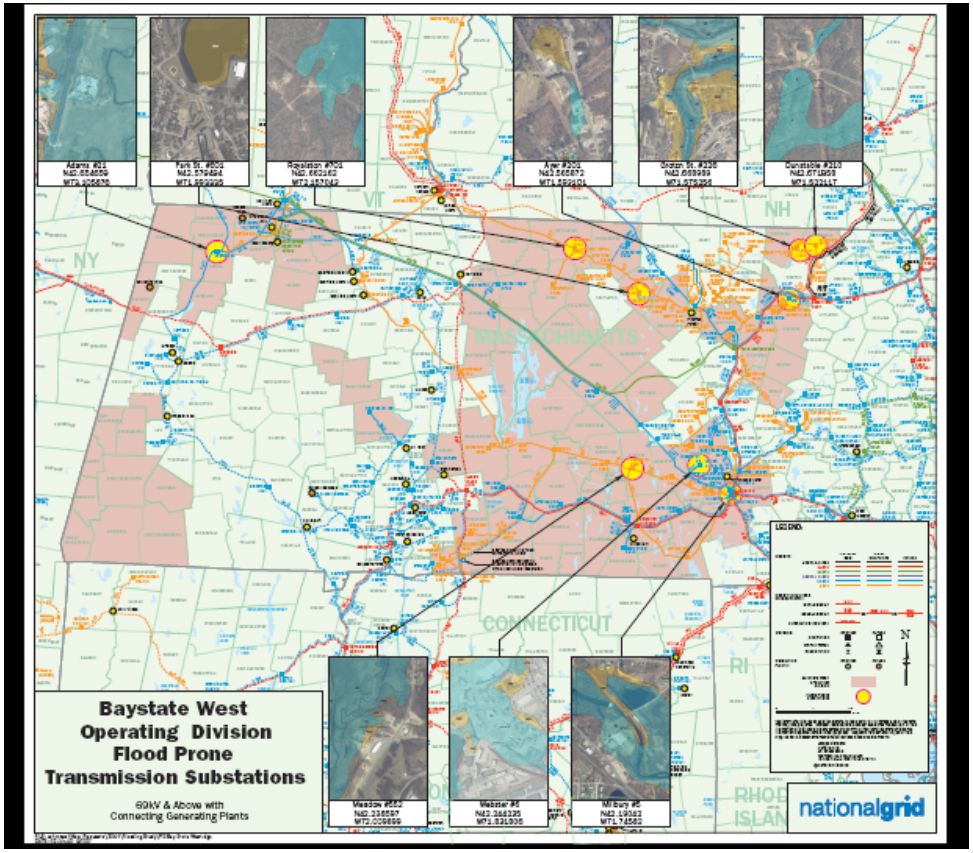
NY High Risk Stations*

NYED

Station ID	Station Name	Flood Risk Zone
NY09-0080	Albany Steam Plant Station	AE
NY09-0120	Cascade Tissue Station	AE
NY09-0890	Eddys Lane Pump	A
NY09-1490	Inghams Station 20	A
NY09-1670	Liberty Street Station 94	AE
NY09-1810	Mechanicville Station 971	AE
NY09-2440	Rensselaer Station 132	AE
NY09-2470	Riverside Station 288	AE
NY09-2830	School Street Station 975	AE
NY09-2860	Schuylerville Station 39	AE
NY09-2860	Schuylerville Station 39	AE

* BFE data is not available for the revised flood zone mapping. Station elevations must be measured by Survey.

Flood Prone Substation Mapping



Past Major Substation Flood Events (Station removed from service)

Division	Substation	State	Comments
Ocean State	**Hope 15**	RI	In 2010, station completely flooded and removed from service
Ocean State	**Hunt River 40**	RI	In 2010, station completely flooded and removed from service
Ocean State	**Pawtuxet 31**	RI	In 2010, station completely flooded and removed from service
Ocean State	**Pontiac 27**	RI	In 2010, station completely flooded and removed from service
Ocean State	**Riverside 8**	RI	In 2010, station completely flooded and removed from service
Ocean State	**Sockanosett 24**	RI	In 2010, station completely flooded and removed from service
Ocean State	**Warwick Mall 28**	RI	In 2010, station completely flooded and removed from service
Ocean State	**Westerly 16**	RI	In 2010, station completely flooded and removed from service
NYED	**Amsterdam 326**	NY	In 2008, station completely flooded and removed from service
NYED	**Canajoharie 31**	NY	In 2008, station completely flooded and removed from service
NYED	**Inghams 20**	NY	In 2008, station completely flooded and removed from service
NYED	**Saint Johnsville 335**	NY	In 2008, station completely flooded and removed from service

Past Minor Substation Flood Events (Equipment /site access impacts)

Division	Substation	State	Comments
North and Granite	**Lynn 21**	MA	In 2009 4kV reactors flashed inside building due to flooding
North and Granite	**West Methuen 63**	MA	115kV Line AB mechanisms get flooded during heavy rain
North and Granite	**Enfield 7**	NH	Trouble getting to regulators due to high water in station
North and Granite	**Maplewood 16**	MA	Pumps in the basement of control house
North and Granite	**Manchester 23**	MA	High ground water (recently approx. 1 ft in station),
North and Granite	**Topsfield 26**	MA	Access to site affected - Route 1 and Sub driveway closed
North and Granite	**Wellington 11**	MA	Pumps in the basement of control house
North and Granite	**Hillside 66**	MA	Catch basin was plugged and station flooded in 2008
North and Granite	**Lawrence 1**	MA	River flooded a few years back, river flowed through station
North and Granite	**Spicket River 13**	NH	Site is dry, however, access to site has been an issue
Bay State South	**Ames Sub 911**	MA	in 2010 6" of water inside sub, access to site affected
Bay State South	**East Bridgewater 797**	MA	In 2010, 2 feet of water at back fence
Bay State South	**Houghs Neck 6**	MA	in 2010, water in the building - no action taken
Bay State West	**Adams Sub 21**	MA	Entire station under water and access affected
Bay State West	**Ayer Sub 201**	MA	Water up to the top of cable trench covers
Bay State West	**Cooks Pond 23**	MA	Station is always wet - O&M worker broke leg on ice
Bay State West	**Five Corners 527**	MA	Station has flooded in the past - station remained in service
Bay State West	**Prospect St 219**	MA	During heavy rain - approx. 6" of water in station

Past Minor Substation Flood Events (equipment/ site access impacts)

Division	Substation	State	Comments
Ocean State	**Hope Valley 41**	RI	Water in station during heavy rains
Ocean State	**Jepson 37**	RI	Water in station during heavy rains
Ocean State	**Johnston 18**	RI	Water in station during heavy rains
Ocean State	**Staples 112**	RI	Water in station during heavy rains
Ocean State	**South Aquidneck 122**	RI	Water in station during heavy rains
NYCD	**Newton Falls 774**	NY	Station flooded and site access affected caused by beaver dams
NYCD	**South Oswego 292**	NY	Station flooded and site access affected caused by beaver dams
NYCD	**Taylorville 770**	NY	Station gets flooded due to water run off and access affected
NYCD	**Union Falls 844**	NY	When river is at high level, yard gets wet and access affected
NYCD	**Whitesboro 632**	NY	Water has risen to fenceline, however, did not impact metaclad
NYWD	**Motimer**	NY	Water in control house 2-3 years back
NYWD	**Ashville**	NY	Site access was affected a few years back

Recent Flood Event Field Feedback

- Establish pre and post flood response plan for substations "at risk"".
- During expected flood events, need timely release of list of substations "to monitor".
- Switch-out substations sooner than later
- Unknown ground surface condition with high level of water poses safety risk
- Pumps got submerged in water with raising water level- had to come out with make shift platforms (desks, etc.)
- Document to cover what station service circuits to be switched off /tasks to perform when station is shut down.
- Document to cover post flood action (what to re-use, what to replace, what to test, who to call for de-contamination)
- Tracking process to identify
  - pre & post flood actions performed to facilitate fast restoration
  - assets temporarily removed, permanently removed and replaced.

