SCARBOROUGH WWTF FLOOD PROOFING PROJECT

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- REAL OR IMAGINED?? WHAT DO YOU THINK??
 - "ENVIRONMENT AMERICA" REPORTS THAT NEW ENGLAND IS SEEING EXTREME PRECIPITATION EVENTS INCREASE IN FREQUENCY.
 - UNH REPORTED FOUR 100-YEAR FLOODS IN A 5 YEAR PERIOD.
 - CRMC REPORTS THAT THE TIDES IN NEWPORT, RI HAVE SHOWN AN INCREASE IN THE ACTUAL YEAR-TO-YEAR READINGS OF ROUGHLY 10.5 INCHES BETWEEN 1930 AND 2013.
 - AT THE LOCAL LEVEL, WE HAVE SEEN WATER IN AREAS WHERE WE NEVER SAW WATER BEFORE.
 SOMETIMES INTUITIVE KNOWLEDGE AND "LOCAL EXPERIENCE" IS WORTH MORE THAN THE SCIENCE (PURE OR FUZZY)...
 - SO, WHETHER YOU BELIEVE THE SCIENCE OR NOT, IT CERTAINLY APPEARS THAT CHANGE IS HAPPENING!



- ACCEPTING SOME FORM OF CLIMATE CHANGE AS THE "NEW NORM", WHAT DO YOU DO?
 - UTILITIES IN COASTAL COMMUNITIES ARE KEY COMPONENTS OF OUR QUALITY OF LIFE.
 - SEWER SYSTEMS, BY THEIR VERY NATURE END UP IN LOW LYING AREAS, AND TREATMENT PLANTS
 ARE OFTEN LOCATED DOWNHILL OF EVERYTHING ELSE AND NEED TO BE CLOSE TO A DISCHARGE
 POINT (OCEAN, BAY, RIVER GREAT FOR DISCHARGE PURPOSES BUT ADDS TO SITE VULNERABILITY).
 - WHAT ARE YOUR OPTIONS??
 - RELOCATE YOUR FACILITY NOT PRACTICAL IN MOST CASES.
 - HARDEN YOUR FACILITY NUMEROUS OPTIONS AVAILABLE.







- HURRICANE SANDY 2012, AND THE SCARBOROUGH WWTF
 - PRIOR TO SANDY, WE HAD NEVER OBSERVED FLOODING FROM THE ATLANTIC OCEAN ACTUALLY
 ON OUR PROPERTY. DESPITE RECEIVING A GLANCING BLOW ONLY, OCEAN WAVES FROM SANDY
 BREACHED OUR PROPERTY.
 - OUR ORIGINAL PLANT DESIGN IN THE LATE 1960'S INCLUDED AN AT-GRADE INFLUENT PUMP STATION WITH OPEN GRATING – DID NOT ANTICIPATE AN OCEAN IMPACT OF ANY KIND...
 - CRITICAL PORTIONS OF OUR SITE WERE IN A FEMA VELOCITY (V) ZONE. THIS IMPACTED OUR ABILITY
 TO CONSTRUCT CERTAIN PLANT IMPROVEMENTS, AS NEW CONSTRUCTION IN A "V" ZONE IS VERY
 DIFFICULT TO GET PERMITTED.

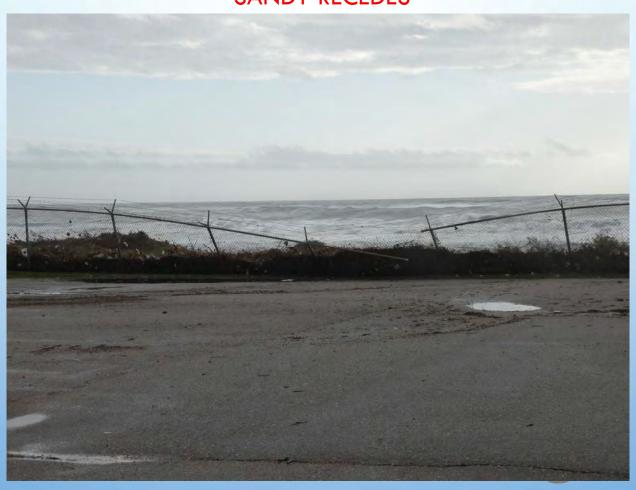


- FLOODED THE AT-GRADE HEADWORKS
- FLOODED BELOW-GRADE MOTORS AND INFLUENT PUMPS.
- INTRODUCED SALT WATER TO THE TREATMENT PROCESS NOT GOOD
- SOIL EROSION OF OCEANSIDE GRASS BUFFER
- DAMAGED FENCING

