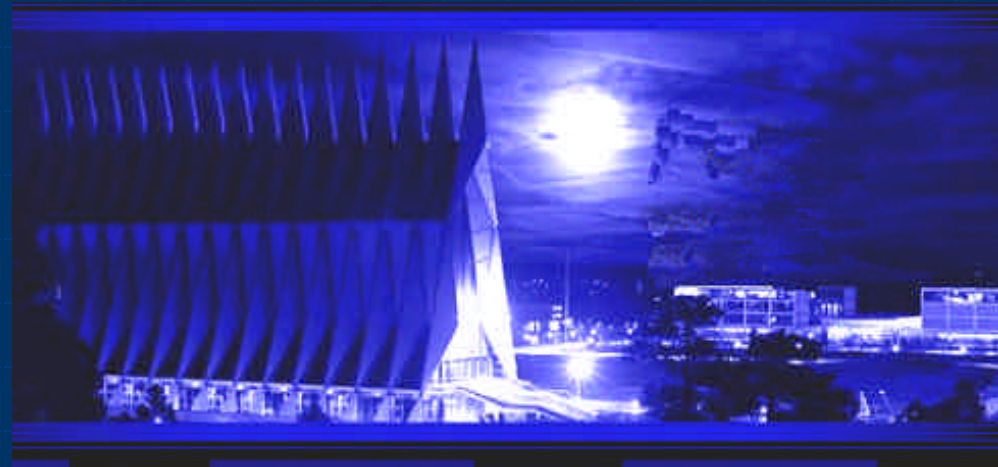




# Benefits of GIS in Infrastructure Solutions US Air Force Academy Environmental Program



*Prepared by:  
Tetra Tech EM, Inc.*

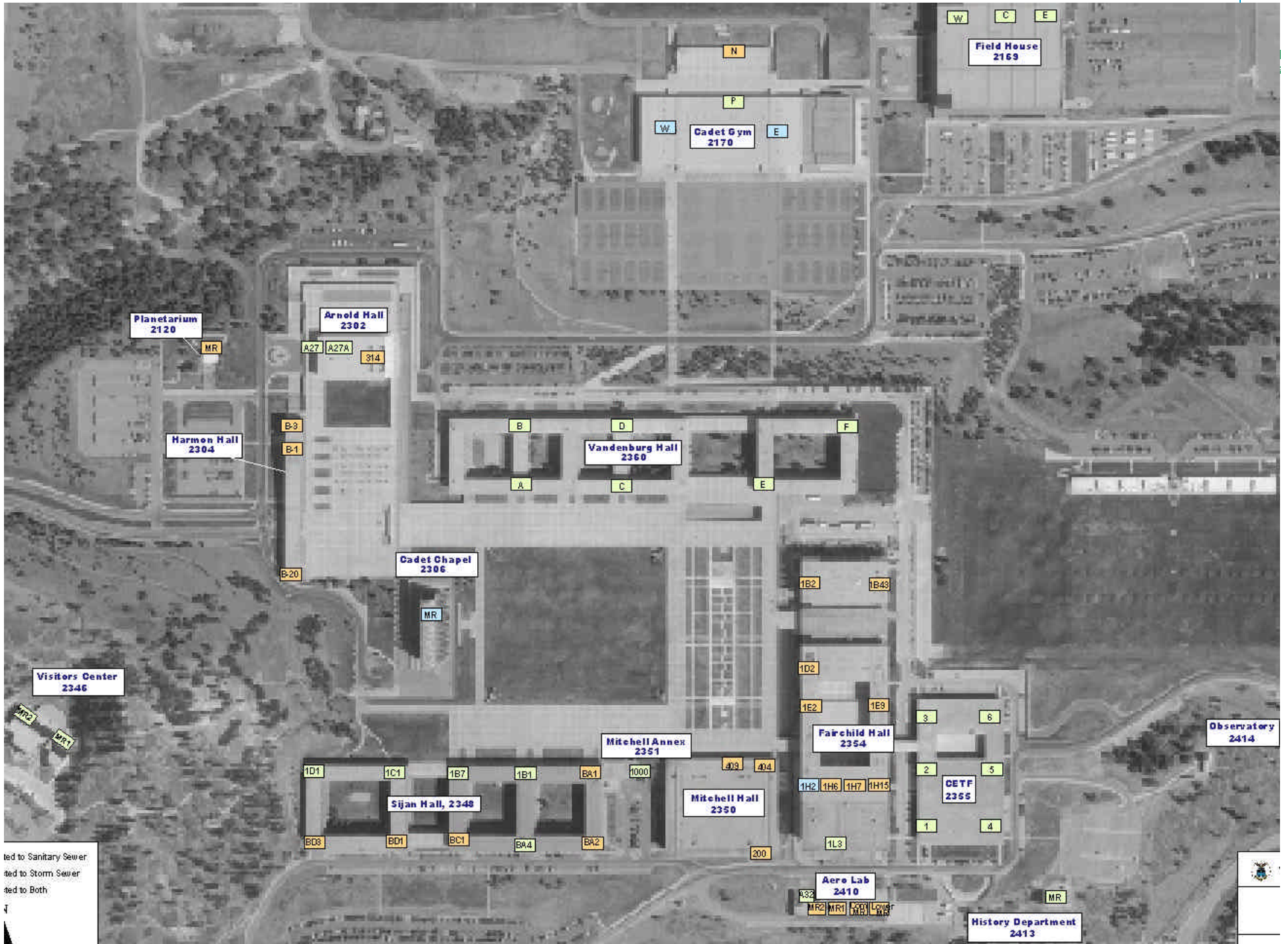




## Words to use in an Abstract

The U.S. Air Force Academy, with a history of Department of Defense award-winning environmental initiatives, conducted an evaluation of their storm and sanitary sewer infrastructure system. Under this evaluation, the Academy not only addressed recent environmental concerns, but also used the opportunity to integrate a long-term spill prevention strategy, response, and mitigation plan into the Academy's comprehensive base wide geographic information system (GIS) database.





