Hazen

When Manholes Go Missing:

Stream Solutions for Municipal Sanitary Systems

EcoStream 2018 – Stream Ecology & Restoration Conference

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Purpose

How do you evaluate stream/asset conflicts?

When is stream restoration the best protection option?

Outline

1. Asset protection benefits
2. Identification and prioritization of stream/asset conflicts
3. Mitigation measures
4. Pros and cons
5. Recommendations

1. Asset protection benefits

What's an asset?

Linear assets

sanitary sewer

water mains

gas lines

electric lines

fiber optic cable

overhead towers

fencing

storm drains

Non-linear assets

access roads

parking areas

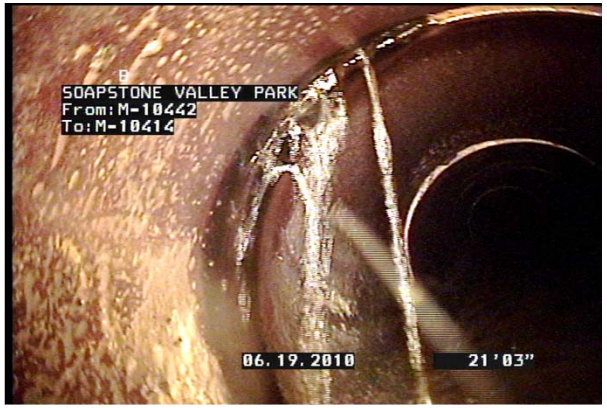
floodwalls

buildings

tanks

equipment

Asset protection benefits

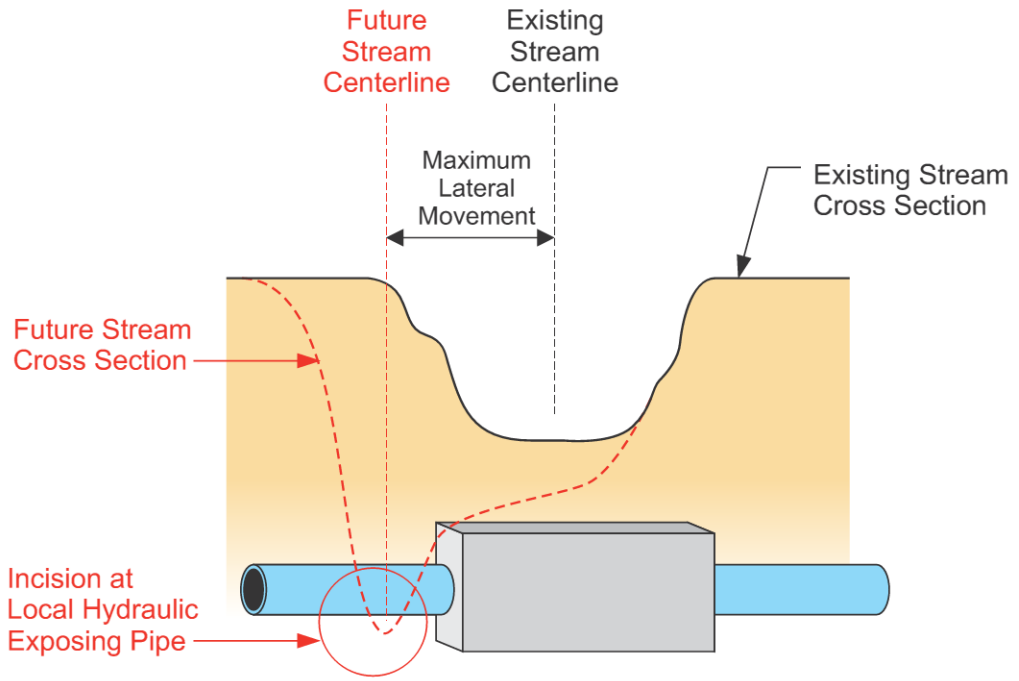


Infiltration and exfiltration (I/E), what's the big deal?