Water Related Risks due to Climate Change

Assessing risk – Checklist for water-related risks

- ***Is the site in an area at risk from current or future climate change impacts and extreme weather events such as:***
  - Sea level rise
  - Storm surges, extreme high water levels and tidal flooding
  - Flash floods, slow onset flooding and fluvial flooding
  - Groundwater rise flooding
  - Land erosion/landslips/subsidence
  - Storm damage
  - Water shortage?
- ***Could development in particular areas potentially increase climate-related risks in the locality in terms of:***
  - Increased surface water run-off
  - Causing changes to the flood or groundwater regimes elsewhere
  - Increased pressure for new or enhanced flood or coastal defence measures
  - Increased pressure for water resources?

Adapted from The Planning Response to Climate Change by ODPM 2004

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Menu of Climate Adaption Options (*Adapting to climate change impacts on water management: a guide for planners prepared for South East England Regional Assembly by AEA Technology)

Addressing flood risk	Development zoning	
	Provision of safe access	
	Land raising and raising floor levels	
	Flood warning	
	Flood proofing walls (internal and external) and floors	Flood proofing
	Flood proofing fixtures and fittings e.g. raising circuitry levels	
	Temporary barriers (require developers to provide information packs)	
	Flood proofing gardens	
	Design of channel and hydraulic structures	
	Developer contributions to strategic flood risk management	
	Compensatory flood storage	
	Filter strips, soakaways, swales, filter drains, infiltration basins, detention basins, retention ponds, permeable and porous paving surfaces, infiltration trenches	Management of development runoff (SUDS type measures)
	Minimisation of directly connected areas	
	Reed beds and wetlands	
	Green roofs	
	Use of flood defences and pumping to drain the low-lying area behind defences	

Flood Resilient Construction

Hierarchy of building design (ie sequential test)

1. **Flood avoidance (relocate away from hazard, raise floor).**
2. **Flood resistance (stop water entering).**
3. **Flood resilience (water can enter but impact is limited- no permanent damage).**
4. **Flood repairable (water can enter, damaged elements can easily be repaired or replaced).**

<0.3m = water exclusion

0.3 - 0.6m = resistance/resilience

>0.6m = water entry strategy

LYNN Sub (Power Center elevated)

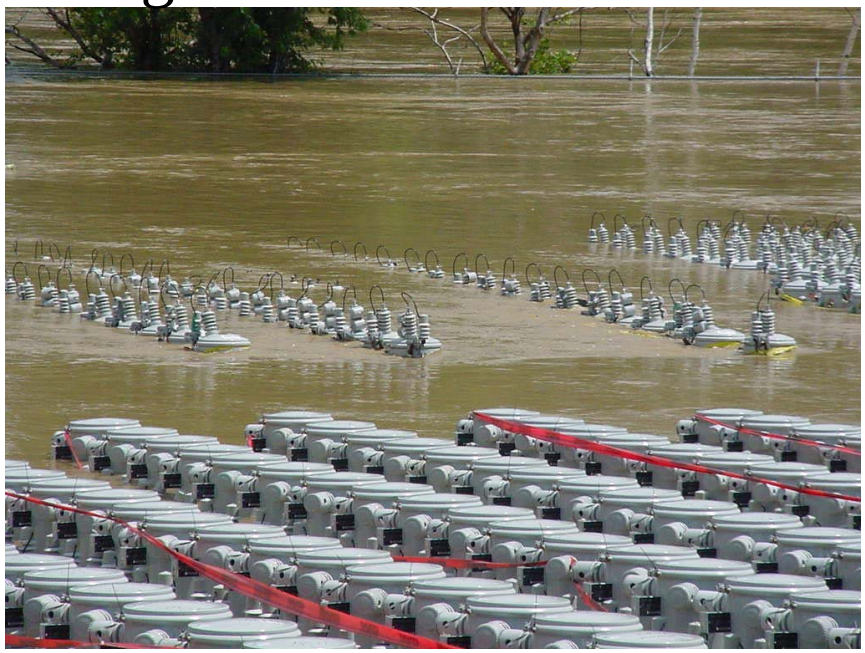
Mobile Unit

Example: Mitigation Measure

Example: Mitigation measure

Equipment Storage Area Assessment

Binghamton Service Center



KEYSPAN

1/18/2008

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Design Criteria

- Avoid locating new substations in flood zone areas
- Design flood elevation minimum 24 inches above 100 year base flood elevation
- For major rebuild/upgrades at existing stations located in flood zone designated areas, consider station relocation as an option.

Next Steps

- Compile site elevation for high risk substations (including substations with past major and minor flood events)- estimated cost $300k
- Assess vulnerable equipment based on BFE and local knowledge
- T&D Planning to rank "high risk substations" based on criticality and load serve options.
- Establish mitigation & contingency plan and develop strategy for implementation
  - High risk BPS stations & substations with major flood events.
  - Balance of high risk substations and substations with minor flood events
- Use Cascade as a central data repository and maintain data at established intervals
- Address lessons learned
- Develop/update Relevant Engineering Documents
- Review equipment storage areas based on flood risk
- Monitor US Agency (FEMA, EPA, etc) Climate Change Initiatives

Substation	Address	100-Year Flood Elevation (ft NAVD 88)	Flood Elevation Source (1)	Nov 2010 Surveyed Yard Elev. (ft NAVD 88)	Distance from Flood Elevation (ft)	Approx. Difference from Legacy Plan (ft)	Comparison Point	Equipment Vulnerability (2)
Riverside Substation No. 8	1000 Florence Drive Ext., Woonsocket, RI	128	FIRM	121.5	-6.5	+21.1	tower "BB" foundation	High
Staples Substation No. 112	25 Staples Road, Cumberland, RI	N/A	N/A	280.8	N/A	0	concrete equipment pad elevation	Low (3)
Johnston Substation No. 18	165 Central Avenue, Johnston, RI	N/A	N/A	164.7	N/A	+78.6	spot elevation at east fence corner	Low (3)
Pawtuxet Substation No. 31	70 Bellows Street, Warwick, RI	15	FIRM	9.9	-5.1	N/A	no elevations on legacy drawing	High
Sockanosset Substation No. 24	19 Electronic Drive, Warwick, RI	21	FIRM	19.3	-1.7	0	spot elevation at eastern fence line	High
Pontiac Substation No. 27	14 Ross Simon Drive, Cranston, RI	26.5	FIRM	26.9	0.4	-1.25	spot elevations along southwest fence	Medium
Warwick Mall Substation No. 28	400 Bald Hill Road, Warwick, RI	34	FIRM	32.6	-1.4	N/A	no elevations on legacy drawing	High
Hope Substation No. 15	15 Hope Furnace Road, Scituate, RI	190	FIRM	191.7	1.7	0	matching contours	Low
Hunt River Substation No. 40	5890 Post Road, Warwick, RI	29	USGS QUAD	25	-4	-71.5	spot elevations along south and east fence	High
Hope Valley Substation No. 41	1152 Main Street (Route 3), Hopkinton, RI	82	FIRM	83.2	1.2	-18.7	transformer pad elevation	Low
Westerly Substation No. 16	69 Canal Street, Westerly, RI	10	FIRM	7.8	-2.2	0	negligible difference from legacy drawing	High
Jepson Substation No. 37	500 Jepson Lane, Portsmouth, RI	161	USGS QUAD	162.8	1.8	-56.75	spot grades along eastern edge of crushed stone	Low
South Aquidneck Substation No. 122	1220 Aquidneck Avenue, Middletown, RI	13	FIRM	10.3	-2.7	N/A	no elevations on legacy drawing	Medium

(1) Flood elevations that were determined using USGS Topographic Quads are assumed by correlating contour lines on the Quad Map with Flood Boundaries on the FIRM Map

(2) For comparison purposes, equipment vulnerability is rated as follows:

HIGH - below flood elevation to at flood elevation

MEDIUM - 0 to 2 feet above flood elevation

LOW - 2+ feet above flood elevation

(3) Based on our analysis, it would appear that flooding at this location is drainage related rather than flood zone related

LEGEND

—×———×— PERIMETER FENCE

FLOOD ZONE A, AREAS OF 100-YEAR FLOOD, NO BASE FLOOD ELEVATIONS DETERMINED

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR KENT COUNTY COMMUNITY PANEL NO. 4454090007D REVISED APRIL 16, 1991.