ted to Sanitary Sewer  
 ted to Storm Sewer  
 ted to Both



# Spills & the Air Force Academy

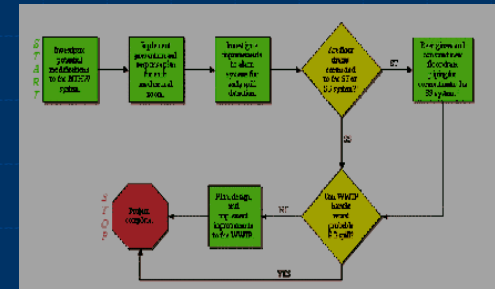
- ◆ Past: Spills have occurred



- ◆ Present: Spills can occur



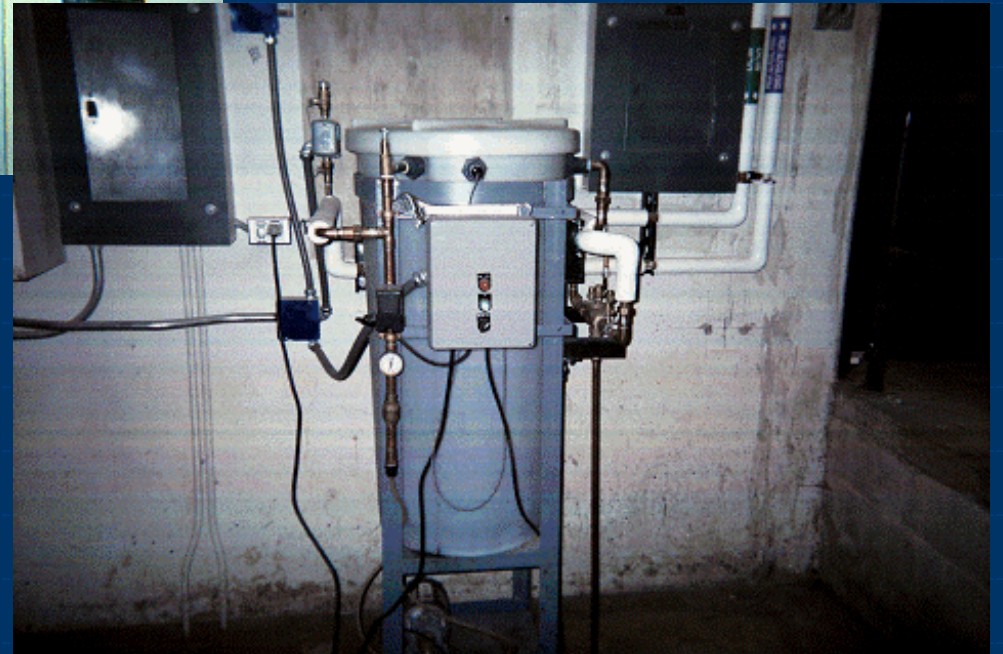
- ◆ Future: Spills can be prevented



# Antifreeze / Anti-Corrosion Agents



Propylene glycol (PG) and ethylene glycol (EG) are used as antifreeze and anticorrosive agents in heating and cooling systems in Cadet Area buildings.



# Spill 1: August 2001 Leak

- ◆ PG-contaminated water leaked for 4 days
- ◆ Approximately 10,000 gallons of contaminated water released
- ◆ At a 20% concentration, that equals approximately 2,000 gallons of PG



- ◆ Floor drains in the room were connected to the storm sewer system
- ◆ PG was released untreated into Lehman Run
- ◆ PG collected in three ponds on the Eisenhower Golf Course

# Environmental Impact:

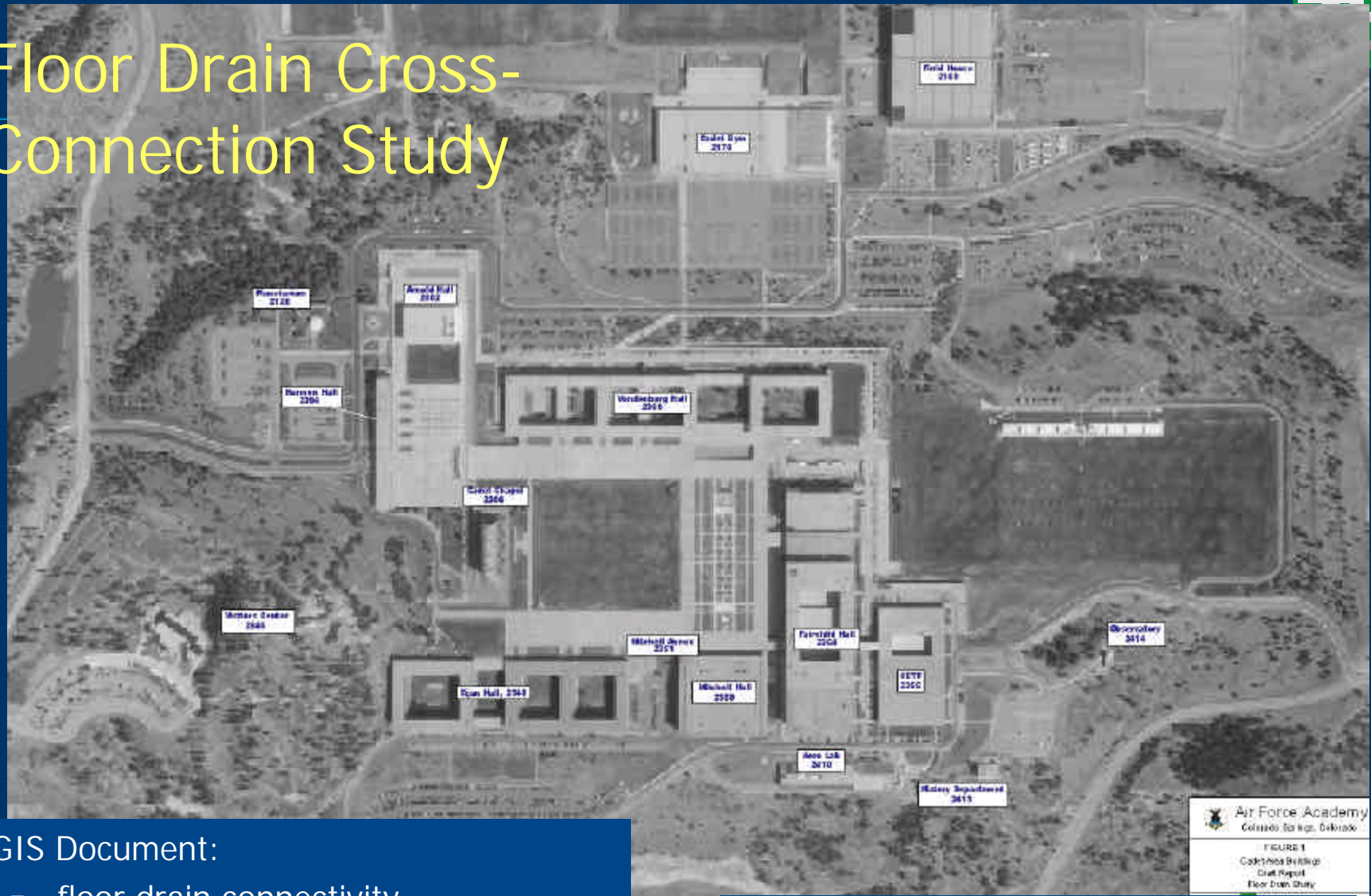
- ◆ Dissolved oxygen levels in all 3 ponds dropped
- ◆ Most biological activity ceased
- ◆ Remediation attempts were unsuccessful
- ◆ Contaminated water eventually was pumped to the WWTP for treatment