Infiltration costs money

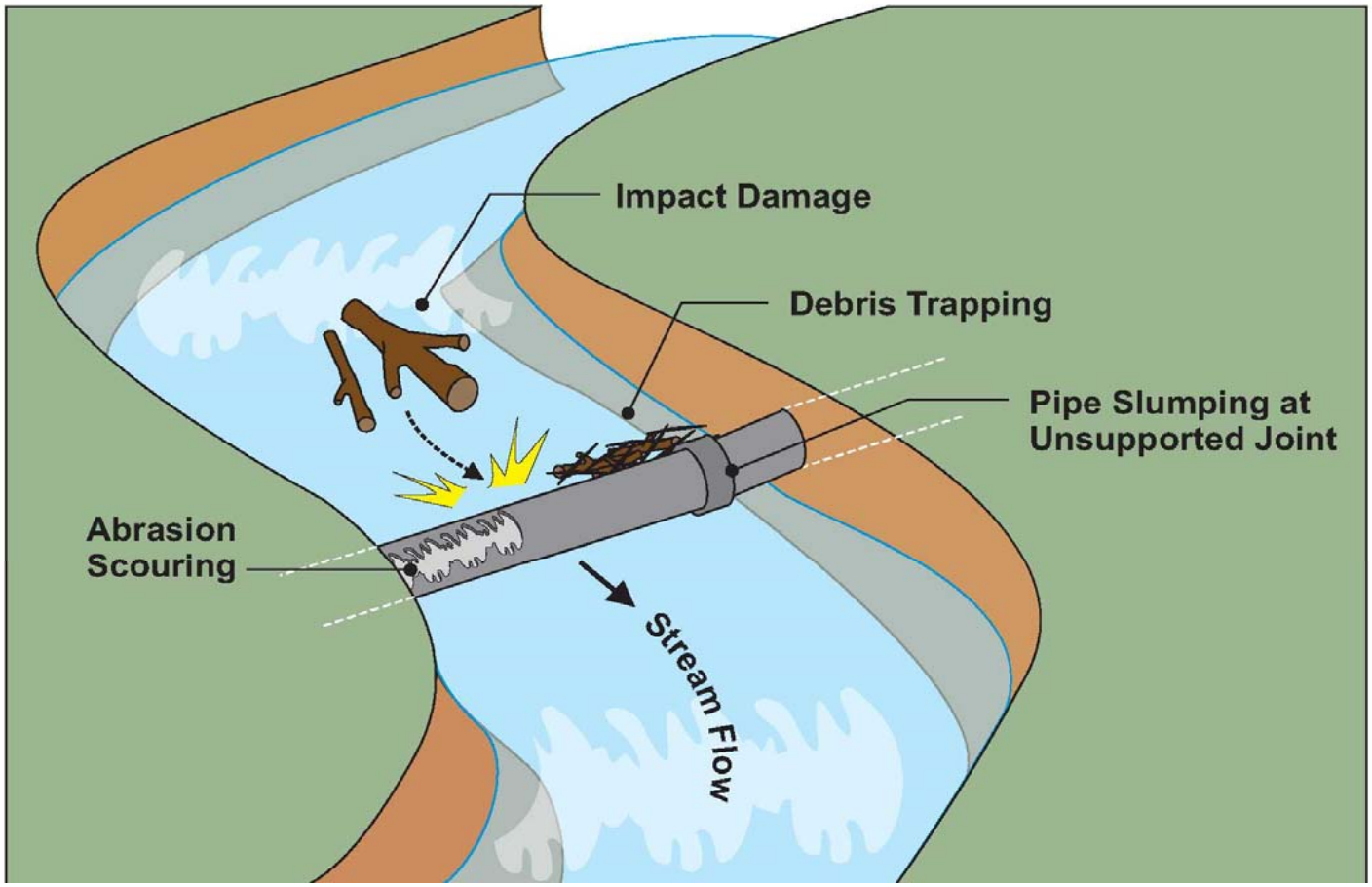
Exfiltration costs the environment

Asset exposures within streams represent extreme dangers of I/E



Asset protection benefits

Asset exposure risk



Asset protection benefits

Design life

Materials: brick, reinforced concrete, vitrified clay, iron and steel, PVC, HDPE

Factors affecting design life vary: chemistry, loading, temperature, flow rate, construction methods, soil characteristics, to name a few

Estimates of design life vary, but generally range between 50 and 100 years

How old is your system?

2. Identifying and prioritizing conflicts

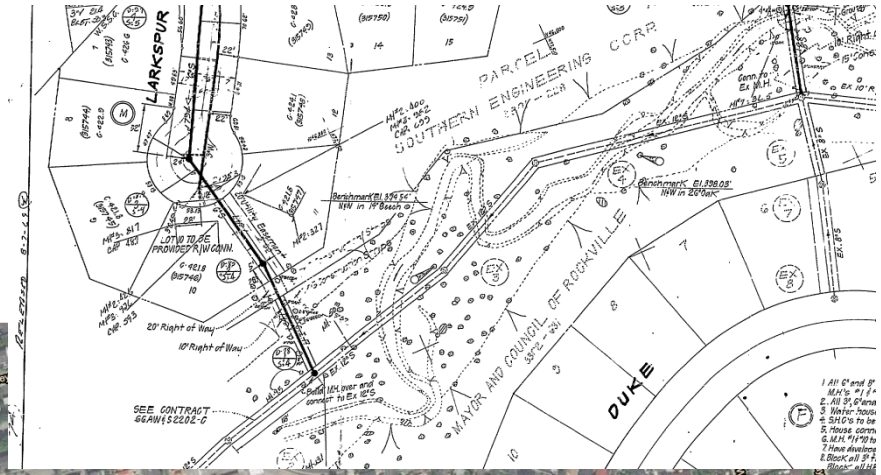
How do we know we have problems?