REVISIONS			
NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING: FLOOD ANALYSIS PLAN

PROJECT:
HUNT RIVER SUBSTATION NO. 40
5890 POST ROAD
WARWICK, RHODE ISLAND

PLAN SET: RHODE ISLAND FLOOD STUDY

CONECO Engineers Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE: 508-697-3191 • 800-548-3350 • FAX 508-697-5996
EMAIL: Admin@coneco.com • WEB SITE: http://www.coneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 80'
PROJECT #:	5004.1
SHEET NO.	1 OF 01

LEGEND

PERIMETER FENCE (RED ON PLANS)

FLOODWAY AREAS IN ZONE AE

FLOOD ZONE AE, AREAS OF 100–YEAR FLOOD, BASE FLOOD ELEVATIONS DETERMINED

FLOOD ZONE X500, AREAS OF 500–YEAR FLOOD

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR WASHINGTON COUNTY PANEL NO. 139 OF 368, MAP NO. 44009C0139H EFFECTIVE, OCTOBER 19, 2010.

0 100 200
SCALE: 1"=100'

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451–1120

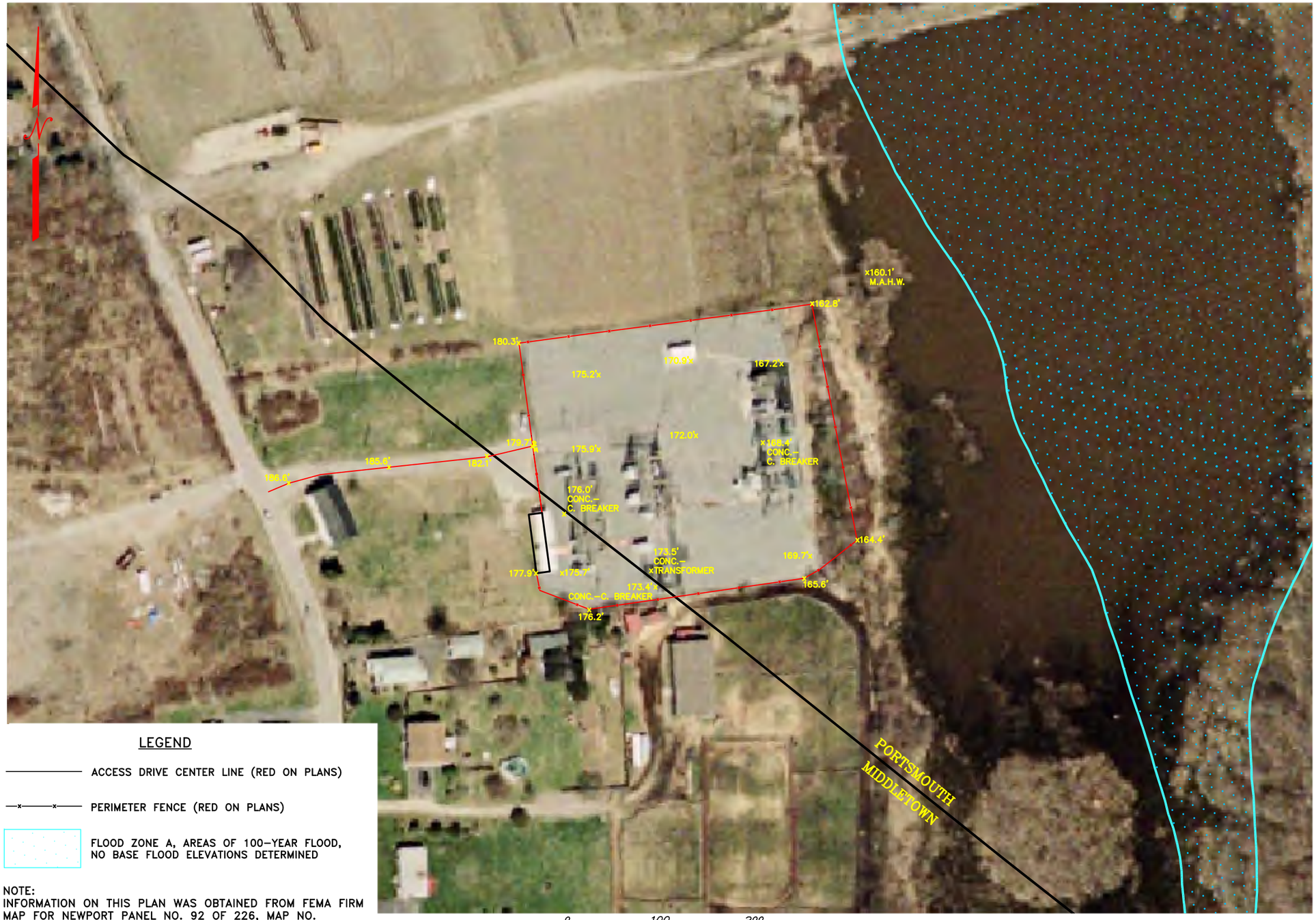
PROJECT:
WESTERLY SUBSTATION NO. 16
69 CANAL STREET
WESTERLY, RHODE ISLAND

DRAWING:
FLOOD ANALYSIS PLAN

PLAN REF:
RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508–697–3191 • 800–548–3305 • FAX 508–697–5996
EMAIL: Admin@coneco.com • WEB SITE: http://www.coneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 100'
PROJECT #:	5168.1
SHEET NO.	1 OF 01



LEGEND

——— ACCESS DRIVE CENTER LINE (RED ON PLANS)

—x———x— PERIMETER FENCE (RED ON PLANS)

FLOOD ZONE A, AREAS OF 100–YEAR FLOOD, NO BASE FLOOD ELEVATIONS DETERMINED

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR NEWPORT PANEL NO. 92 OF 226, MAP NO. 44005C0092H EFFECTIVE APRIL 5, 2010.

0 100 200
SCALE: 1"=100'

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451–1120

DRAWING:
FLOOD ANALYSIS PLAN

PROJECT:
JEPSON SUBSTATION NO. 37
500 JEPSON LANE
PORTSMOUTH, RHODE ISLAND

PLAN SET:
RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508–697–3191 • 800–548–3355 • FAX 508–697–5996
EMAIL: Admin@coneco.com • WEB SITE: http://www.coneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 100'
PROJECT #:	5302.1
SHEET NO.	1 OF 01

LEGEND

- ACCESS DRIVE CENTER LINE (RED ON PLANS)
- PERIMETER FENCE (RED ON PLANS)
- XXX BASE FLOOD ELEVATION LINE
- STREAM/RIVER BANK LINE
- FLOODWAY AREAS IN ZONE AE

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR PROVIDENCE COUNTY PANEL NO. 402 OF 451, MAP NO. 44007C0402G EFFECTIVE MARCH 2, 2009.

