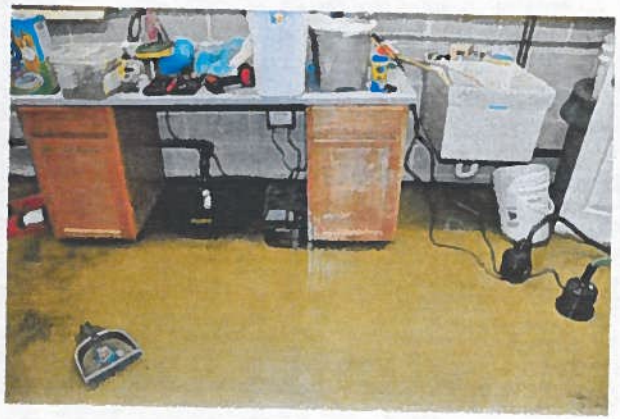
TYPES OF FLOODING

- STREETS
- REAR YARDS
- BASEMENTS
  - STORM WATER
  - SANITARY BACK-UP



STORM SEWER DESIGN

- PRIMARY STREETS
  10 YEAR STORM
- SECONDARY STREETS
  5 YEAR STORM
- RETENTION BASIN
  10 YEAR STORM
- COUNTY CULVERTS
  25 YEAR STORM

STREET FLOODING

- OCCURS WHEN THE RAIN EVENT EXCEEDS THE CAPACITY OF THE STORM MAIN

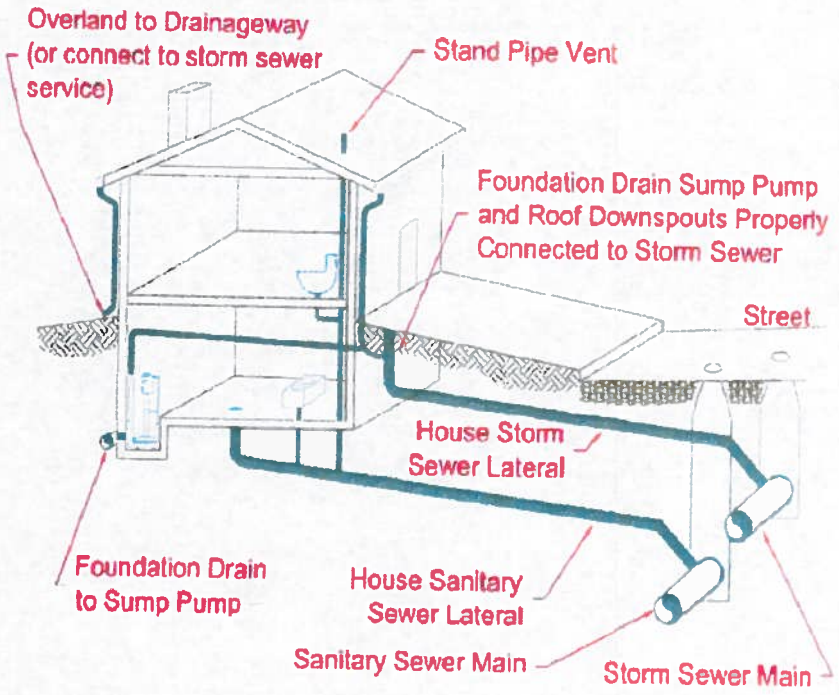
- CURB INLETS ARE FULL OF DEBRIS
  - Leaves
  - Grass
  - Branches
  - Ice

REAR YARD DRAINAGE

- WESTLAKE IS FLAT
- REAR YARD SWALES ARE BLOCKED BY LANDSCAPING
- MANY LOTS ARE SHAPED LIKE A BOWL
- YARD DRAINS REQUIRE MAINTENANCE
- MANY LOTS WERE BUILT WITHOUT DRAINAGE

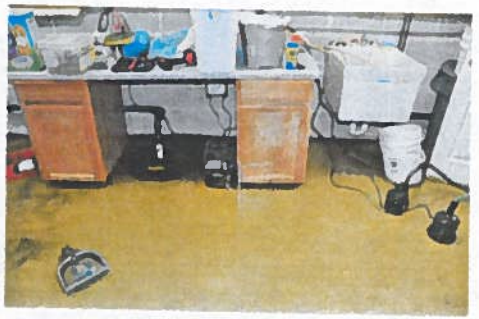
HOUSE PLUMBING

- STORM SEWER
  - DOWNSPOUTS
  - FOUNDATION DRAIN
  - SUMP PUMP
  - YARD/DRIVEWAY DRAINS
- SANITARY SEWER
  - SHOWERS
  - SINKS
  - TOILETS
  - WASHING MACHINE
- FLOOR DRAINS
  - STORM OR SANITARY