- Maintenance and inspection records
- Service forecasts and longevity assessments
- Third-party notification
- Legal and regulatory action

Identifying and prioritizing conflicts

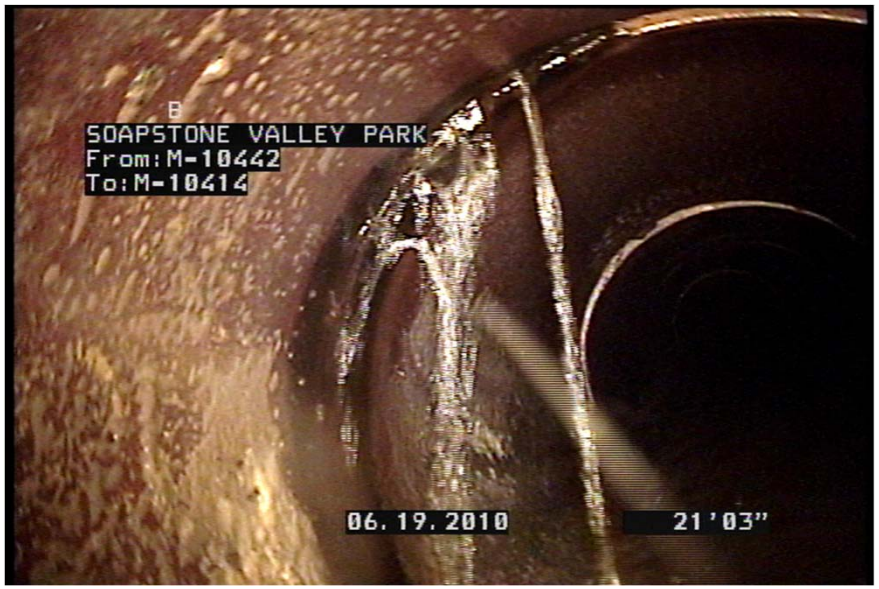
Identification approaches

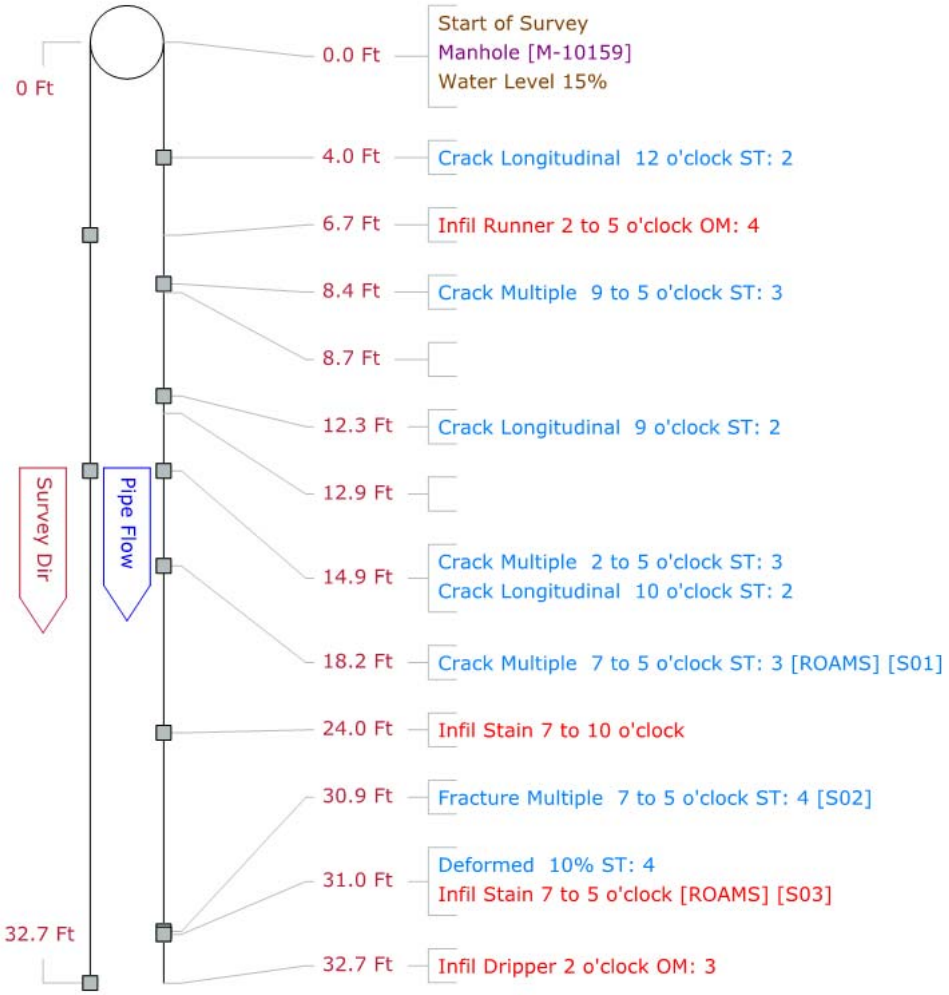
- Records research
- Remote inspection
- Manual inspection