0 60 120
SCALE: 1"=60'

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING: FLOOD ANALYSIS PLAN

PROJECT:
HOPE SUBSTATION NO. 15
15 HOPE FURNACE ROAD
SCITUATE, RHODE ISLAND

PLAN SET: RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
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EMAIL: Admin@conecco.com • WEB SITE: http://www.conecco.com

DATE:	12/07/2010
DRAWN/CHECK:	TLD/RTL
SCALE:	1" = 60'
PROJECT #:	5536.1
SHEET NO.	1 OF 01

LEGEND

- PERIMETER FENCE (RED ON PLANS)
- XX BASE FLOOD ELEVATION LINE
- FLOODWAY AREAS IN ZONE AE
- FLOOD ZONE AE, AREAS OF 100-YEAR FLOOD, BASE FLOOD ELEVATIONS DETERMINED
- FLOOD ZONE X500, AREAS OF 500-YEAR FLOOD

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR WASHINGTON COUNTY PANEL NO. 64 OF 368, MAP NO. 44009C0064H EFFECTIVE OCTOBER 19, 2010.

0 80 160
SCALE: 1"=80'

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING:
FLOOD ANALYSIS PLAN

PROJECT:
HOPE VALLEY SUBSTATION NO. 41
1152 MAIN STREET (ROUTE 3)
HOPKINTON, RHODE ISLAND

PLAN SET:
RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
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PHONE 508-697-3191 • 800-248-3355 • FAX 508-697-5996
EMAIL Admin@conecco.com • WEB SITE http://www.conecco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 80'
PROJECT #:	5597.1
SHEET NO.	1 OF 01

LEGEND

ACCESS DRIVE CENTER LINE (RED ON PLANS)

PERIMETER FENCE (RED ON PLANS)

STREAM/RIVER BANK LINE

FLOOD ZONE X, AREAS DETERMINED TO BE OUTSIDE THE 500-YEAR FLOODPLAIN.

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR PROVIDENCE COUNTY PANEL NO. 303 OF 451, MAP NO. 44007C0303G EFFECTIVE MARCH 2, 2009. THE SITE IS APPROXIMATELY 0.4 MILES AWAY FROM THE CLOSEST 100-YEAR FLOODPLAIN BOUNDARY.

0 100 200

SCALE: 1"=100'

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR: NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING: FLOOD ANALYSIS PLAN

PROJECT: JOHNSTON SUBSTATION NO. 18
165 CENTRAL AVE.
JOHNSTON, RHODE ISLAND

PLAN SET: RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
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PHONE 508-697-3191 • 800-548-3355 • FAX 508-697-5996
EMAIL Admin@conneco.com • WEB SITE http://www.conneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 100'
PROJECT #:	6397.1
SHEET NO.	1 OF 01

0 60 120

SCALE: 1"=60'

0 200 400

SCALE: 1"=200'

LEGEND

- ACCESS DRIVE CENTER LINE (RED ON PLANS)
- PERIMETER FENCE (RED ON PLANS)
- XX BASE FLOOD ELEVATION LINE
- STREAM/RIVER BANK LINE
- FLOODWAY AREAS IN ZONE AE
- FLOOD ZONE AE, AREAS OF 100-YEAR FLOOD, BASE FLOOD ELEVATIONS DETERMINED
- FLOOD ZONE X, AREAS OF 500-YEAR FLOOD

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR PROVIDENCE COUNTY PANEL NO. 427 OF 451, MAP NO. 44007C0427G EFFECTIVE MARCH 2, 2009.

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING:
FLOOD ANALYSIS PLAN

PROJECT:
PONTIAC SUBSTATION NO. 27
14 ROSS SIMON DRIVE
CRANSTON, RHODE ISLAND

PLAN BY:
RHODE ISLAND FLOOD STUDY

CONECO
Engineers, Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE: 508-697-3191 • 800-548-3355 • FAX: 508-697-5996
EMAIL: Admin@coneco.com • WEB SITE: http://www.conecо.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	AS NOTED
PROJECT #:	6726.1
SHEET NO.	1 OF 01

LEGEND

PERIMETER FENCE (RED ON PLANS)

STREAM/RIVER BANK LINE

FLOOD ZONE X, AREAS DETERMINED TO BE OUTSIDE THE 500-YEAR FLOODPLAIN.

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR PROVIDENCE COUNTY PANEL NO. 177 OF 451, MAP 44007C0177G EFFECTIVE MARCH 2, 2009. THE SITE IS APPROXIMATELY 0.6 MILES AWAY FROM THE CLOSEST 100-YEAR FLOODPLAIN BOUNDARY.

0 80 160

SCALE: 1"=80'

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

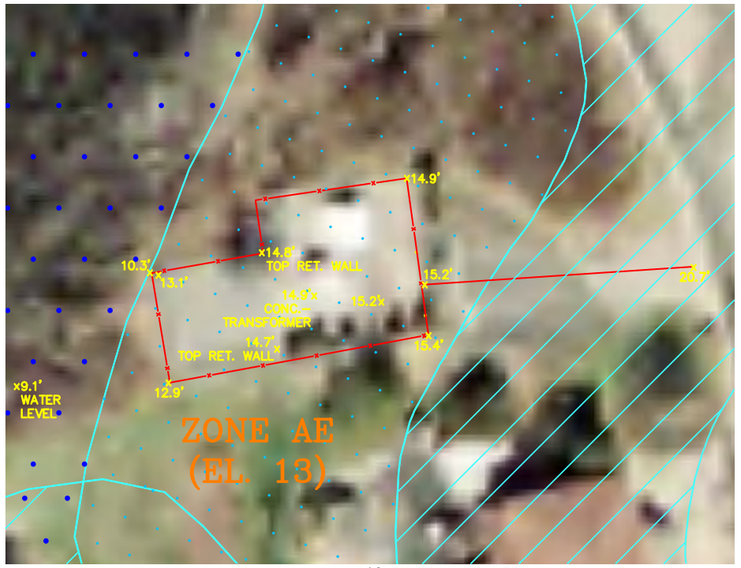
DRAWING:
FLOOD ANALYSIS PLAN

PROJECT:
STAPLES SUBSTATION NO. 112
25 STAPLES ROAD
CUMBERLAND, RHODE ISLAND 02864

PLAN BY:
RHODE ISLAND FLOOD STUDY

CONECO
Engineers Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 • 800-548-3350 • FAX 508-697-5996
EMAIL Admin@coneco.com • WEB SITE: http://www.coneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 80'
PROJECT #:	6900.0
SHEET NO.	1 OF 01



0 40 80

SCALE: 1"=40'

0 80 160

SCALE: 1"=80'

LEGEND

- ACCESS DRIVE CENTER LINE (RED ON PLANS)
- PERIMETER FENCE (RED ON PLANS)
- OTHERWISE PROTECTED AREAS (OPA's)
- FLOOD ZONE VE, COASTAL FLOOD ZONE WITH VELOCITY HAZARD (WAVE ACTION); BASE FLOOD ELEVATIONS DETERMINED
- FLOOD ZONE AE, AREAS OF 100-YEAR FLOOD; BASE FLOOD ELEVATIONS DETERMINED
- FLOOD ZONE X, AREAS OF 500-YEAR FLOOD

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR NEWPORT COUNTY PANEL NO. 181 OF 226, MAP NO. 44005C0181H EFFECTIVE APRIL 5, 2010.