# Floor Drain Cross-Connection Study

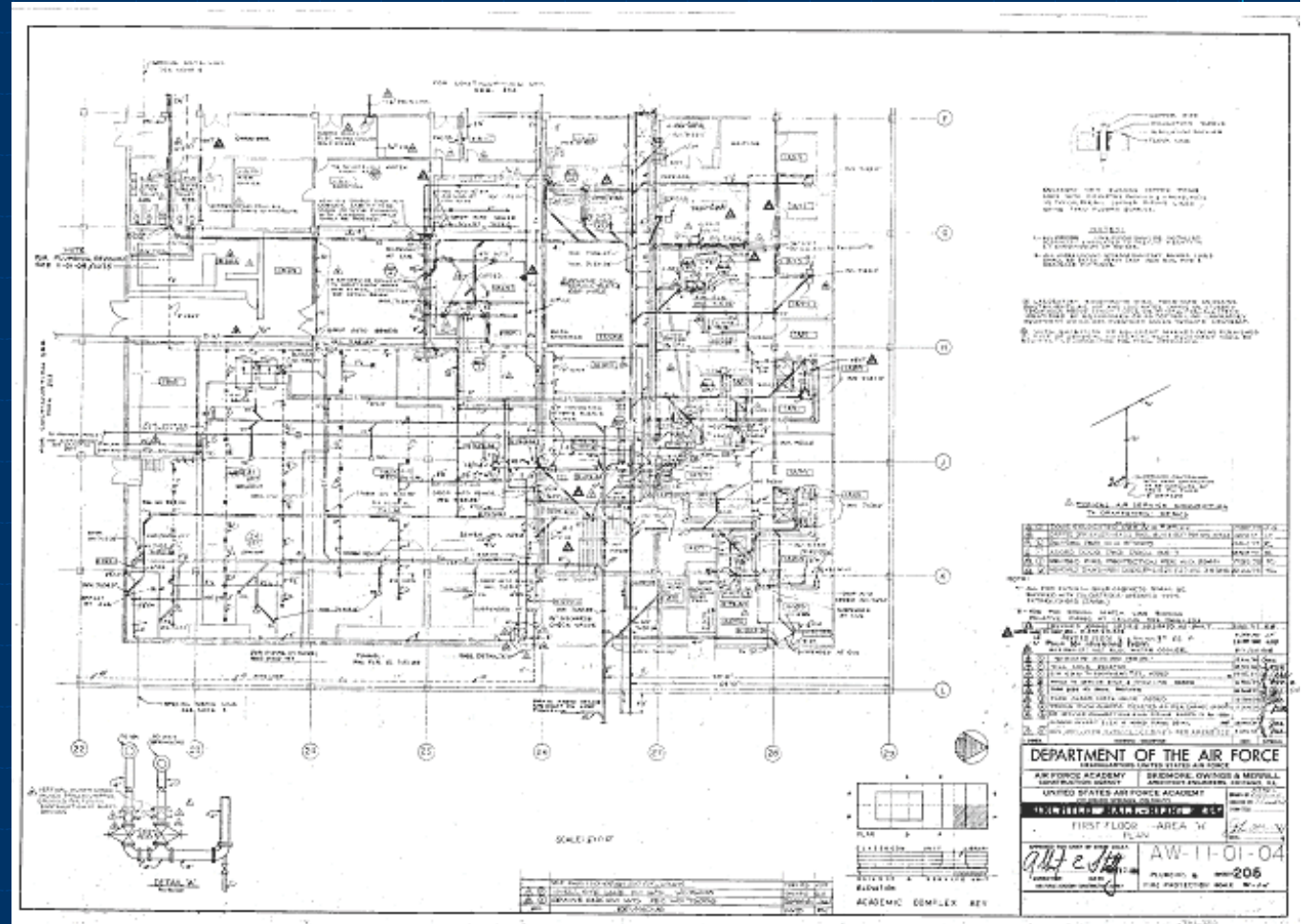


- ◆ GIS Document:
  - floor drain connectivity
  - environmental impacts of PG
  - treatment capacity of the WWTP
  - additional chemical releases

- ◆ Recommend solutions
- ◆ Outline Costs

# First Steps:

- ◆ Step 1: Discussions with USAFA staff including:
- ◆ Step 2: Review of GIS data including as-built drawings, utility drawings, and topography.



- ◆ Step 3: Review of mechanical room design drawings – also on AFA computer system

# Preliminary Site Visits:

## Step 4: Reconnaissance site visits

- Ground-truth the accuracy of the GIS design drawings.
- ID pollution sources.

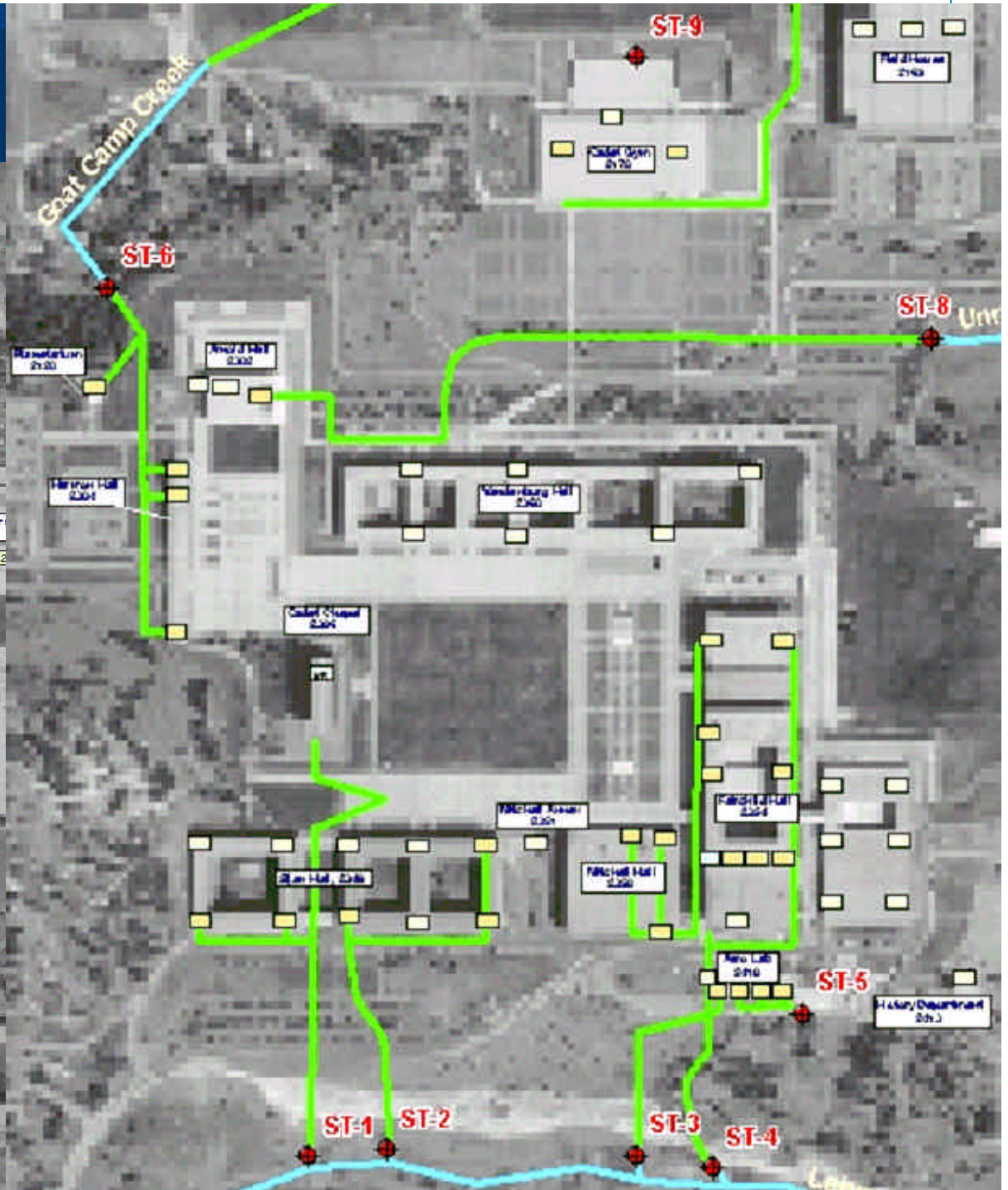


## Step 5: Dye-testing

- ◆ Verify the accuracy of GIS and design drawings
- ◆ Determine floor drain connections for mechanical rooms where drawings were not available
- ◆ Determine floor drain connections for mechanical rooms that had been renovated since the original drawings were produced
- ◆ 43 (73%) mechanical rooms were dye-tested
- ◆ 30 (51%) Cadet Area mechanical rooms have floor drains connected to storm sewers
- ◆ All require corrective action

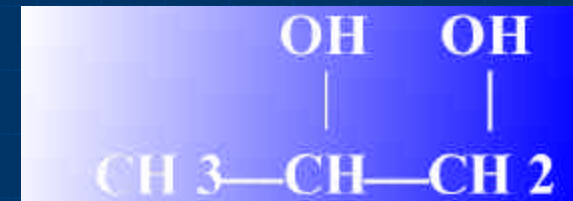


# Results



# PG Spill: Potential Environmental Impacts

- ◆ 19 million gallons of clean stream water required for dilution of one 55-gal drum
- ◆ Environmental damage would extend far downstream of initial discharge location
- ◆ Damage to a free-flowing stream would be similar to that in the golf course ponds
- ◆ A spill similar to the August 2001 would likely overwhelm the exist WWTP without equalization