SCARBOROUGH WWTF FLOOD PROOFING PROJECT SANDY APPROACHES



SCARBOROUGH WWTF FLOOD PROOFING PROJECT SANDY RECEDES





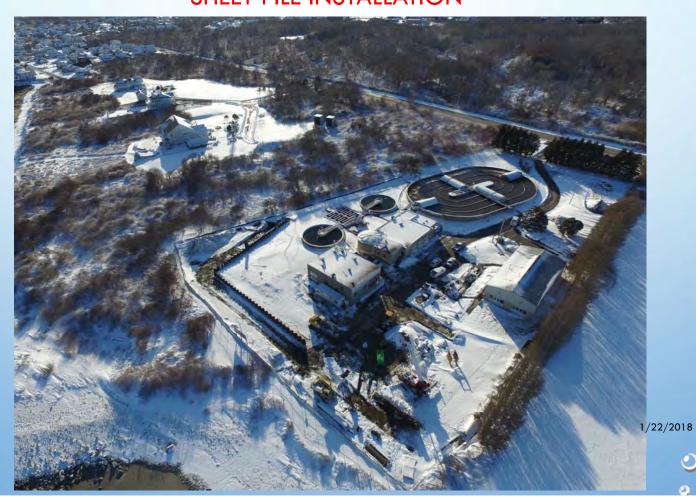
KEY DESIGN ELEMENTS INCLUDED THE FOLLOWING:

- WE RETAINED A MARINE ENGINEERING FIRM, RT GROUP (NORTH KINGSTOWN) TO PREPARE A MATRIX OF FLOOD PROOFING AND HARDENING OPTIONS FOR US.
- SURVIVABILITY CAN THE HARDENING SURVIVE A MAJOR STORM?
- IS IT BETTER (I.E. EASIER AND LESS EXPENSIVE) TO CONSTRUCT INDIVIDUAL BUILDING HARDENING SYSTEMS (FLOOD DOORS, ELEVATED HATCHES) V. FLOOD PROOFING THE ENTIRE FACILITY?
- IN OUR CASE, AS OUR EXPANSION OPTIONS ARE LIMITED IN A FEMA "V" ZONE, CAN A SYSTEM BE DESIGNED THAT WOULD ULTIMATELY <u>REMOVE THIS DESIGNATION</u> FOR OUR SITE? THIS FACTOR LIMITED CERTAIN DESIGN OPTIONS, AND ADDED TO THE PROJECT COST.
 - EFFECTIVENESS OF THE SOLUTION.
 - EASE OF PERMITTING.



- THE FINAL OPTION THAT WE SELECTED INCLUDED A STEEL SHEET PILE WALL (DRIVEN PILES) WITH WATERSIDE STONE RIPRAP TO PROTECT THE PILING AND A LANDWARD SIDE EARTHEN BERM FOR STABILIZATION. A PORTION OF THE BARRIER WAS POURED IN PLACE CONCRETE (IN THE AREA OF UNDERGROUND PIPING).
- THE HORSESHOE-SHAPED BARRIER WAS DESIGNED TO EXTEND BACK TO MEET THE 100 YEAR FLOOD ELEVATION CONTOURS.
- WORKING CLOSELY WITH CRMC, WE INCORPORATED A SEA LEVEL RISE COMPONENT INTO THE DESIGN
 - WHILE THERE WAS NO FIXED REGULATORY GUIDANCE ON THIS AT THE TIME OF OUR
 DESIGN\PERMITTING, THE FIGURE OF 1.5 2 FEET IN 50 YEARS WAS RECOMMENDED BY CRMC. THIS DID
 ADD TO THE PROJECT COST...

SCARBOROUGH WWTF FLOOD PROOFING PROJECT SHEET PILE INSTALLATION



SCARBOROUGH WWTF FLOOD PROOFING PROJECT PREP WORK FOR POURED IN PLACE SECTION;

BERM WORK





- THE PLANT PROPERTY SLOPES DOWN FROM OCEAN ROAD TO THE OCEAN (MAKES SENSE, RIGHT??).
- THE BARRIER WOULD THEN TRAP STORM WATER FROM RAIN STORMS ON THE PLANT SITE (I.E.
 BEHIND THE BERM). RT GROUP DESIGNED A STORM WATER SYSTEM TO CATCH AND TREAT
 (SAND FILTER RIDEM REQUIREMENT) THE STORM WATER BEFORE IT DISCHARGES TO THE
 OCEAN.
- ONE-WAY VALVES ALLOW THE STORM WATER TO FLOW OUT AND KEEP THE OCEAN FROM ENTERING.