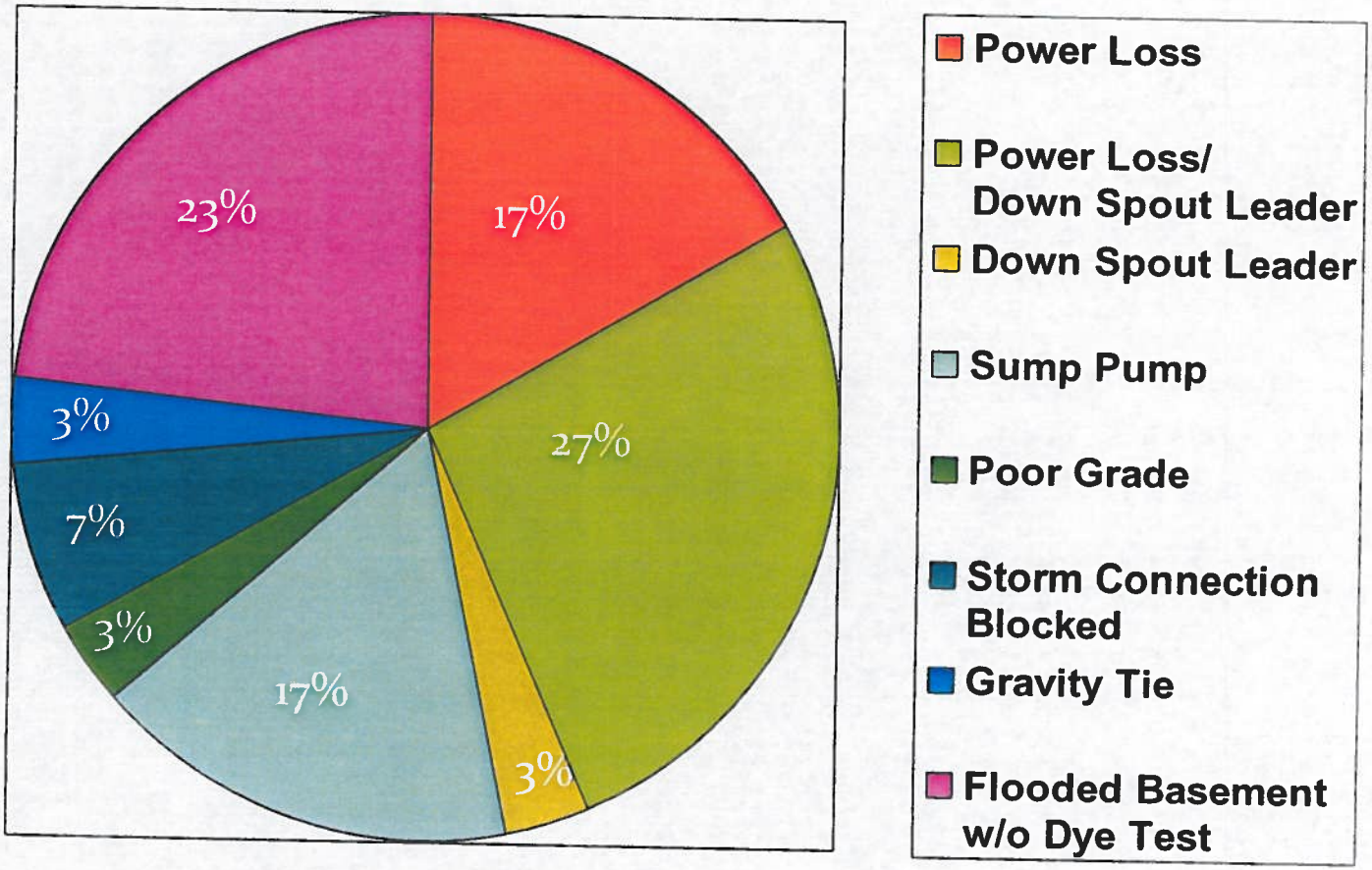


BASEMENT FLOODING

- STORM WATER INFILTRATION
  - COMPROMISED FOUNDATION DRAIN
  - SUMP PUMP FAILURE
  - GRAVITY TIE
  - COMPROMISED DOWNSPOUT LEADER
  - POOR GRADE AT FOUNDATION
  - COMPROMISED STORM CONNECTION
- SANITARY BACK-UP



2005 ESTATES BASEMENT FLOOD STUDY



COMPROMISED PLUMBING

- IF THE DOWNSPOUT LEADER IS COMPROMISED WATER IS NOT DRAINED AWAY FROM THE HOUSE AND CONTRIBUTES TO BASEMENT FLOODING

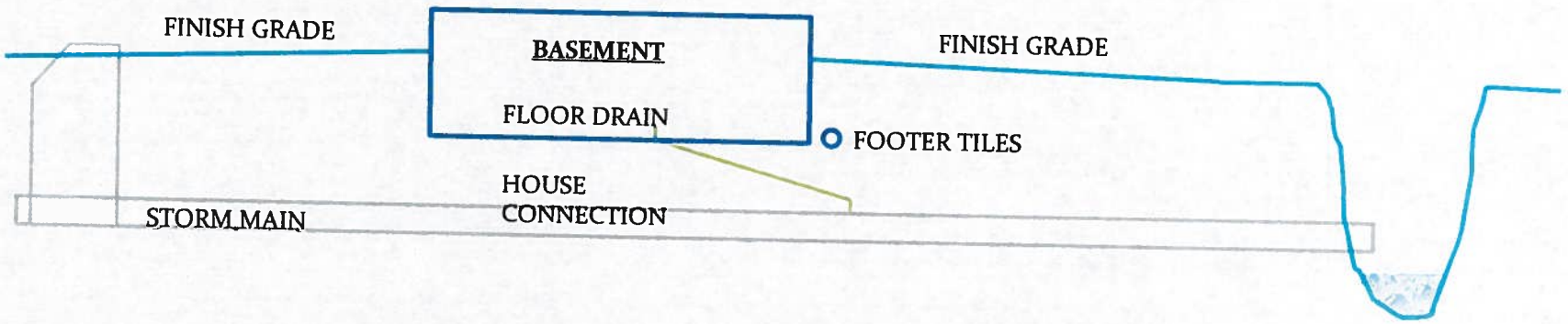
GRAVITY TIE

- STORM MAIN IS IN SURCHARGE CONDITION DURING MAJOR RAIN EVENTS
- WATER MIGRATES UP THE STORM CONNECTION
- WATER FLOODS THE BASEMENT
  - FOUNDATION DRAIN
  - FLOOR DRAIN (IF CONNECTED TO STORM)

FLOODING WITH GRAVITY TIE

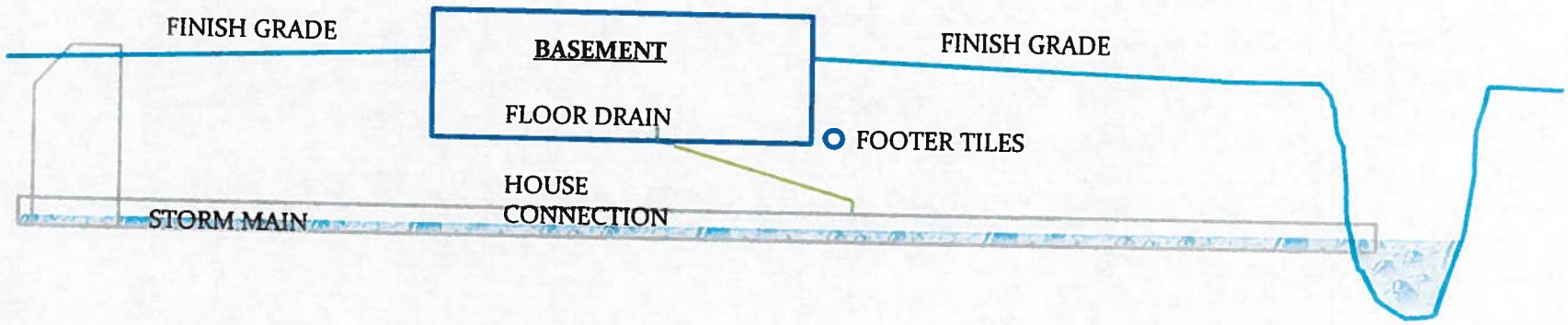
- BRETTON WOODS
- HOLLYWOOD / DUNFORD
- CANTERBURY ROAD
- HILLIARD BLVD.
- WESTHILL / ALLEN
- MELROSE / MAYBELLE
- HORSESHOE
- LOWER DOVER