# Spills & the Air Force Academy

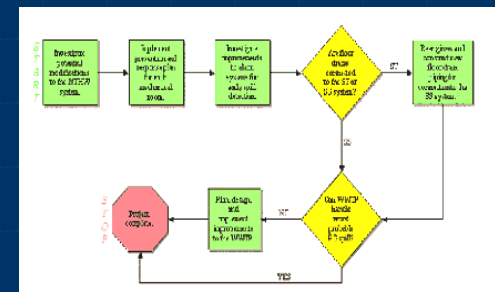
- ◆ Past: Spills have occurred



- ◆ Present: Spills can occur



- ◆ Future: Spills can be prevented



# Potential Alternatives & Measures

- ◆ Partial closure of floor drains
- ◆ Valved closure of floor drains
- ◆ Crocks in floor drains
- ◆ Alarm systems
- ◆ Prevention and response plan
- ◆ Spill containment measures
- ◆ Rerouting of floor drains to the sanitary sewer system
- ◆ Storm sewer outfall emergency diking
- ◆ Storm sewer outfall emergency shut-off sluice gates



# Short-term Recommendation

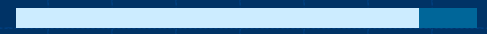
- ◆ Modifications to the MTHW system
  - PG substitute with lower BOD
  - Reconsider need for antifreeze
  - Reduce concentration of PG
  - Add dye
- ◆ Prevention and GIS-based Response plan
  - Floor drain covers and dikes (pillows)
  - Training
  - GIS, Maps, signs, and labels



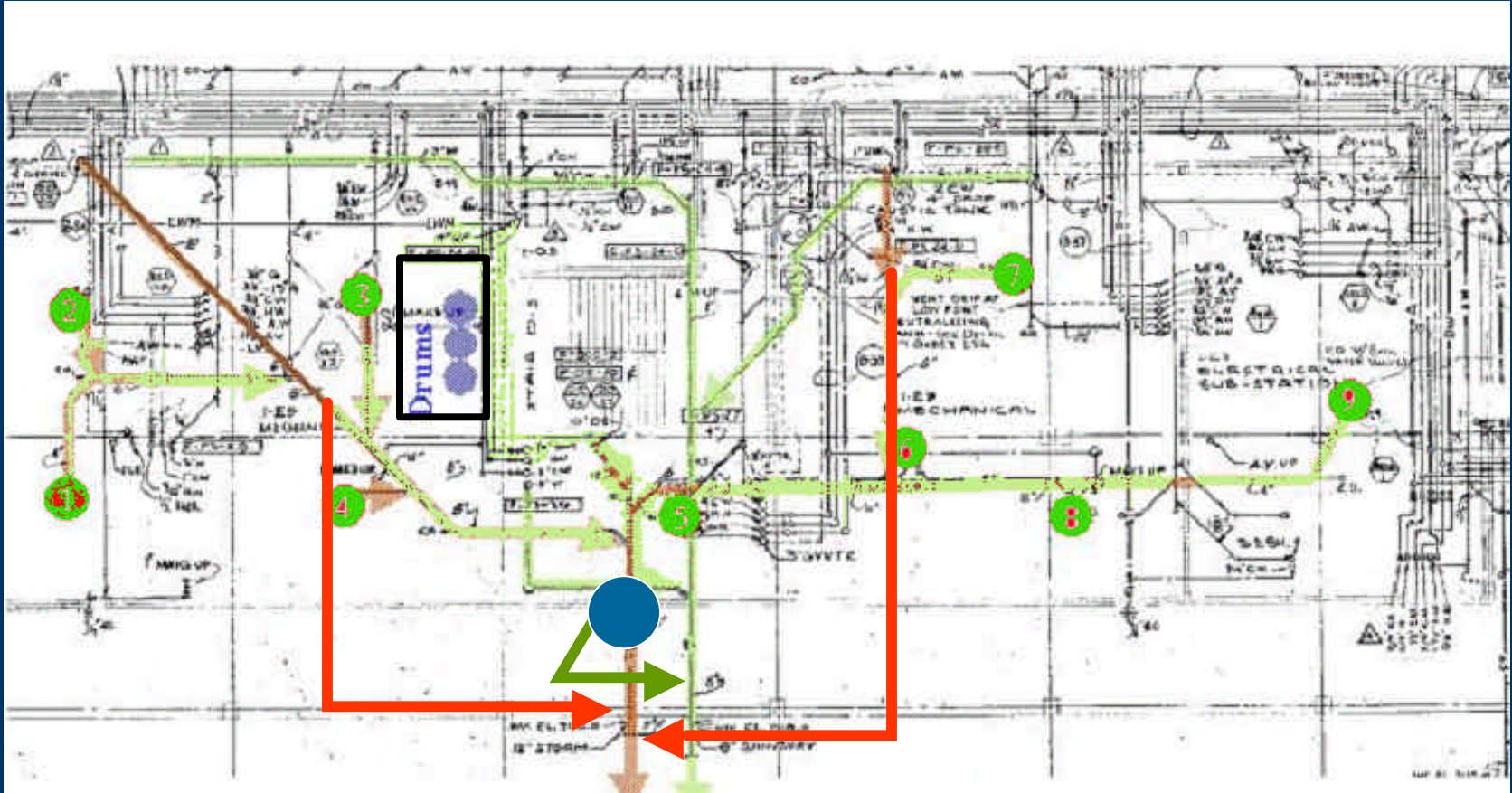


# Long Term Recommendations

- ◆ Analysis of the WWTP
- ◆ Eliminate cross-connections via comprehensive GIS analysis and reengineering of all floor drains connected to the storm sewer system
- ◆ Construct containment berms around all PG feeder tanks and storage areas
- ◆ Design alarm systems for early spill detection
- ◆ Better integration of GIS and spill response plan via GeoBase

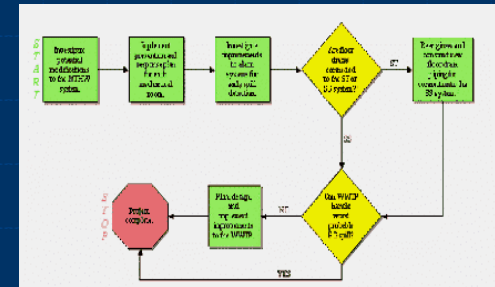


# Long Term Recommendations



# Summary

- ◆ Past: Spills have occurred (August 2001)
- ◆ Present: Spills can occur (30 rooms have PG and there are numerous leaks)
- ◆ Future: Spills can be prevented (Short-Term: education and preparation, Long-Term: designed modifications)



## Internal Links

[Executive Summary](#)