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING:
FLOOD ANALYSIS PLAN

PROJECT:
SO. AQUIDNECK SUBSTATION NO. 122
1220 AQUIDNECK AVENUE
MIDDLETOWN, RHODE ISLAND

PLAN SET:
RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE: 508-697-3191 • 800-548-3355 • FAX: 508-697-3996
EMAIL: Admin@coneco.com • WEB SITE: http://www.coneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	AS NOTED
PROJECT #:	6903.1
SHEET NO.	1 OF 01

LEGEND

- ACCESS DRIVE CENTER LINE (RED ON PLANS)
- PERIMETER FENCE (RED ON PLANS)
- XX BASE FLOOD ELEVATION LINE
- STREAM/RIVER BANK LINE
- FLOOD ZONE AE, AREAS OF 100-YEAR FLOOD, BASE FLOOD ELEVATIONS DETERMINED
- FLOODWAY AREAS IN ZONE AE
- FLOOD ZONE X, AREAS OF 500-YEAR FLOOD

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR KENT COUNTY COMMUNITY PANEL NO. 4454090003E REVISED JUNE 16, 1992.
BASE FLOOD ELEVATION LINES AND SURVEY INFORMATION BASED ON NAVD 88 DATUM.

0 300 600
SCALE: 1"=300'

0 80 160
SCALE: 1"=80'

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING: FLOOD ANALYSIS PLAN

PROJECT: PAWTUXET SUBSTATION NO. 31
70 BELLOWS STREET
WARWICK, RHODE ISLAND

PLAN SET: RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
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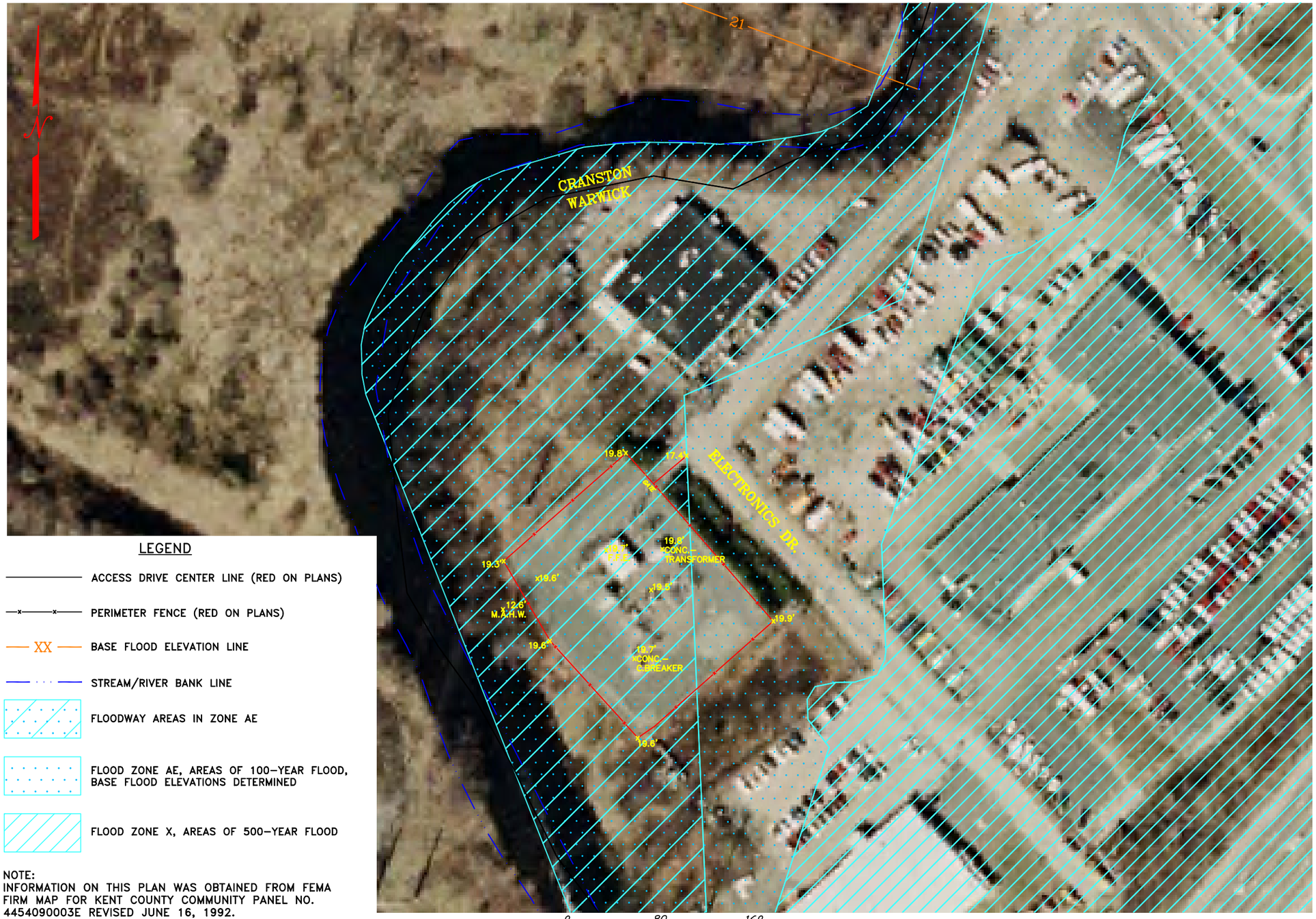
PHONE 508-697-3191 • 800-548-3358 • FAX 508-697-5898
EMAIL Admin@conecoinc.com • WEB SITE http://www.conecoinc.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	AS NOTED
PROJECT #:	6904.0
SHEET NO.	1 OF 01



LEGEND

- ACCESS DRIVE CENTER LINE (RED ON PLANS)
- PERIMETER FENCE (RED ON PLANS)
- XX BASE FLOOD ELEVATION LINE
- STREAM/RIVER BANK LINE
- FLOODWAY AREAS IN ZONE AE
- FLOOD ZONE AE, AREAS OF 100–YEAR FLOOD, BASE FLOOD ELEVATIONS DETERMINED
- FLOOD ZONE X, AREAS OF 500–YEAR FLOOD

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR KENT COUNTY COMMUNITY PANEL NO. 4454090003E REVISED JUNE 16, 1992.
BASE FLOOD ELEVATION LINES AND SURVEY INFORMATION BASED ON NAVD 88 DATUM.

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451–1120

DRAWING:
FLOOD ANALYSIS PLAN

PROJECT:
SOCKANOSSET SUBSTATION NO. 24
19 ELECTRONIC DRIVE
WARWICK, RHODE ISLAND

PLAN SET:
RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
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PHONE 508–697–3191 • 800–548–3355 • FAX 508–697–5996
EMAIL: Admin@conneco.com • WEB SITE: http://www.conneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 80'
PROJECT #:	6905.0
SHEET NO.	1 OF 01

0 80 160
SCALE: 1"=80'

0 200 400
SCALE: 1"=200'

LEGEND

- PERIMETER FENCE (RED ON PLANS)
- XX BASE FLOOD ELEVATION LINE
- FLOODWAY AREAS IN ZONE AE
- FLOOD ZONE AE, AREAS OF 100-YEAR FLOOD, BASE FLOOD ELEVATIONS DETERMINED
- FLOOD ZONE X500, AREAS OF 500-YEAR FLOOD

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR KENT COUNTY COMMUNITY PANEL NO. 4454090002D REVISED APRIL 16, 1991.
BASE FLOOD ELEVATION LINES AND SURVEY INFORMATION BASED ON NAVD 88 DATUM.