GRAVITY TIE-BASEMENT FLOODING



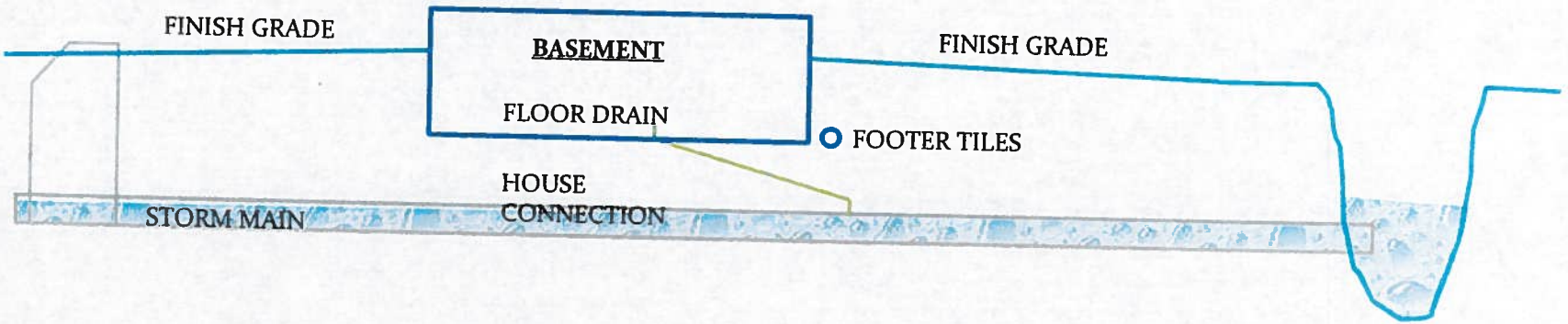
RAIN EVENT CAUSES INCREASE FLOWS IN DITCH