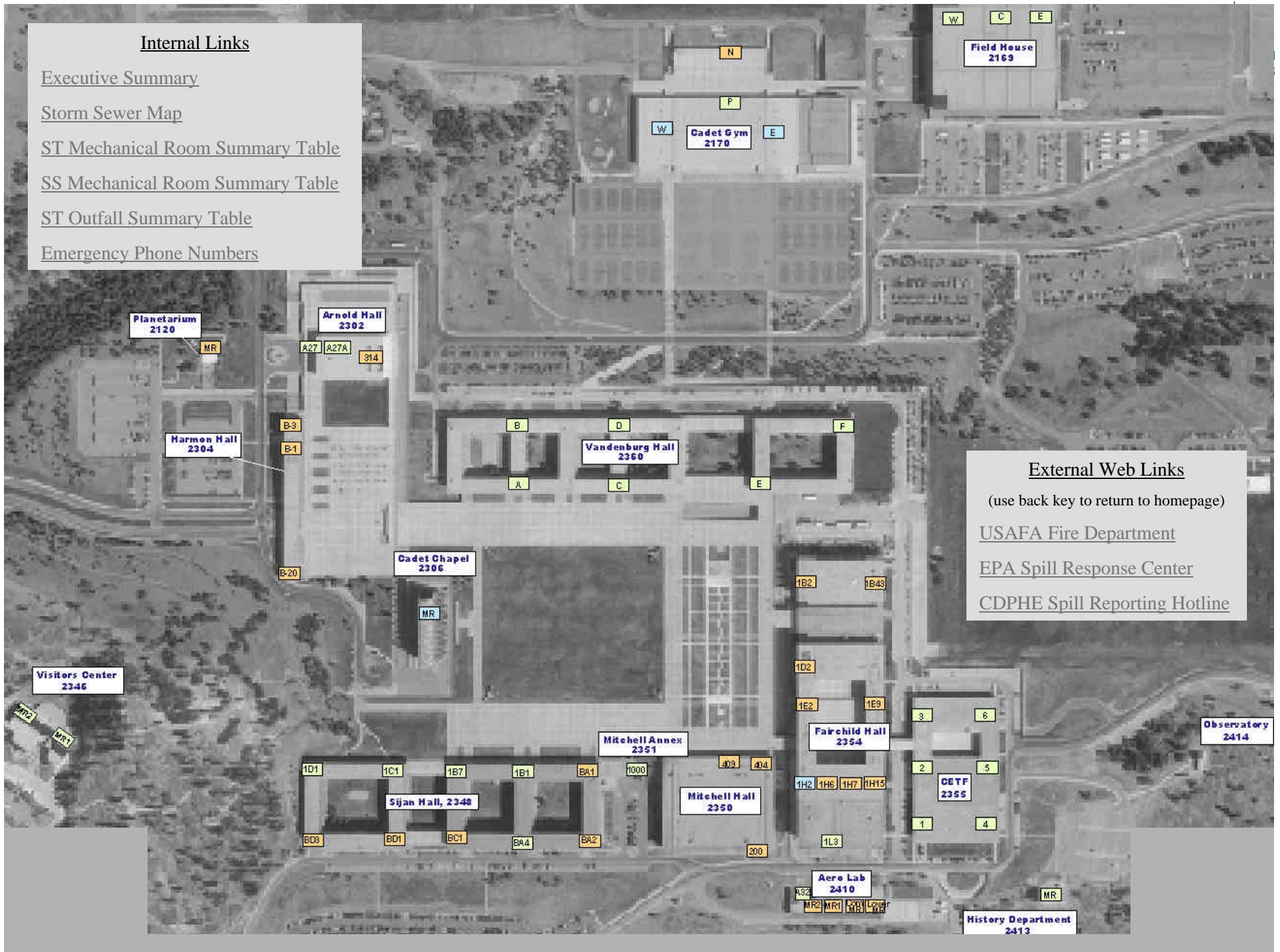
[Storm Sewer Map](#)

[ST Mechanical Room Summary Table](#)

[SS Mechanical Room Summary Table](#)

[ST Outfall Summary Table](#)

[Emergency Phone Numbers](#)



## External Web Links

(use back key to return to homepage)

[USAFA Fire Department](#)

[EPA Spill Response Center](#)

[CDPHE Spill Reporting Hotline](#)



## EXECUTIVE SUMMARY

In August 2001, water contaminated with propylene glycol (PG) leaked out of the medium temperature hot water (MTHW) system and entered a floor drain in a Fairchild Hall mechanical room at the U.S. Air Force Academy (USAFA). The floor drain was connected to the storm sewer system rather than the sanitary sewer system, and the leak went undetected for several days. Consequently, a large volume of PG spilled into the Lehman Run drainage. The PG flowed downstream and collected in three ponds on the Eisenhower Golf Course where several months of remediation were required to return the ponds to prespill conditions.

To reduce the possibility of future PG spills, Tetra Tech EM, Inc. (Tetra Tech) was retained under General Services Administration Contract GS-10F-0076K to investigate floor drains in the USAFA Cadet Area mechanical rooms. Eleven buildings were identified in the original scope of work; however, to complete the analysis of Cadet Area storm and sanitary sewer connections, an additional five buildings were added under a separate order number.

To gain a comprehensive understanding of storm and sanitary sewer connections in all Cadet Area mechanical rooms, Tetra Tech conducted the following:

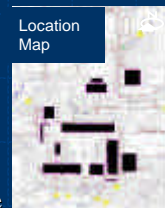
- A review of USAFA design drawings for all mechanical rooms
- Reconnaissance site visits to all mechanical rooms
- Interviews with USAFA staff
- Dye-tests in all mechanical rooms with unconfirmed floor drain connections (73 percent of mechanical rooms)

Investigation results indicate that 30 of 59 (51 percent) Cadet Area mechanical rooms have floor drains connected to storm sewers and require corrective action.

Tetra Tech also analyzed the potential environmental impacts of a PG spill. Results indicate that if a PG spill enters a free-flowing stream, the environmental consequences would be—at best—similar to those that occurred after the August 2001 spill. However, if, unlike last year, the contaminated water could not be detained and treated in a pond, environmental damage would extend far downstream of the initial discharge location. Tetra Tech's analysis also determined that a large PG spill into the sanitary sewer system could exceed the treatment capacity of the USAFA wastewater treatment plan (WWTP).

Because future releases of PG to the sanitary or storm sewer system could significantly damage WWTP processes or the environment, Tetra Tech recommends the following corrective measures be taken:

- Investigate reducing the concentration of PG in the MTHW system and consider replacing PG with a less harmful anticorrosive agent.
- Consider using dye in the MTHW system to provide a visual indication of system leaks.
- Implement a spill prevention and response plan.
- Construct secondary containment around all PG feeder tanks and storage areas.
- Investigate modifications to current alarm systems to provide early detection of spills.
- Eliminate all cross-connections via comprehensive reengineering of all floor drains currently connected to the storm sewer system.
- Evaluate the capacity of the WWTP to treat the worst probable PG spill. If this spill exceeds the WWTP's capabilities, improvements to the WWTP will be required. Redesign should focus on using existing, unused tanks for additional storage and biological load equalization.
- Investigate spill potential and floor drain connections in other areas of the USAFA where PG or other potentially damaging chemicals are used.