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

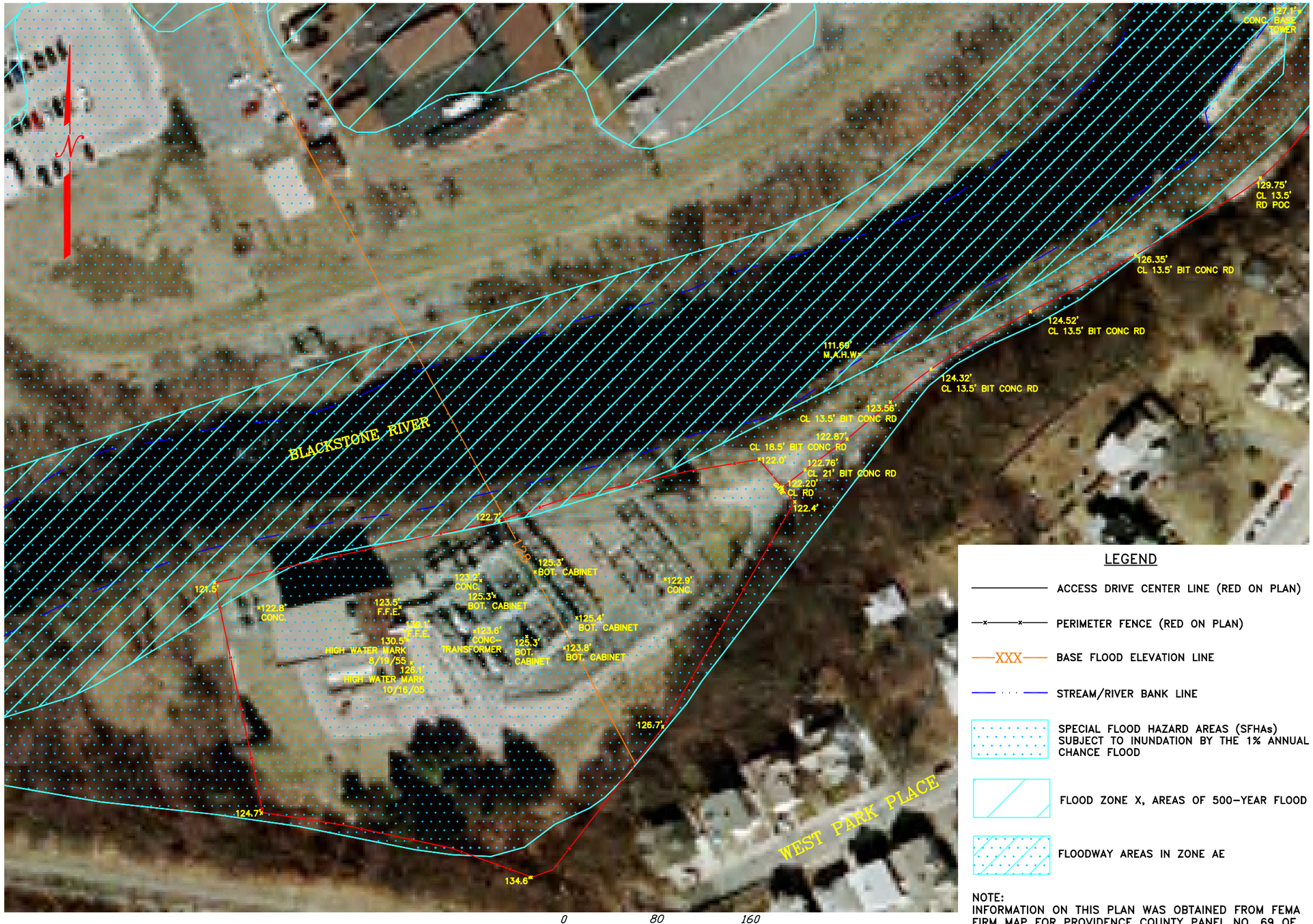
PROJECT:
WARWICK MALL SUBSTATION NO. 28
400 BALD HILL ROAD
WARWICK, RHODE ISLAND

DRAWING:
FLOOD ANALYSIS PLAN

PLAN BY:
RHODE ISLAND FLOOD STUDY

CONECO Engineers, Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE: 508-697-3191 • 800-548-3355 • FAX: 508-697-5996
EMAIL: Admin@conecco.com • WEB SITE: http://www.conecco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	AS NOTED
PROJECT #:	6906.0
SHEET NO.	1 OF 01



LEGEND

- ACCESS DRIVE CENTER LINE (RED ON PLAN)
- PERIMETER FENCE (RED ON PLAN)
- XXX BASE FLOOD ELEVATION LINE
- STREAM/RIVER BANK LINE
- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
- FLOOD ZONE X, AREAS OF 500-YEAR FLOOD
- FLOODWAY AREAS IN ZONE AE

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM FEMA FIRM MAP FOR PROVIDENCE COUNTY PANEL NO. 69 OF 451, MAP NO. 44007C0069G EFFECTIVE MARCH 2, 2009.

REVISIONS			
NO.	DATE	DESCRIPTION	DR/CK

PREPARED FOR:
NATIONAL GRID
40 SYLVAN WAY
WALTHAM, MASSACHUSETTS 02451-1120

DRAWING:
FLOOD ANALYSIS PLAN

PROJECT:
RIVERSIDE SUBSTATION NO. 8
1000 FLORENCE DRIVE EXTENSION
WOONSOCKET, RHODE ISLAND

PLAN SET:
RHODE ISLAND FLOOD STUDY

CONECO
Engineers, Scientists & Surveyors
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 • 800-248-3355 • FAX 508-697-5996
EMAIL Admin@coneco.com • WEB SITE: http://www.coneco.com

DATE:	12/07/2010
DRAWN/ CHECK:	TLD/RTL
SCALE:	1" = 80'
PROJECT #:	6907.0
SHEET NO.	1 OF 01

RI Flood Mitigation Options Being Reviewed

This report summarizes the recommendations for National Grid is in the process of developing improvement plans to eight substations following the flooding events in Rhode Island from March 30 - April 1, 2010. Below is a summary of options being considered.

- Major river flooding occurred at certain locations along the following rivers:
  - Pawtuxet River – Cranston, Warwick 11 feet above historic record
  - Pawcatuck River – Westerly – Tidal flooding – 4 feet above flood stage
  - Blackstone River – Woonsocket – Near flood stage – least impacted
- Eight Substations were flooded and either locked out or switched offline. Water levels up to eighty six inches above finished grade were recorded in the Westerly and Sockanosset Substations, with 2 - 5 feet of water in the other 6 substations.

A common recommendation for each of the locations listed below was to review the recent flood history and the predicted 100 year flood elevation. The corresponding proposed solutions that are presented provide flood protection against a flood comparable to floods that occurred in the spring of 2010 or the Federal Emergency Management Agency's published 100 year flood elevation, whichever is higher. Each solution will allow the substation to remain in-service during a flood event. Any equipment that needs to be raised will be raised at least 12 inches above the peak flood elevation. Each location was also evaluated for installation of flood protection barriers; however, none of the substations were determined to be suitable candidates.

Sockanosett Substation

Option 1 - Replace and Elevate the Sub

- Install an outdoor Metal-clad Switchgear Power Center (MCSPC) located on an elevated foundation 98 inches above grade and a steel ramp, stairway and work platform with rails.
- Raise both T1 and T2 control panels to 98 inches above grade or replace them with submersible rated control cabinets and submersible cable connectors for ancillary equipment.
- Install steel stairways and work platforms with rails for workers access to the transformer control cabinets.
- Relocate the 115 kV high side circuit switchers (CS) control box to 98 inches above grade or replace them with submersible rated control cabinets.
- Install open bus from T1 and T2 to the new MCSPC (use the existing buses for part of the run).
- Install 23kV getaway cables from the switchgear to each of the two feeders.
- Install 23kV cables from the switchgear to each of the two capacitor banks.
- Raise the existing capacitor bank control cabinets to 98 inches above grade or replace them with submersible rated control cabinets and submersible cable connectors to go to the vacuum switch.

Westerly Substation

Option 1 - Replace and Elevate the Sub

- Install an outdoor Metal-clad Switchgear Power Center (MCSPC) located on an elevated foundation 84 inches above grade and a steel ramp, stairway and work platform with rails. The MCSPC will be located where the older abandoned switch-yard structures are.
- Replace both T2 and T4 with 25/33/40 MVA, LTC transformers and relocate them to the area of the older abandoned switch-yard. Purchase these transformers with controls located 84 inches above grade or with submersible control cabinets and submersible cable connectors for ancillary equipment. Some lower mounted fans will be destroyed during a flood event. Planning has indicated a need for higher capacity transformers at this substation.
- Install steel stairways and work platforms with rails for workers access to the transformer control cabinets.