GRAVITY TIE-BASEMENT FLOODING



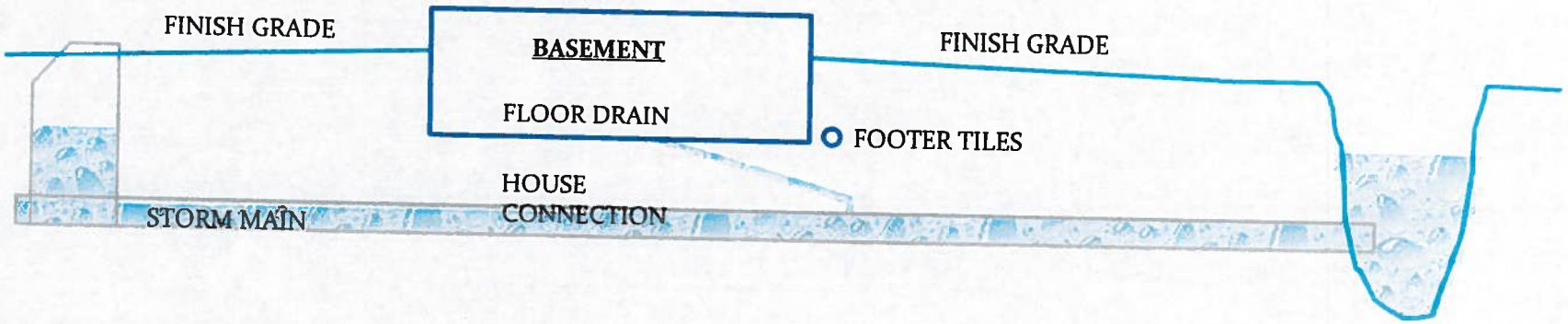
AS RAIN EVENT PROGRESSES DITCH FLOW INCREASES AND STORM MAIN FLOW INCREASES

GRAVITY TIE-BASEMENT FLOODING



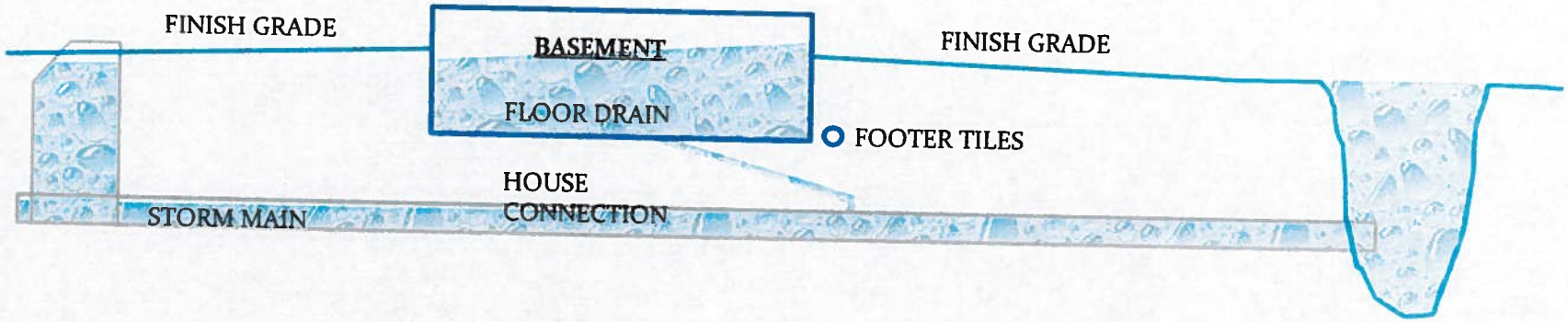
DITCH WATER ELEVATION INCREASES AND STORM MAIN BECOMES SURCHARGED

GRAVITY TIE-BASEMENT FLOODING



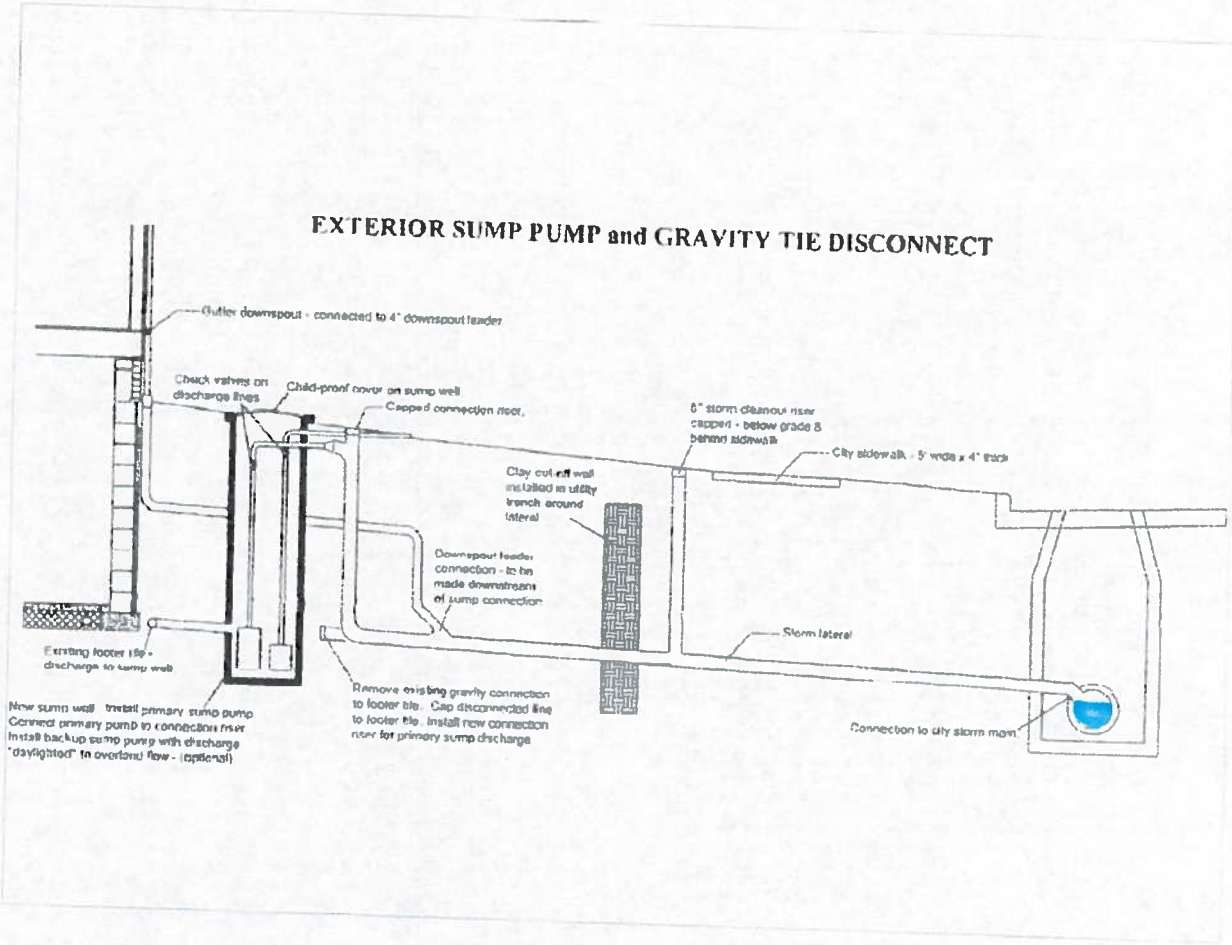