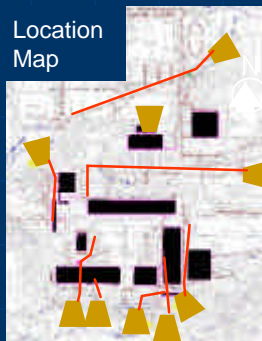


# Executive Summary

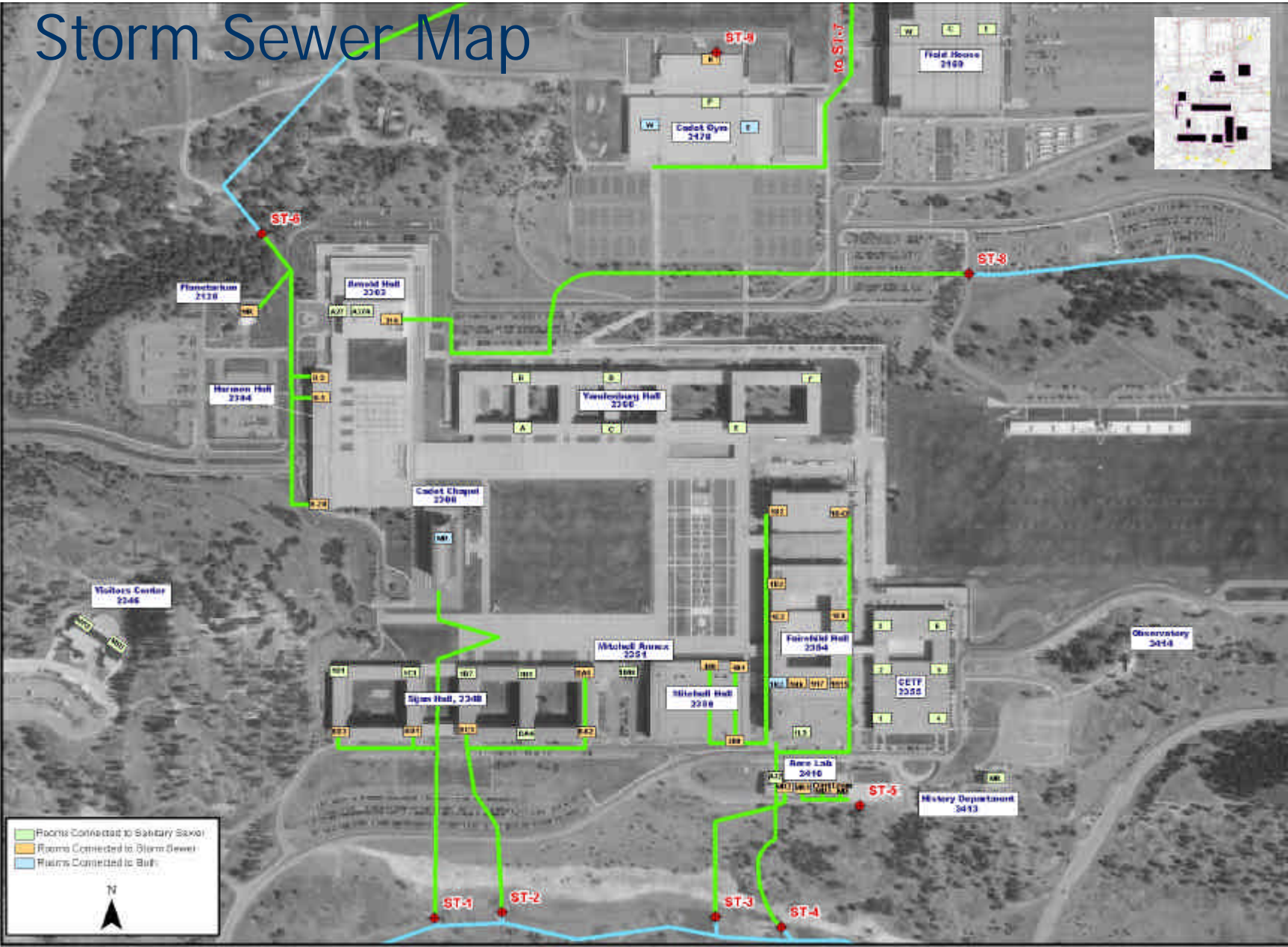
# Phone List

## Emergency Response Phone Numbers:

- ◆ Bryce Tobyne: (719)333-8394
- ◆ Bob Greene: (719)333-7174
- ◆ USAFA Fire Department: 911
- ◆ EPA National Response Center: (800)424-8802
- ◆ CDPHE Spill Reporting Hotline: (877)518-5608



# Storm Sewer Map

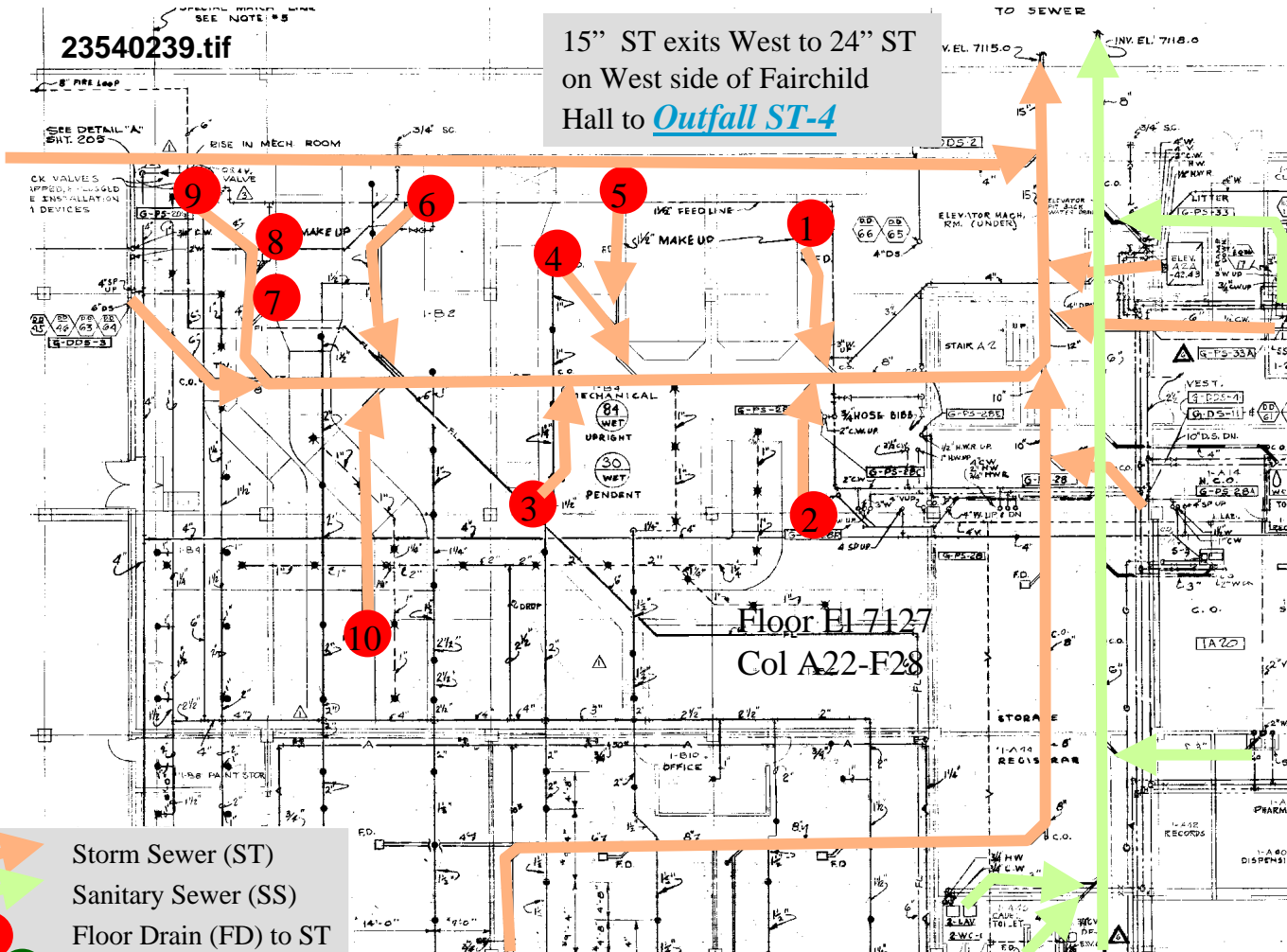










4" ST from mechanical room D2

23540239.tif

15" ST exits West to 24" ST on West side of Fairchild Hall to Outfall ST-4



 Storm Sewer (ST)  
 Sanitary Sewer (SS)  
 Floor Drain (FD) to ST  
 FD to SS  
 FD Clogged  
 Chemical Storage