- Replace the 34.5 kV high side breakers with circuit switchers (CS) and relocate them to the area of the older abandoned switch-yard. The CS shall be specified with the control box mounted 84 inches above grade.
- Install open bus from T2 and T4 to the new MCSPC.
- Extend the two 34.5 kV lines to the new transformer location.
- Install 15kV getaway cables from the switchgear to each feeder.
- Install 15kV cables from the switchgear to each capacitor bank.
- Move the existing capacitor banks to the area of the older abandoned switch-yard.

Option 2- Replace the Sub in existing building

- Install an indoor Metal-clad Switchgear located in the abandoned brick substation building which is located at a higher elevation than the existing yard and did not flood (except for the basement)
- Replace the windows and doors in the building and re-point the bricks where needed. Scrape and paint the interior walls and ceilings where needed. Replace the heating system with a HVAC system that would be installed on the first floor. Upgrade electrical systems, doors and other components of the building to satisfy current code.
- Remove the retired 4kV relay and control panels and install new relay and control panels.
- Replace both T2 and T4 with 25/33/40 MVA, LTC transformers and relocate them to the area closer to the brick building. Purchase these transformers with controls located 84 inches above grade or with submersible rated control cabinets and submersible cable connectors for ancillary equipment. Some lower mounted fans will be destroyed during a flood event. Planning has indicated a need for higher capacity transformers at this substation.
- Replace the two 34.5 kV high side breakers with circuit switchers (CS) and relocate them to the area of the relocated transformers. The CS shall be specified with the control box mounted 84 inches above grade or with submersible rated control cabinets.
- Install 34.5 kV underground cables from T2 and T4 to the new metal-clad switchgear located in the building.
- Extend the two 34.5 kV overhead lines to the new transformer location.
- Install 15kV getaway cables from the switchgear to each feeder.
- Install 15kV cables from the switchgear to each capacitor bank.
- Move the existing capacitor banks to an area closer to the building.

Option 3 - Abandon the site and feed the load from other subs

- Remove and retire the existing substation.
- Build out proposed new Hopkinton Substation to allow additional capacity for Westerly load
- Additions to existing Langworthy Substation to allow additional capacity for Westerly load

Pawtuxet Substation

Option 1 - Abandon the site and feed the load from other subs

- This substation floods to some extent during every heavy rain event.
- Move the load at this sub to Lakewood 2.
- Remove and retire the existing substation.

Option 2 - Elevate the Substation Equipment at risk

- Install an outdoor Metal-clad Switchgear Power Center (MCSPC) located on an elevated foundation 90 inches above grade and a steel stairway and work platform with rails. Install the MCSPC in a new location nearby. (Land availability needs to be investigated)
- Install open bus from the transformer to the MCSPC.
- Replace the transformer with a 5 MVA, LTC type with the control cabinet mounted 90 inches above grade.

- Replace the wooden pole superstructure with a steel or aluminum space frame equivalent.

Pontiac Substation

Option 1 - Elevate the Substation Equipment at risk

- The station reclosers are presently installed approximately 1 inch higher than the peak flood level and do not require any modifications to be made.
- Extend the low profile substation by adding Bay D and mounting the cross buses 3 feet higher than normal for a new tie breaker between bus 1 & bus 2.
- Install a new 1200 amp tie breaker mounted higher than normal with the bottom of the cabinet 66 inches above grade. This tie breaker is required to tie the buses together for loss of one transformer.
- Replace three Bay C vacuum breakers with VSA reclosers mounted with the control cabinets 66 inches above grade or as high as possible without raising the foundations.
- Raise transformer T1's control cabinet with the bottom mounted at 66 inches above grade or replace it with a submersible rated control cabinet and submersible cable connectors for ancillary equipment.
- Install a steel stairway and work platform with rails for workers access to T1's control cabinet.
- Re-work transformer T2's control cabinet by raising the LTC motor up by 23 inches and modifying the drive shaft. Relocate the terminal blocks to the top half of the cabinet. Install another cabinet on the side of the existing and relocate the LTC controller and other sensitive equipment above flood level. The minimum height to mount the bottom of the new cabinet is 66 inches above grade.
- Install a steel stairway and work platform with rails for workers access to T2's control cabinet.
- Move the T1 and T2 sudden pressure relays up to a level of 66 inches above grade and replace each transformer's oil pumps with submersible connector type.
- Move the fan control cable junction box to a level of 66 inches above grade and replace the control cables to the fans. Some lower mounted fans will be destroyed during a flood event.
- Replace the control house with a prefabricated house with all relays and controls installed and wired. Install the new control house 66 inches above grade on elevated piers.

Warwick Mall Substation

Option 1 - Abandon the site and feed the load from other subs

- Remove and retire the existing substation.

Option 2 - Recommendation / Cost – Elevate the Substation equipment at risk

- Replace existing reclosers 28F1 and 28F2 with VSA reclosers and Form 6 controls.
- Raise the 28F2 regulator control cabinet to 63 inches above grade.
- Raise both regulator by-pass switches for worker safety clearance.
- Install (2) new galvanized steel frame raising kits to raise the regulator by-pass switches.
- Raise the transformer T1 and T2 control cabinets to 63 inches above grade or replace with submersible rated control cabinets and submersible cable connectors for ancillary equipment.
- Raise the sudden pressure relays on T1 and T2 to 63 inches above grade.
- Replace the oil pumps on T1 and T2 with submersible connector type.
- Raise the T1 and T2 grounding CTs to 63 inches above grade.
- Raise the AC distribution panels to 63 inches above grade.
- Raise the motor operators on the 2266 and 2230 air-break switches to 63 inches above grade.

Hunt River Substation

Option 1 - Elevate the Substation Equipment at risk / $400 K

- Replace existing recloser 40F1 with a VSA recloser and Form 6 controls.

- Raise the 40F1 regulator control cabinets to 42 inches above grade.
- Install a new foundation for 40F1 located on the centerline of the bay to meet electrical clearances.
- Replace the outdoor cabinet housing the RTU with larger one in order to raise other misc equipment inside to 30 inches above grade.
- Install a shelf in existing battery cabinet and move batteries to higher level 30 inches above grade.
- Raise the motor operators on the 3312 and 84T3 air-break switches to 42 inches above grade.
- Raise the transformer control cabinet on T2 to 42 inches above grade.
- Raise the transformer ground CT to 42 inches above grade.

Hope Sub

Option 1 - Elevate the Substation Equipment at risk

- Replace the control house with a prefabricated house with all relays and controls installed and wired. Install the new control house 40 inches above grade on elevated piers.