AS STORM MAIN SURCHARGES WATER MIGRATES UP THE STORM CONNECTION

GRAVITY TIE-BASEMENT FLOODING

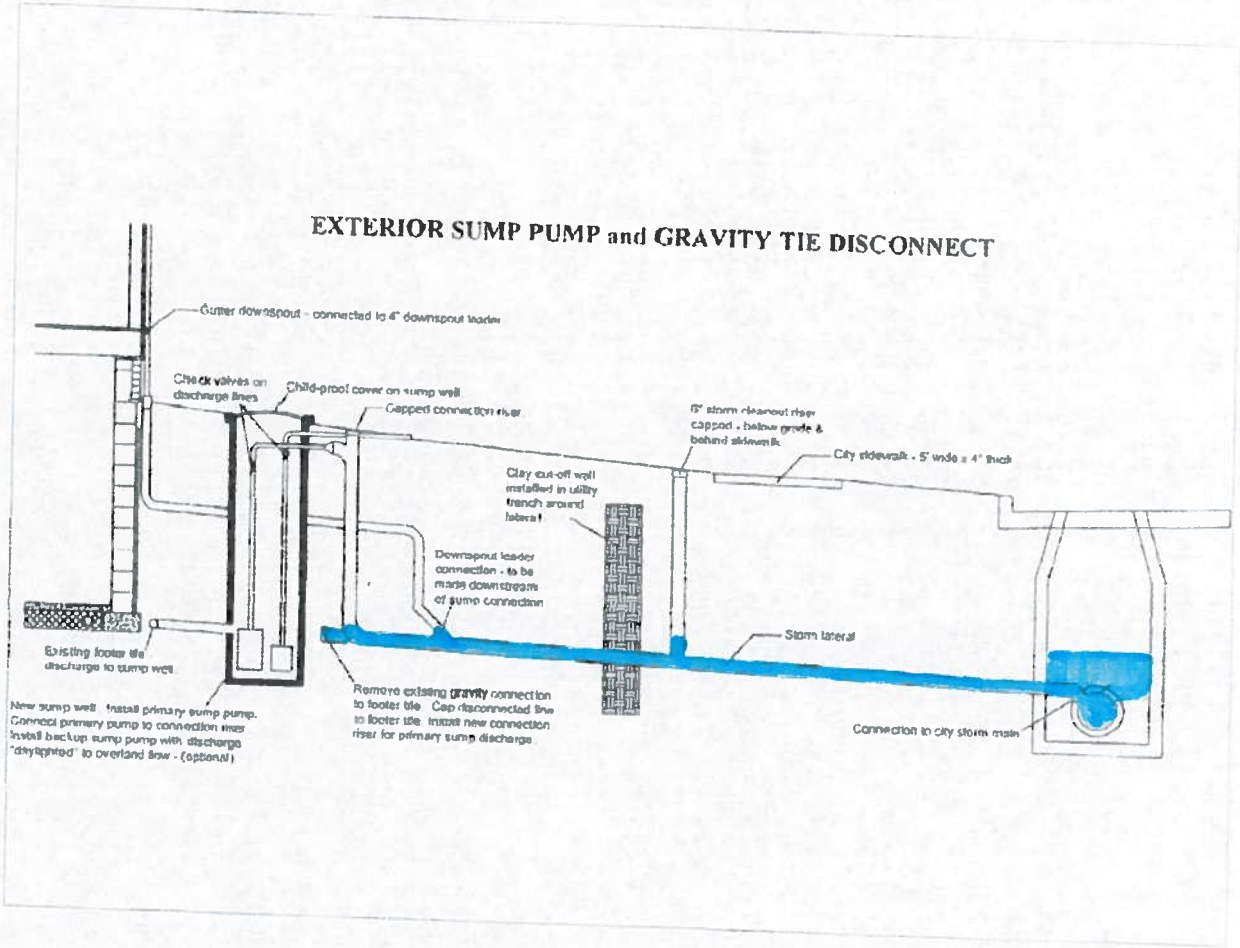


AS DITCH APPROACHES FLOOD STAGE WATER FLOODS THE BASEMENT THRU THE FLOOR DRAIN AND/OR FOUNDATION DRAIN. WATER SEEKS THE FLOOD STAGE ELEVATION

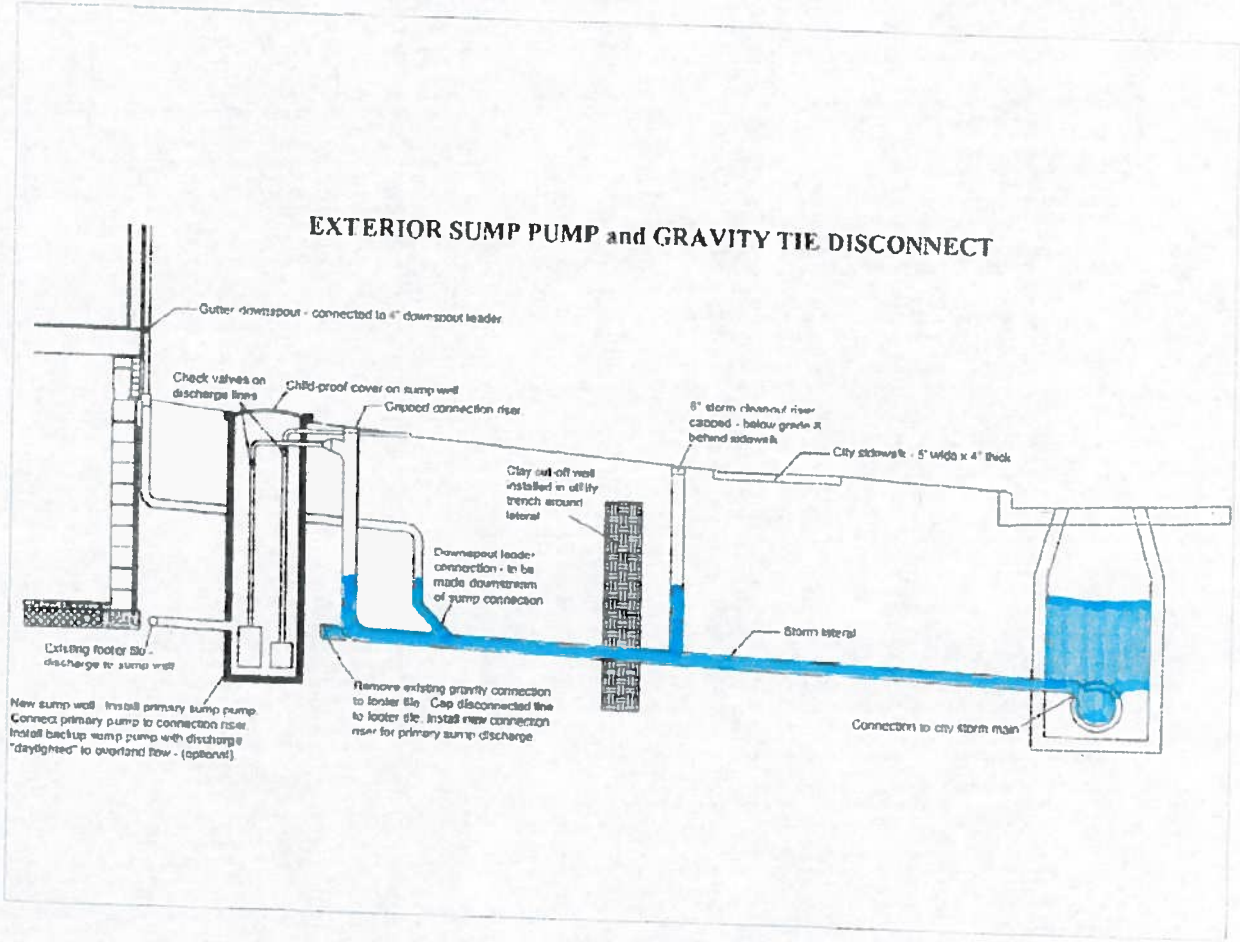
EXTERIOR SUMP PUMP-GRAVITY TIE DISCONNECT