23540239 File name of drawing in Attachment A



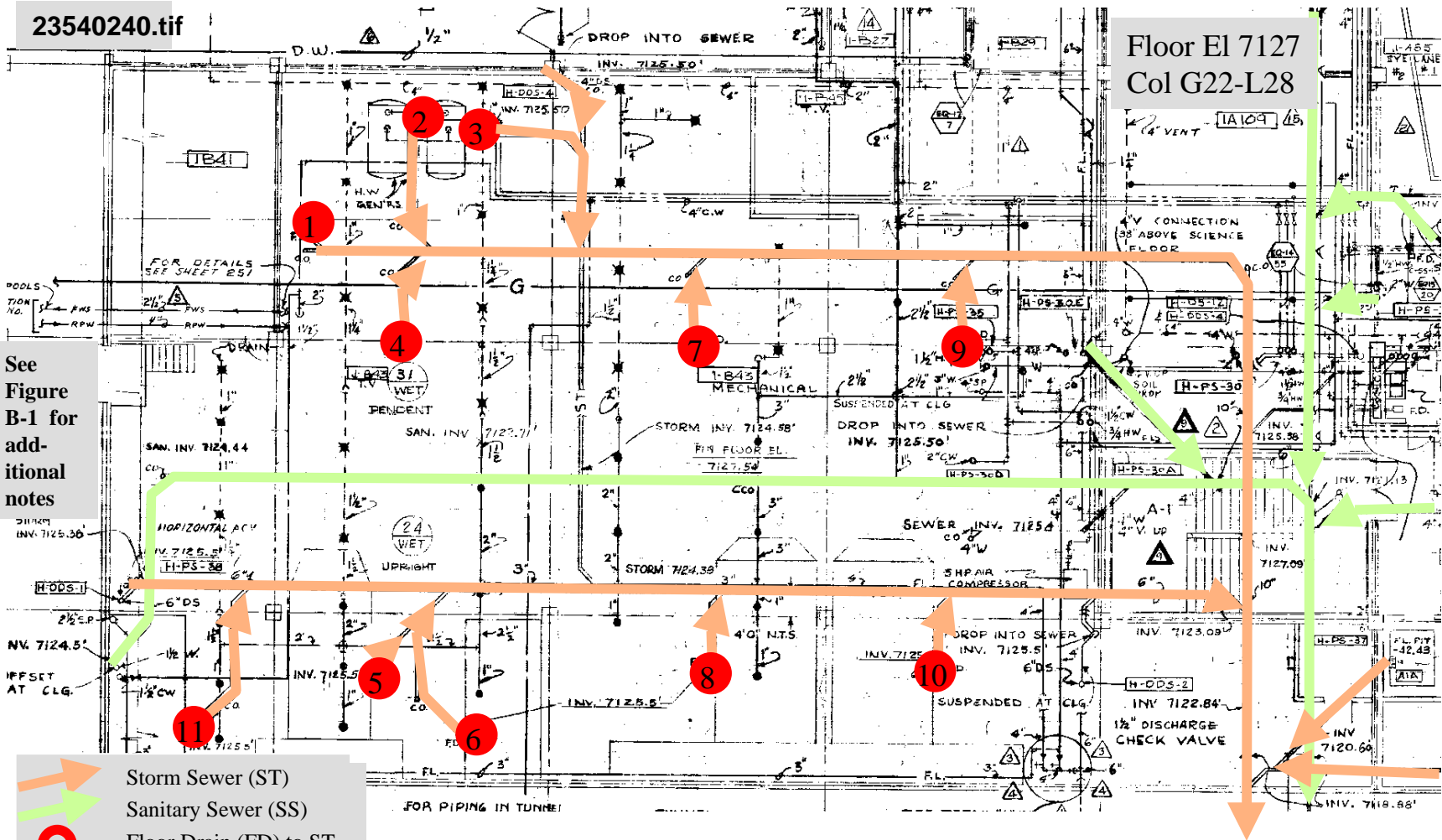
Drawings taken from scanned drawings provided by U.S. Air Force Academy. All drawings are unsealed and not field verified.

El=Elevation  
Col = Structural Column row  
Dwg = Drawing  
FM= Force Main







Fairchild 1B2

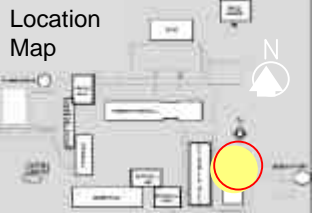
23540240.tif

Floor El 7127  
Col G22-L28



See Figure B-1 for additional notes

-  Storm Sewer (ST)
-  Sanitary Sewer (SS)
-  Floor Drain (FD) to ST
-  FD to SS
-  FD Clogged
-  Propylene Glycol (PG) Tank and/or Feed System



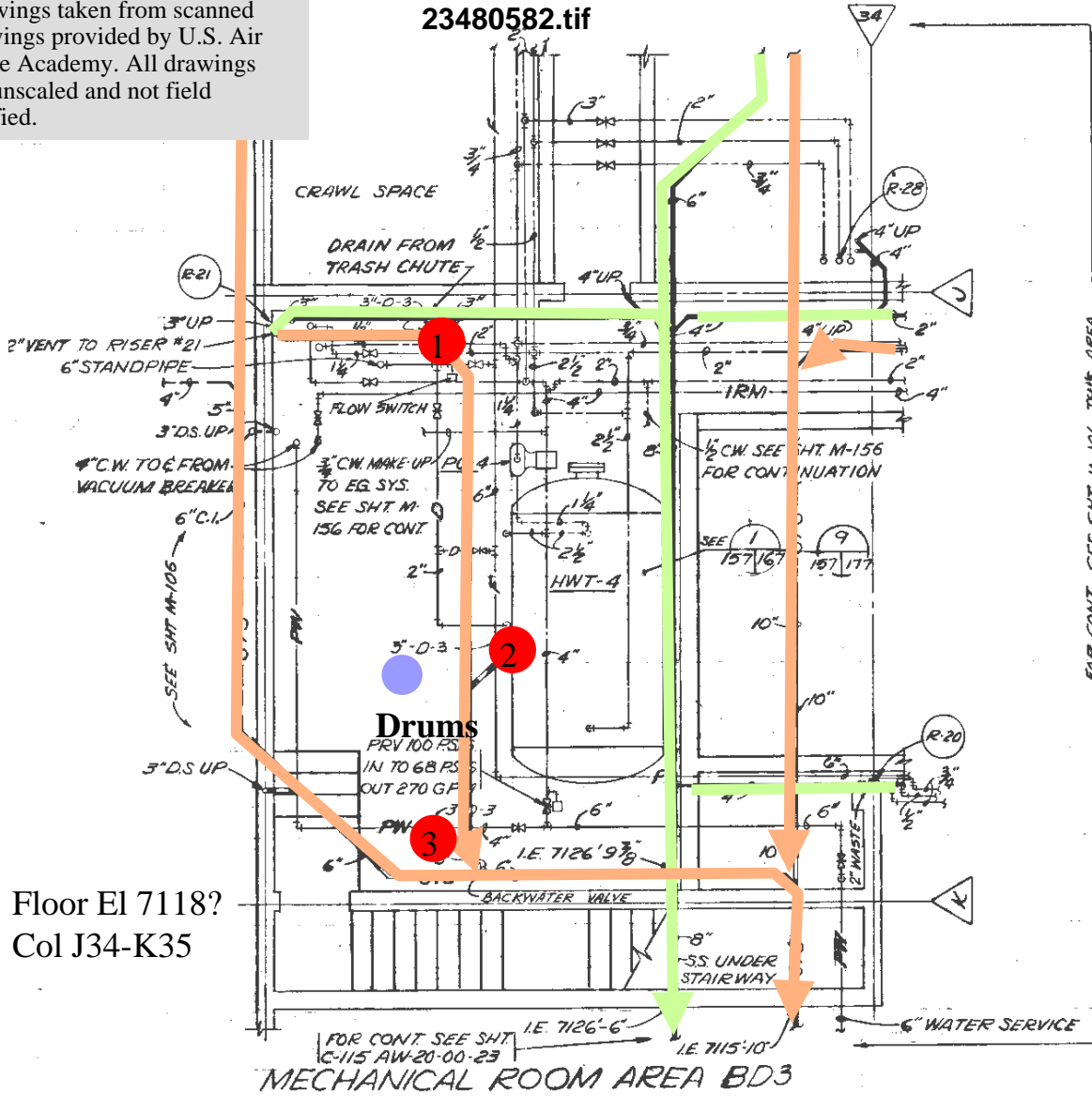
10" ST exits East to 24" ST on East side of Fairchild Hall to Outfall ST-4







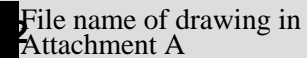
# Fairchild 1B43

File name of drawing in Attachment A

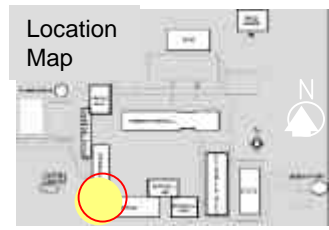
Drawings taken from scanned drawings provided by U.S. Air Force Academy. All drawings are unscaled and not field verified.