Riverside Sub

Option 1 - Elevate the Substation Equipment at risk

- Replace both T1 and T2 control panels located 96 inches above grade or with submersible rated control cabinets and submersible cable connectors for ancillary equipment. Some lower mounted fans will be destroyed during a flood event.
- Install steel stairways and work platforms with rails for workers access to the transformer control cabinets
- Raise the 5 existing 115kV OCB control cabinets with the bottoms mounted at 96 inches above grade or replace them with a submersible rated control cabinet and submersible cable connectors for ancillary equipment.
- Install steel stairways and work platforms with rails for workers access to the breaker control cabinets

SPENDING RATIONALE	BUDGET CLASSIFICATION	Sum of FY2013 - Budget	Sum of FY2014 - Budget	Sum of FY2015 - Budget	Sum of FY2016 - Budget	Sum of FY2017 - Budget
Statutory/Regulatory	3rd Party Attachments	705,000	571,000	588,000	604,000	620,000
	Land and Land Rights - Dist	297,000	304,000	312,000	320,000	328,000
	Meters - Dist	1,815,000	1,909,000	2,039,000	2,139,000	2,213,000
	New Business - Commercial	5,950,000	7,028,000	4,855,000	5,172,000	5,463,000
	New Business - Residential	3,304,000	3,439,000	3,620,000	3,797,000	3,946,000
	Outdoor Lighting - Capital	571,000	591,000	615,000	634,000	654,000
	Outdoor Lighting - Capital MV	-	-	-	-	-
	Public Requirements	3,709,000	3,616,000	3,051,000	2,371,000	2,466,000
	Transformers & Related Equipment	3,655,000	3,836,000	3,992,000	4,151,000	4,358,000
Statutory/Regulatory Total		20,006,000	21,294,000	19,072,000	19,188,000	20,048,000
Damage/Failure	Damage/Failure	9,772,000	9,936,000	10,219,000	10,507,000	10,803,000
	Major Storms - Dist	650,000	675,000	700,000	725,000	750,000
Damage/Failure Total		10,422,000	10,611,000	10,919,000	11,232,000	11,553,000
Asset Condition	__Woonsocket & Related	825,000	-	-	-	-
	Asset Replacement	8,583,000	12,849,000	9,998,000	11,279,000	10,747,000
	Asset Replacement - I&M (NE)	2,500,000	4,000,000	4,200,000	4,410,000	4,630,500
	Safety	-	-	-	362,000	1,361,000
	____Flood Damage Avoidance Engineering Studies	1,205,000	6,786,000	6,627,000	2,750,000	-
Asset Condition Total		13,113,000	23,635,000	20,825,000	18,801,000	16,738,500
Non-Infrastructure	Corporate/Admin/General	-	-	-	-	-
	General Equipment	186,000	196,000	209,000	218,000	228,000
	Telecommunications Capital - Dist	150,000	150,000	150,000	150,000	150,000
Non-Infrastructure Total		336,000	346,000	359,000	368,000	378,000
System Capacity and Perform	__Coventry & Related	975,000	-	-	-	-
	__Hopkinton & Related	800,000	3,300,000	5,450,000	1,500,000	-
	__Newport & Related	450,000	2,350,000	8,183,000	5,653,000	2,250,000
	__West Warwick & Related	325,000	2,950,000	5,005,000	2,840,000	1,725,000
	Load Relief	5,576,000	7,746,000	2,497,000	12,692,000	14,544,500
	Reliability	4,497,000	2,768,000	2,690,000	2,726,000	2,763,000
	Reliability - FEEDER HARDENING	1,500,000	-	-	-	-
System Capacity and Performance Total		14,123,000	19,114,000	23,825,000	25,411,000	21,282,500
Grand Total		**58,000,000**	**75,000,000**	**75,000,000**	**75,000,000**	**70,000,000**

PROJ	RISK SCORE	Proj Desc	PROJ TYPE	BC2	FY2013 - Budget	FY2014 - Budget	FY2015 - Budget	FY2016 - Budget	FY2017 - Budget
C36229	45	04413 Hopkinton Substation (D-Line)	LINE & OTHER	Flood Damage Avoidance Engineering Studies	0	0	0	0	0
C36214	45	04435 Hopkinton Substation (D-Sub)	SUB	Flood Damage Avoidance Engineering Studies	0	0	0	0	0
C36230	45	04451 Langworthy Substation (D-Sub)	SUB	Flood Damage Avoidance Engineering Studies	0	0	0	0	0
PPM 17346	36	Hunt River Substation - removal costs	SUB	Flood Damage Avoidance Engineering Studies	10,000	10,000	0	0	0
PPM 9802	49	Sockanosset	SUB	Flood Damage Avoidance Engineering Studies	200,000	1,500,000	1,500,000	0	0
PPM 17337	36	Pontiac	SUB	Flood Damage Avoidance Engineering Studies	200,000	1,200,000	500,000	0	0
PPM 17339	36	Pawtuxet Sub	SUB	Flood Damage Avoidance Engineering Studies	10,000	10,000	0	0	0
PPM 17348	35	Warwick Mall	SUB	Flood Damage Avoidance Engineering Studies	0	250,000	1,000,000	2,000,000	0
C36232	45	04417 Langworthy Substation (D-Line)	LINE & OTHER	Flood Damage Avoidance Engineering Studies	0	0	0	0	0
C36234	45	04412 Hope Valley (D_Line)	LINE & OTHER	Flood Damage Avoidance Engineering Studies	0	0	0	0	0
C36527	49	04460 Westerly Substation Retire	SUB	Flood Damage Avoidance Engineering Studies	0	5,000	0	0	0
PPM 17349	36	Riverside Substation - removal costs	SUB	Flood Damage Avoidance Engineering Studies	10,000	10,000	0	0	0
PPM 11969	36	11969 Langworthy Substation (D Sub)	SUB	Flood Damage Avoidance Engineering Studies	250,000	1,150,000	520,000	0	0
PPM 11970	34	11970 Langworthy Substation (D Line)	LINE & OTHER	Flood Damage Avoidance Engineering Studies	25,000	150,000	0	0	0
PPM 11971	34	11971 Hope Valley (D Sub)	SUB	Flood Damage Avoidance Engineering Studies	0	1,000	1,000	0	0
PPM 11972	34	11972 Hope Valley (D Line)	LINE & OTHER	Flood Damage Avoidance Engineering Studies	0	0	5,000	0	0
PPM 11973	34	11973 Hopkinton Phase 2 (D Sub)	SUB	Flood Damage Avoidance Engineering Studies	450,000	1,250,000	2,300,000	750,000	0
PPM 11974	34	11974 Hopkinton Phase 2 (D Line)	LINE & OTHER	Flood Damage Avoidance Engineering Studies	50,000	1,250,000	800,000	0	0
PPM 11975	34	11975 Retire Westerly Station (D Sub)	SUB	Flood Damage Avoidance Engineering Studies	0	0	1,000	0	0
					1,205,000	**6,786,000**	**6,627,000**	**2,750,000**	**0**

Division 2-10 (Electric)
Asset Condition

Request:

For each station affected by flood waters, please identify whether the station suffered damage to station equipment or did the flood only rendered the station inaccessible?

Response:

Station	Equipment Damage	Accessibility
Pontiac	Yes - (See Asset Condition Report – Rhode Island Flood)	Yes Driveway damage had to be repaired before necessary equipment repair could begin
Sockanosset	Yes - (See Asset Condition Report – Rhode Island Flood)	Yes, Sockonosett Substation was not accessible until Friday morning April 2, 2010 due to flood waters and although flood waters had receded within the Substation, the access and driveway were still submerged by approximately 2 feet of water. On Friday, crews gained access via a "Trac" vehicle. Attempts to access the substation by boat were made on Thursday, April 1, 2010 but current from the Pawtuxet River prevented safe access.
Westerly	Yes - (See Asset Condition Report – Rhode Island Flood)	Yes, Accessibility to the substation was not possible until Friday, April 2, 2010
Hope Sub	Yes - (See Asset Condition Report – Rhode Island Flood)	No
Pawtuxet	Yes - (See Asset Condition Report – Rhode Island Flood)	Yes, unable to access station until Saturday April 3rd
Warwick Mall	Yes - (See Asset Condition Report – Rhode Island Flood)	Yes, unable to access station until Friday April 2nd
Hunt River	Yes - (See Asset Condition Report – Rhode Island Flood)	Yes, unable to access station until Thursday April 1st[t].
Riverside	Yes - (See Asset Condition Report – Rhode Island Flood)	No, Some erosion to driveway but station accessible

Prepared by or under the supervision of: Jennifer L. Grimsley