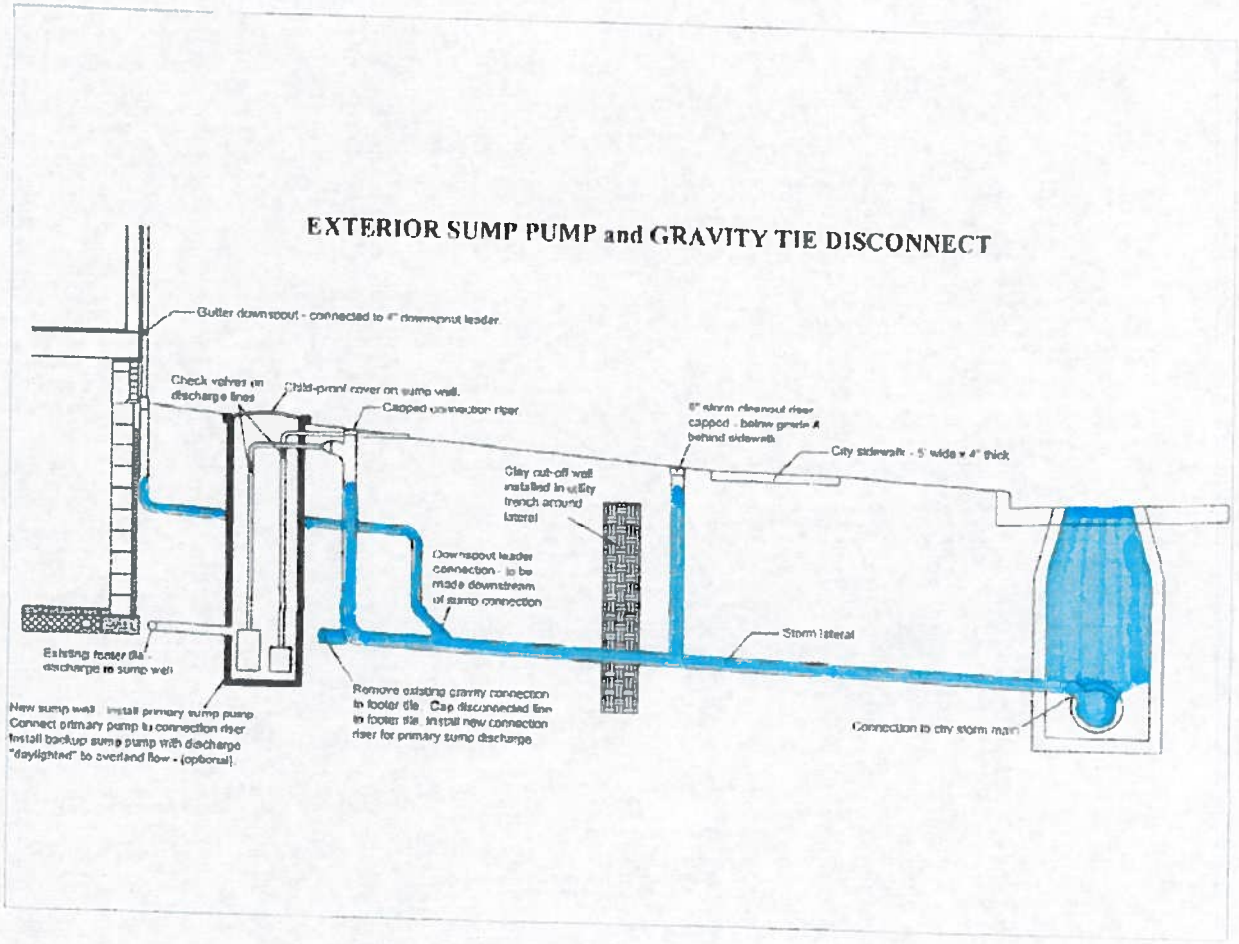
EXTERIOR SUMP PUMP-GRAVITY TIE DISCONNECT



EXTERIOR SUMP PUMP-GRAVITY TIE DISCONNECT



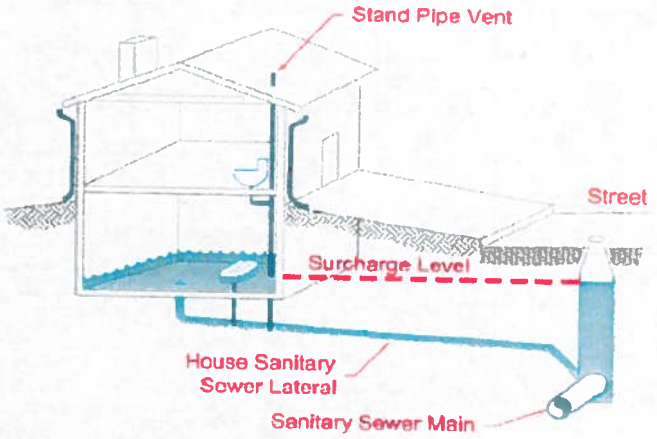
EXTERIOR SUMP PUMP-GRAVITY TIE DISCONNECT



SANITARY SEWER BACK-UP

- RESULTS FROM THE SANITARY SEWER BEING SURCHARGED.

- WATER FROM THE SANITARY SEWER BACKS UP THRU THE CONNECTION AND FLOODS THE BASEMENT:
  - FLOOR DRAINS
  - BASEMENT TOILET
  - BASEMENT SHOWER