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-  Storm Sewer (ST)
-  Sanitary Sewer (SS)
-  Floor Drain (FD) to ST
-  FD to SS
-  FD Clogged
-  Propylene Glycol (PG) Tank and/or Feed System
-  File name of drawing in Attachment A

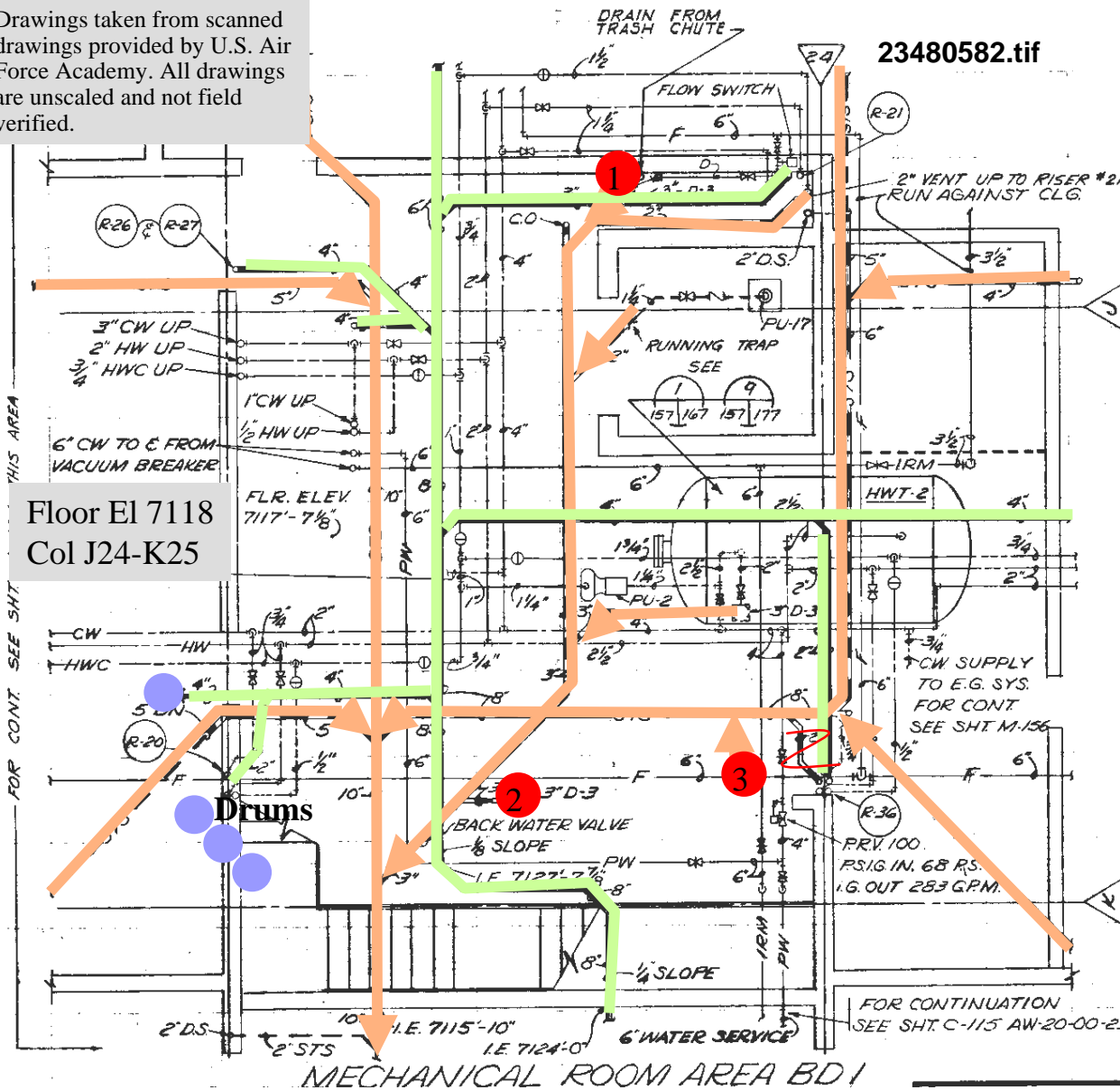
El=Elevation  
 Col = Structural Column row  
 Dwg = Drawing  
 FM= Force Main



Floor El 7118?  
 Col J34-K35

10" ST exits South to 21" ST on South side of Sijan Hall to [Outfall ST-1](#) Sijan BD3 (M)

Drawings taken from scanned drawings provided by U.S. Air Force Academy. All drawings are unscaled and not field verified.



23480582.tif

- Storm Sewer (ST)
- Sanitary Sewer (SS)
- Floor Drain (FD) to ST
- FD to SS
- FD Clogged
- Propylene Glycol (PG) Tank and/or Feed System
- File name of drawing in Attachment A

EI=Elevation  
 Col = Structural Column row  
 Dwg = Drawing  
 FM= Force Main



## Sijan BD1 (K)

10" Storm exits South to 24" ST on South side of Sijan Hall to [Outfall ST-1](#)



Outfall looking North.



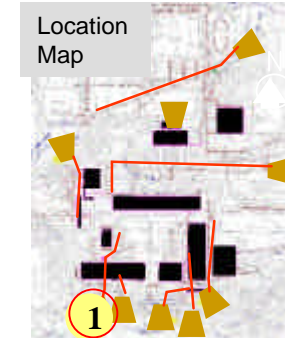
Outfall (highlighted in purple). Looking West.

Twin 42" Outfall located at  
State Plane coordinates:  
427,350 ± N  
2,173,350 ± E  
Colorado Central Zone

Outfall receives flow from the  
**Chapel** and Sijan Hall (**BD1**  
& **BD3**) and discharges  
directly into Lehman Run.



Outfall looking North.



E-1

# Outfall ST-1



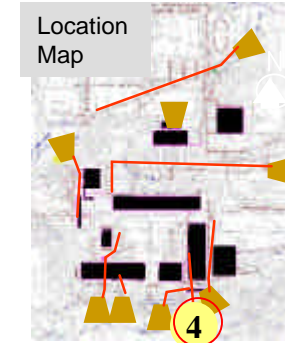
**Outfall (highlighted in purple). Looking Northwest.**

**48" Outfall located at  
State Plane coordinates:  
427,120 ± N  
2,174,470 ± E  
Colorado Central Zone**

**Outfall receives flow from  
Mitchell Hall (200, 404,  
409) and Fairchild Hall  
([1B2](#), [1B43](#), 1D2, 1E2,  
1E9-S, 1E9-N, 1H2, 1H6,  
1H7, 1H15) and  
discharges directly into  
Lehman Run.**



**Outfall (highlighted in purple). Looking North.**



E-4

# Outfall ST-4