Identifying and prioritizing conflicts

Remote inspection





Identifying and prioritizing conflicts

Manual inspection: agency-based

CONDITION / CRITICALITY ASSESSMENT

Manhole	High	34.7
Stream	Mid	25.5
Priority	2	

Stream Criticality	Low	Mid	High
High	7	4	1
Mid	8	5	2
Low	9	6	3

Manhole Criticality

MANHOLE INVENTORY INFORMATION

GIS ID	M-10196	
Date Inspected	9/10/2013	
Related Pipe Inspection	P-78475	
Did Manhole Require Further Examination?	Yes	
Frame/Cover Condition	Good	0
Adjacent Sinkhole	No	0
Odor	No	0
Damage (Inside)	None	0
Damage (Outside)	None	0
Leakage	No	0
Undermining of MH Support	Base Visible	10
Height of Exposed MH (H3)	4.1 feet	3
Distance to Closest Bank (L1)	0 feet	20
Manhole Score - Total and Normalized	33	34.7

Manhole Comments

Bottom of cover is partly broken off, exterior condition is good

STREAM INVENTORY INFORMATION

Related Stream Inspection	P-78475	
Stream Name	Broad Branch	
Bank Material	Bedrock Outcrop and below	0
Max Bank Height/Bankfull Height	Low	0
Bank Angle	75	5
Stratification/Bank Layering	No Stratification	0
Bank Vegetation/Protection	Dense Vegetation/Roots	3
Thalweg Location	Adjacent to Erosion Bank	10
Bank Location	Outside of bend	10
Stream Score - Total and Normalized	28	25.5

Stream Comments

Bank needs filled

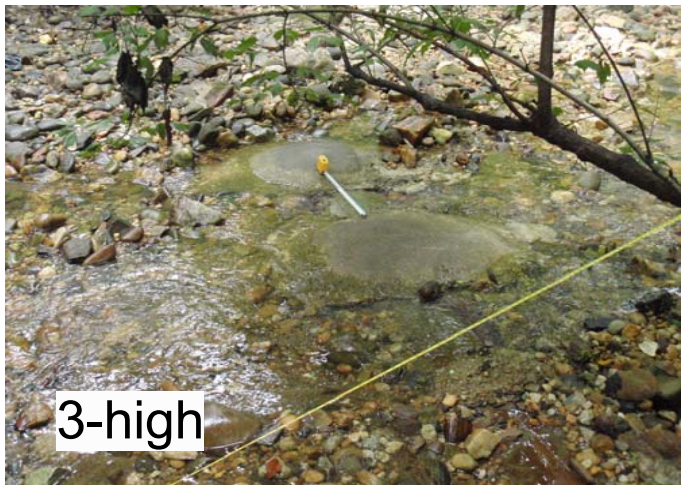
Identification and prioritization of conflicts

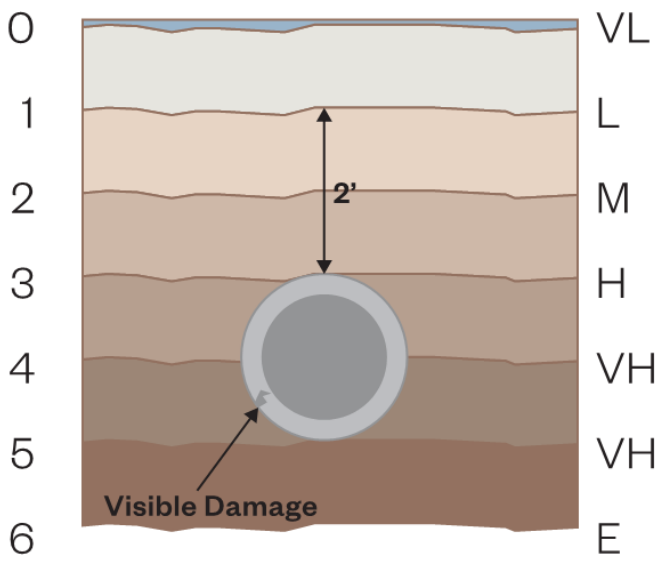
Manual inspection – linear assets

Score	Description	Risk
0	More than 2 feet of cover over the top of the pipe	Very Low
1	Less than 2 feet of cover, pipe/encasement is not exposed	Low
2	Less than 2 feet of cover, pipe /encasement is exposed	Medium
3	Less than one foot of cover, pipe/ encasement is exposed	High
4	Pipe/encasement is exposed to spring line of pipe	Very High
5	Pipe/encasement exposed to bottom of pipe/encasement	Very High
6	Observable deformation in exposed pipe/encasement	Extreme