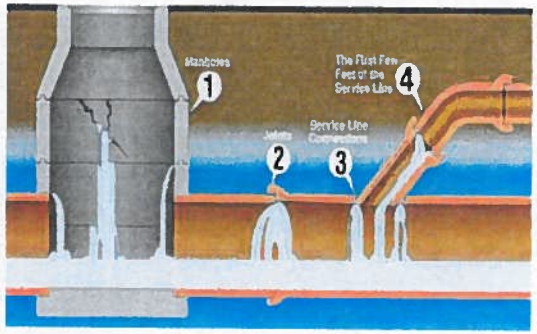


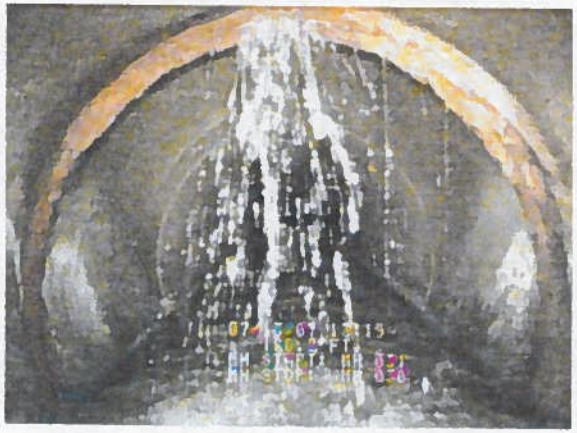
FLOODING WITH SANITARY SEWER BACK-UP

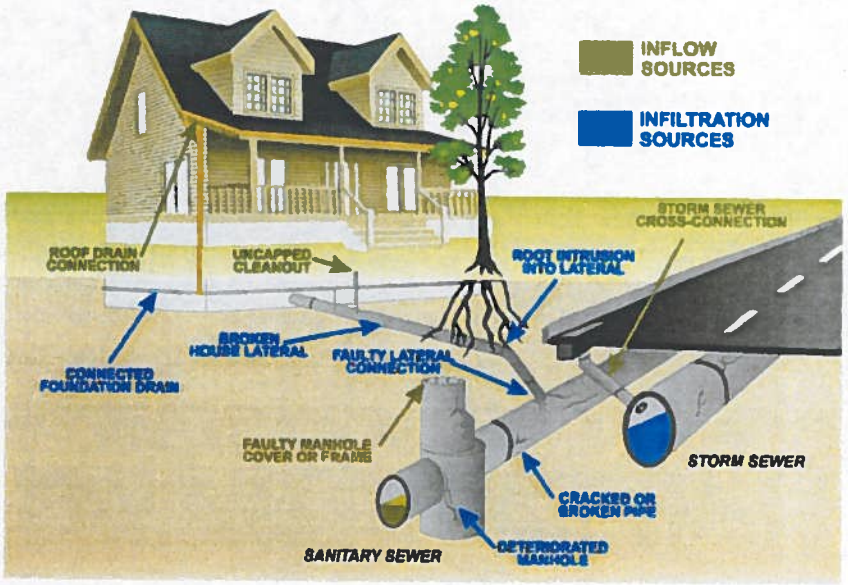
- LOWER DOVER DOVER CENTER
- CEDARWOOD
- BERKELEY ESTATES (ELMWOOD, CHESTNUT …)
- CANTERBURY ESTATES (SALEM PKWY & RADCLIFF)
- HILLIARD BLVD
  - CANTERBURY / COLUMBIA

SANITARY INFILTRATION & INFLOW

- SOURCES OF STORM WATER IN SANITARY MAIN
  - CROSS-CONNECTIONS
  - INFILTRATION
  - INFLOW
  - MANHOLE VENTS



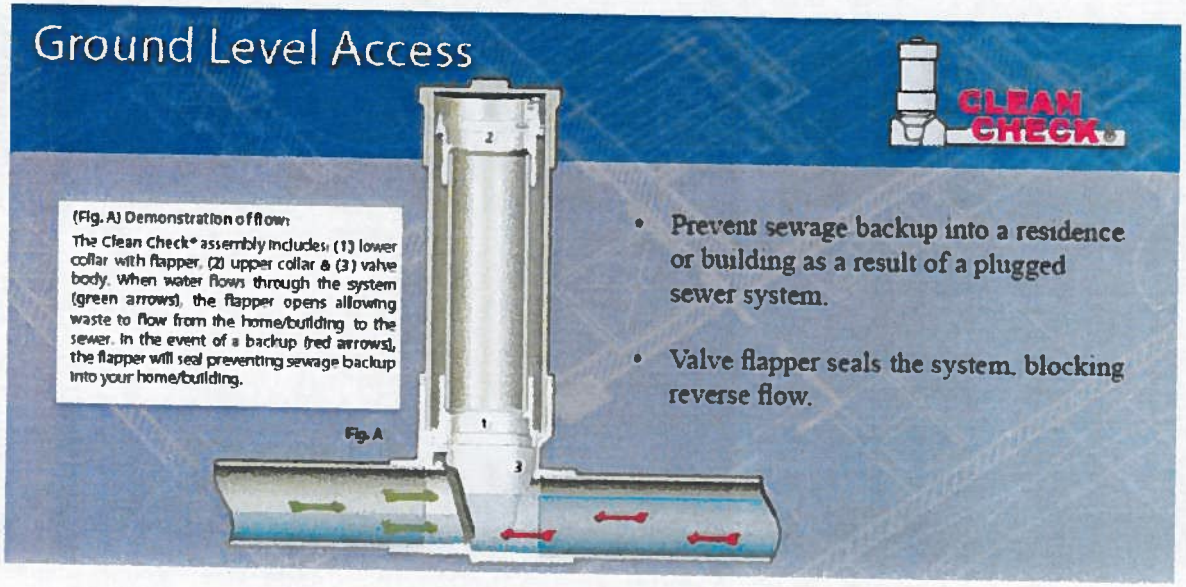




BACKWATER VALVE

- BENEFITS
  - FLAPPER ACCESSED THRU RISER, MH NOT REQUIRED
  - PIPES UNDER THE HOUSE NOT SUBJECTED TO PRESSURE

- BRANDS
  - CLEAN CHECK (75 PSI MODEL AVAILABLE)
  - CANPLAS (CURRENT MODEL IS RATED AT 60 PSI)