SCARBOROUGH WWTF FLOOD PROOFING PROJECT PREP WORK FOR STORM WATER FILTRATION SYSTEM



SCARBOROUGH WWTF FLOOD PROOFING PROJECT STORM WATER VAULT – TIGHTNESS TESTING



SCARBOROUGH WWTF FLOOD PROOFING PROJECT REGULATORY PROCESS

- THE FOLLOWING AGENCIES ALL HAD A PART IN THIS PROJECT:
 - RIDEM STORM WATER DISCHARGE APPROVAL AND VERIFICATION THAT TREATMENT PLANT PROCESSES
 WOULD NOT BE IMPACTED
 - CRMC WORK WITHIN A FLOOD ZONE; SPECIAL EXCEPTION REQUIRED FOR WORK IN A COASTAL ZONE
 EVALUATION OF ALTERNATIVES REQUIRED.
 - US ARMY CORPS WORK WITHIN A FLOOD ZONE (COORDINATED REVIEW WITH CRMC).
 - FEMA WORK WITHIN A FLOOD ZONE, CLOMR AND LOMR APPLICATIONS.
 - CDBG SANDY DISASTER RECOVERY (DR) FUNDING EXTENSIVE RECORDKEEPING REQUIRED THROUGHOUT THE PROJECT.
 - ALLOW LOTS OF TIME FOR DESIGN AND PERMITTING WE BEGAN OUR PROCESS SHORTLY AFTER HURRICANE SANDY, AND DID NOT START CONSTRUCTION UNTIL 2016-17.
 - HAVING A GREAT RELATIONSHIP WITH ALL OF THE REGULATORY AGENCIES HELPS!!!



- DURING THE PRELIMINARY DESIGN PHASE, WE APPLIED FOR A HAZARD MITIGATION GRANT THROUGH THE DHS HURRICANE SANDY DISASTER RECOVERY (DR) PROGRAM. IN ORDER TO BE ELIGIBLE FOR THIS PROJECT, THE FOLLOWING REQUIREMENTS HAD TO BE MET:
 - YOUR COMMUNITY HAS TO HAVE AN <u>APPROVED HAZARD MITIGATION PLAN</u>, AND THE PROJECT HAS TO BE INCLUDED THEREIN.
 - THE PROJECT MUST BE <u>"ACTIONABLE</u>", MEANING THAT YOU CAN REALLY BUILD IT AND THAT IT WILL FUNCTION AS DESIGNED, AND IT MUST BE A REALISTIC AND REASONABLE SOLUTION.
 - PROJECTS MUST BE <u>READY TO PROCEED</u>, AND MUST BE COMPLETED WITHIN AN AGREED-UPON SCHEDULE (TIED TO THE DR PROGRAM REQUIREMENTS).



- THE PROJECT WAS COMPLETED IN A SINGLE CONSTRUCTION SEASON (2017) AT A COST OF APPROXIMATELY \$1.8 MILLION. THIS INCLUDED ENGINEERING COSTS NECESSARY TO SUBMIT THE CLOMR AND LOMR TO FEMA TO REMOVE THE SITE FROM A FLOOD ZONE, AND THE INVESTIGATION OF ALL ALTERNATIVES (INCLUDING RELOCATING THE PLANT
 - CRMC REQUIRED THIS AS PART OF THEIR EVALUATION TO ALLOW FOR A SPECIAL EXCEPTION FOR CONSTRUCTION WORK IN A FLOOD ZONE).
- WE APPLIED FOR AND RECEIVED A GRANT THRU CDBG (SANDY DR FUNDS) IN THE AMOUNT OF \$1
 MILLION. THE BALANCE CAME FROM THE WASTEWATER ENTERPRISE FUND WE SET UP A LINE ITEM
 TO APPROPRIATE FUNDING OVER THE SEVERAL YEAR DESIGN AND PERMITTING PERIOD.

SCARBOROUGH WWTF FLOOD PROOFING PROJECT



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SCARBOROUGH WWTF FLOOD PROOFING PROJECT COMPLETE