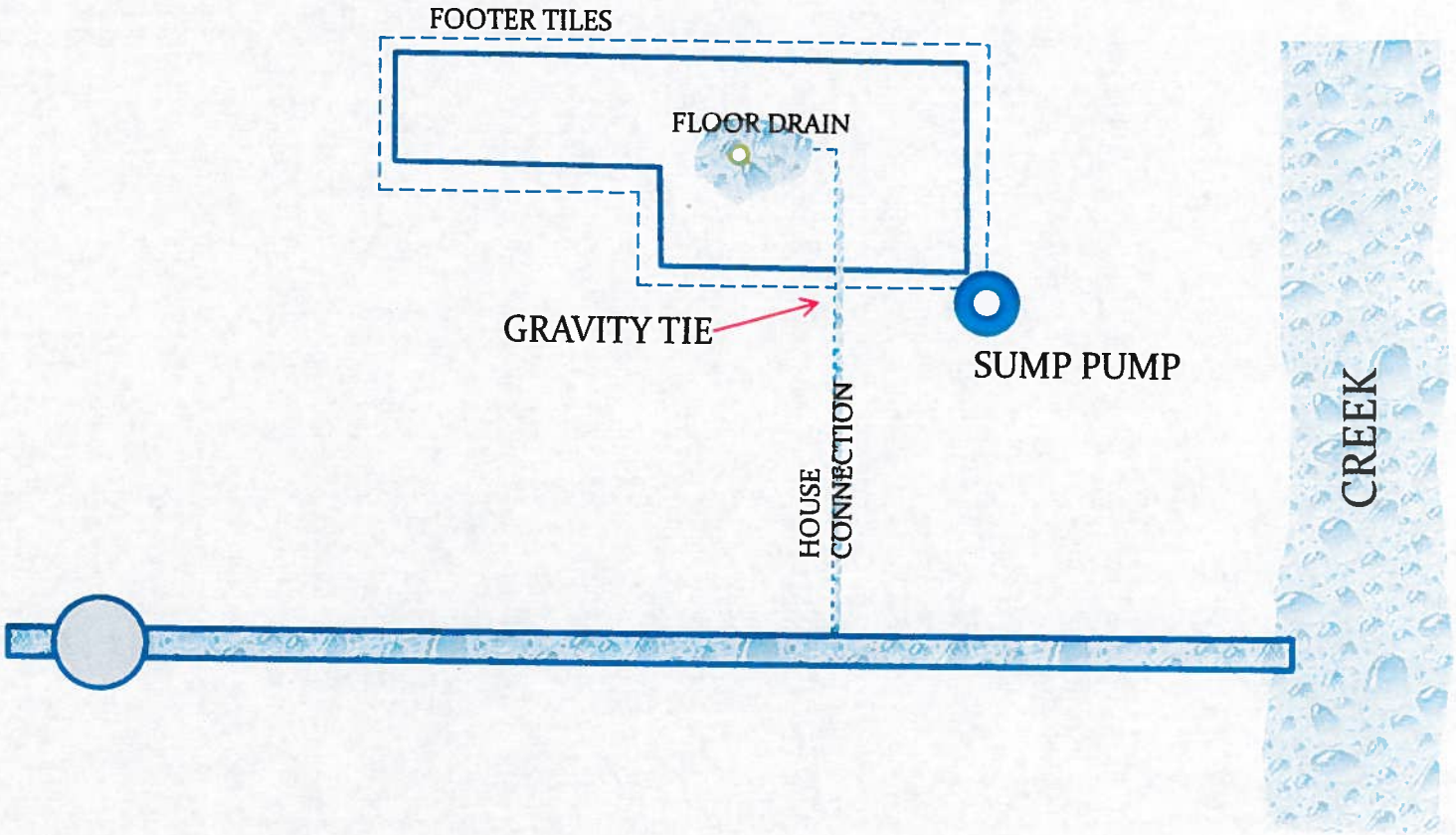


IMPROPER WATER MITIGATION FOR STORM WATER SURCHARGE

- STAND PIPE (USE FOR SANITARY ONLY)
  - FLOOR DRAIN IS PROTECTED
  - BASEMENT WILL FLOOD FROM FOUNDATION DRAIN (STORM)
- SUMP PUMP WITHOUT GRAVITY TIE DISCONNECT
  - BASEMENT WILL STILL FLOOD SINCE THE GRAVITY TIE IS NOT DISCONNECTED

SUMP PUMP WITH GRAVITY TIE

- BASEMENT WILL STILL FLOOD FROM THE FLOOR DRAIN



DYE TESTING PROGRAM

- **FREE** TO ALL RESIDENTS
- SERVICE DEPARTMENT LOCATES - CLEANOUTS
- TEST PERFORMED BY THE DEPARTMENT OF ENGINEERING
- SIMULATE A RAIN EVENT BY PLACING DYE AT VARIOUS DOWNSPOUTS
- CCTV INSPECTION OF STORM CONNECTION AND OTHER PLUMBING IF REQUIRED
- RECOMMENDATIONS GIVEN

BASEMENT FLOODING

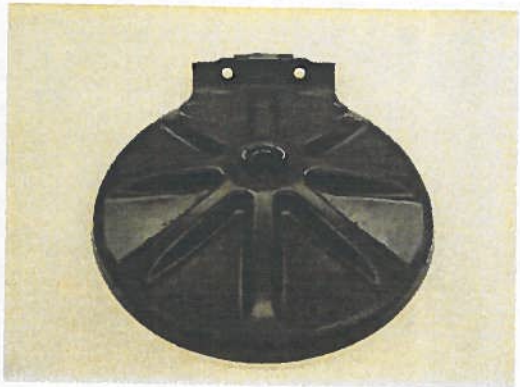
- ENGINEERING
  - HYDRAULIC MODELING OF THE INTERCEPTOR AND MAJOR SANITARY TRUNK LINES (URS)
  - IDENTIFY TRENDS FROM THE DYE TESTING RESULTS
  - CONSULT WITH PROFESSIONALS IN THE REDUCTION OF I/I
  - TEST BACKWATER VALVES AND CONSULT WITH THE MANUFACTURE'S
  - EXPLORE FURTHER I/I REDUCTION TECHNIQUES
    - MANHOLE INFLOW DISHES

- MAINTENANCE
  - BRUSH AND DEBRIS ALONG DOVER DITCH WAS REMOVED
  - VARIOUS STORM MAINS AND CATCH BASINS WERE CLEANED

- RESEARCH (FIELD CREWS DURING MAJOR RAIN EVENT)
  - SANITARY MANHOLES ARE MONITORED AND THE FLOW LEVELS ARE RECORDED FOR ANALYSIS
  - OBSERVE HOW THE INFRASTRUCTURE REACTS DURING THE RAIN
- ENFORCEMENT
  - MANDATORY DYE TEST FOR ALL WATERPROOFING PERMITS
  - INSPECTION TO VERIFY ALL DEFICIENCIES IDENTIFIED DURING DYE TEST ARE ADDRESSED,
- EDUCATION
  - DYE TESTING
  - "MITIGATING WET BASEMENT BROCHURE"

BACKWATER VALVE TESTING

- CLEAN CHECK VALVES INSTALLED PREVIOUSLY FAILED
  - FLAPPER WAS ONLY RATED AT 5 PSI
- MANUFACTURER REDESIGNED THE FLAPPER TWICE
  - 15 PSI
  - >50 PSI
- THE 6" (15 PSI MODEL) WAS TESTED BY DEPARTMENT OF ENGINEERING
  - FLAPPER HELD WITH 17.5' OF WATER
- THE DEPARTMENT OF ENGINEERING WILL INFORM ALL RESIDENTS WITH LOW PRESSURE RATED FLAPPERS TO HAVE THEM REPLACED.



MANHOLE I/I

- VENTED LIDS IN AREAS WITH FLOODING CONTRIBUTE STORM WATER TO SANITARY

- INFLOW DISH REDUCE INFLOW INTO MANHOLE