Identifying and prioritizing conflicts

Manual inspection – linear assets

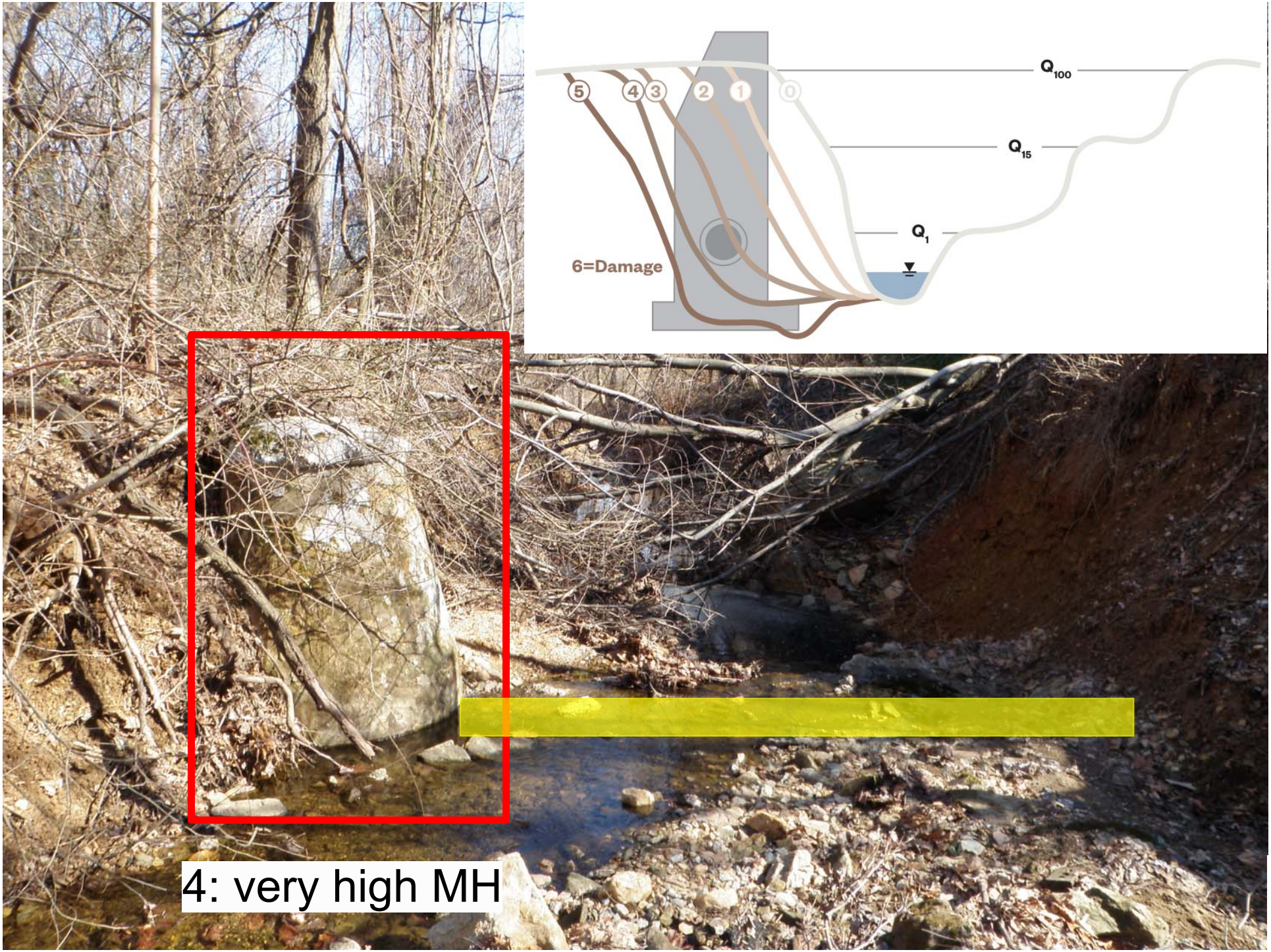




Identifying and prioritizing conflicts

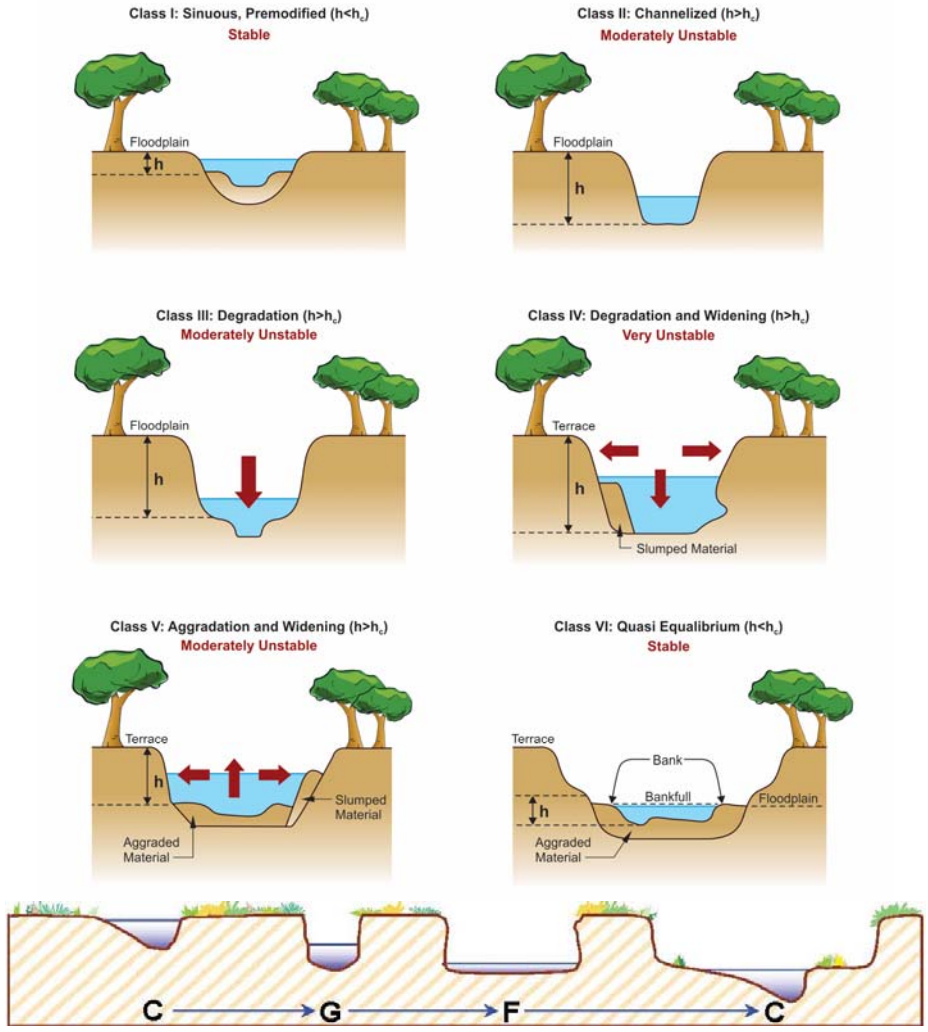
Manual inspection – manholes

Score	Description	Risk
0	MH not at risk of exposure from runoff up to the Q100	Very Low
1	MH not at risk of exposure from runoff up to the Q15	Low
2	MH not at risk of exposure from runoff up to the Q1	Medium
3	MH is current exposed	High
4	Pipe(s) into or out of MH are exposed	Very High
5	Bottom of MH is visible	Very High
6	MH is markedly, visibly damaged or deformed	Extreme


5
4
3
2
1
0
Q_{100}
Q_{15}
Q_1
6=Damage
4: very high MH

Assess stream type and stability

Stable or unstable



3. Mitigation measures

After assessing stream stability, consider:

1. Internal repair

2. External repair

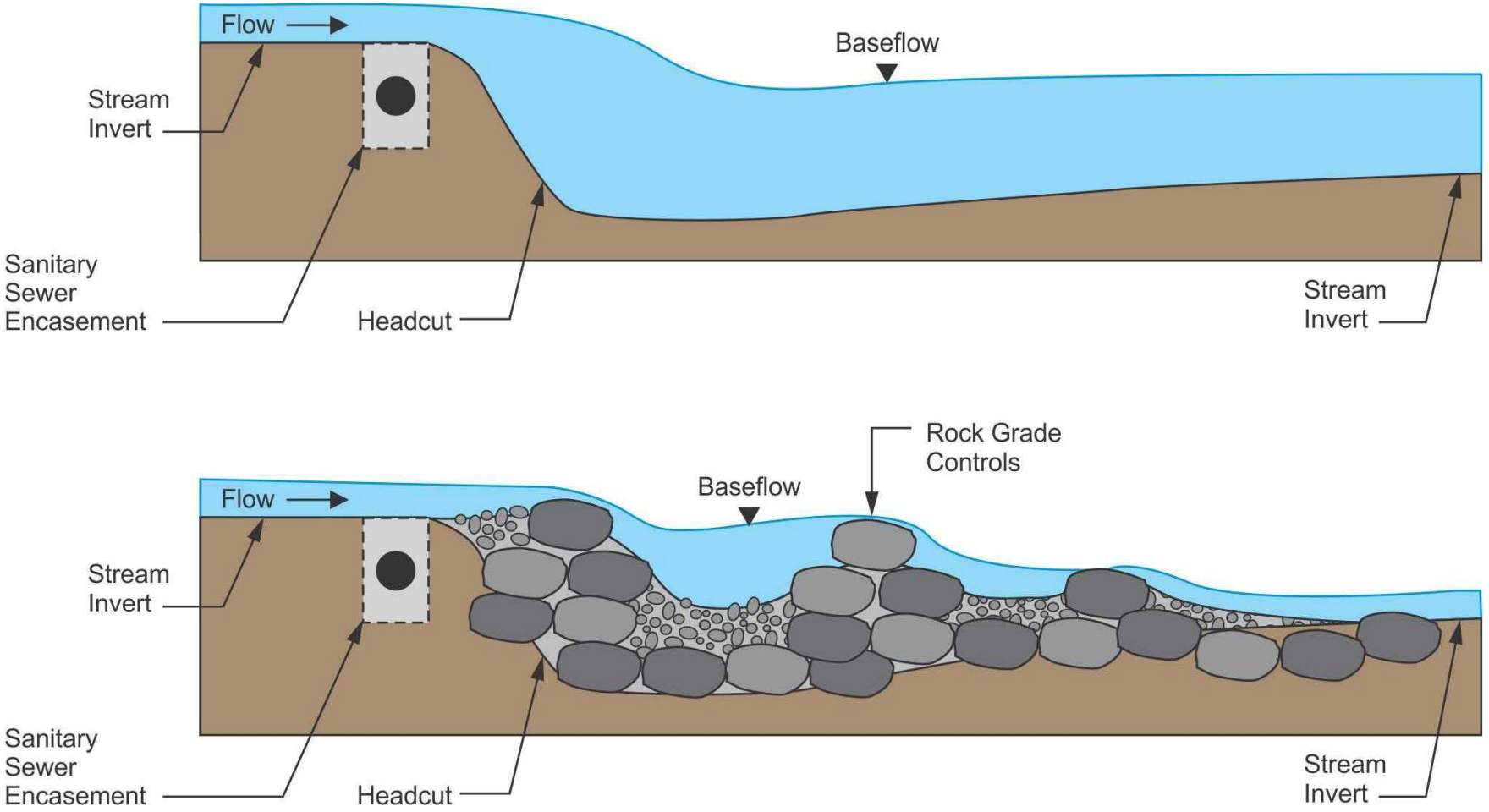
3. Move (relocate) the asset

4. Move (manipulate) the stream (stream restoration)

Mitigation measures: internal repair

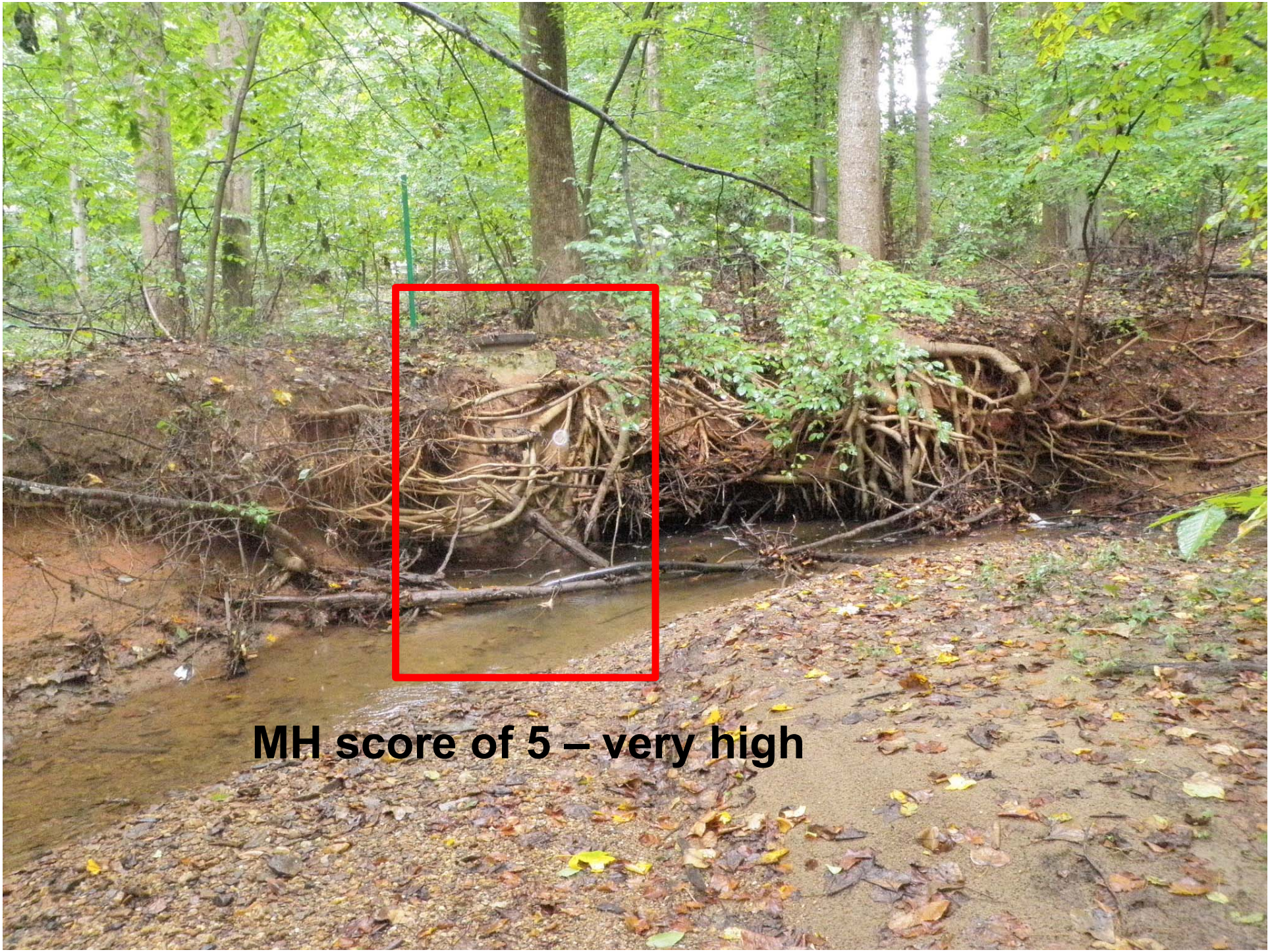
Mitigation measures: external repair

Mitigation measures: external repair

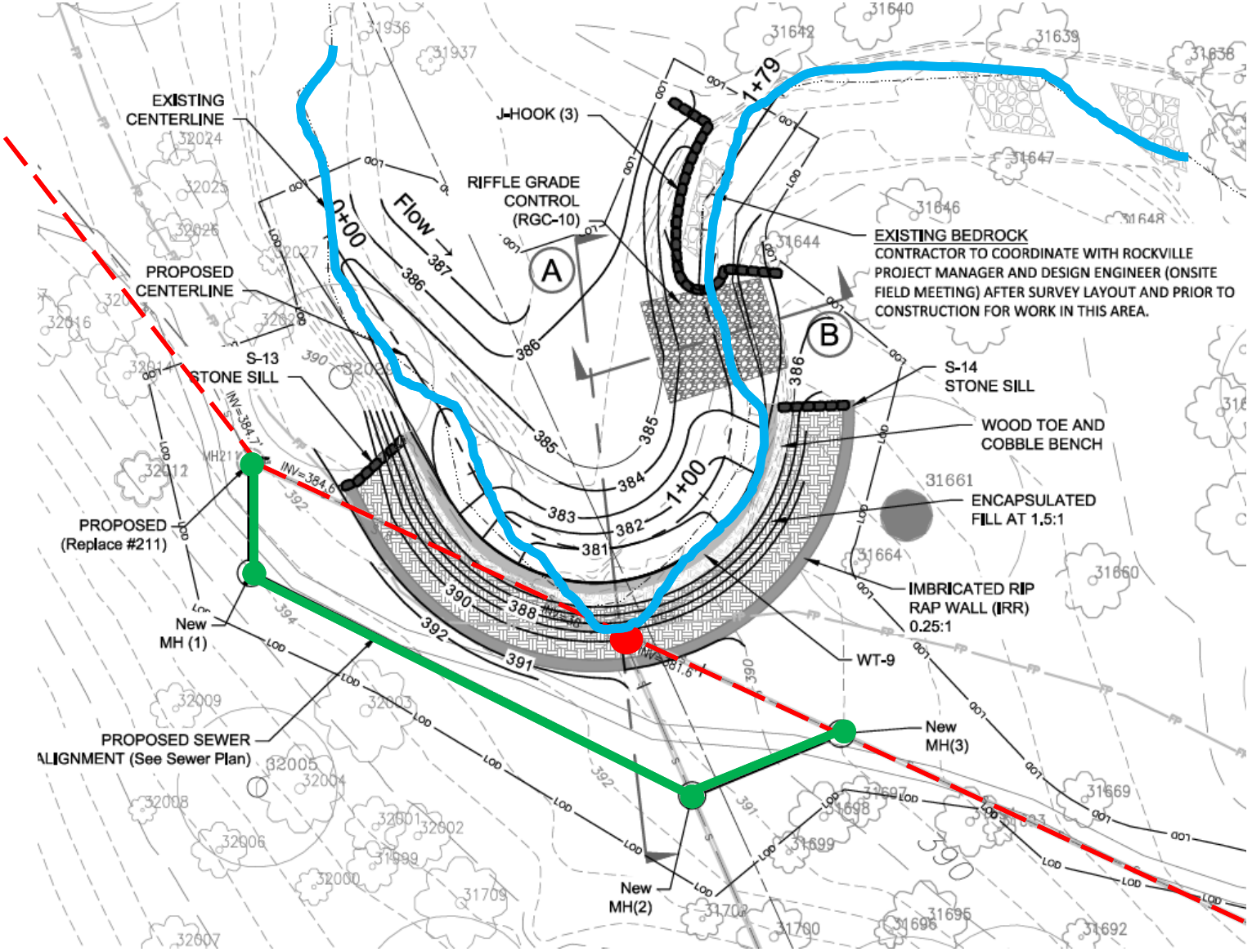


Mitigation measures: external repair

Mitigation measures: external repair


MH score of 5 – very high

Mitigation measures: move the asset

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Mitigation measures: stream restoration

Stream restoration defined as modifying plan, dimension and profile

Mitigation measures

They are not exclusive; some common pairings

Internal + external
Internal + stream restoration
Asset relocation + external

Mitigation measures: restoration and external

4. Pros and cons

Snapshot

Method	Pros	Cons
Internal	Very minor impact, uses old asset as protection	Need good access; may not fully address issue
External	Less time, less money	Poor longevity; probable geofluvial impact
Relocation	Longevity	Capacity and engineering constraints
Restoration	Best aesthetics, perception and ecological uplift	Expense, risk

Pros and cons

Good, fair, poor

Stream is …
stable unstable

Method	Time	Money	Ecology	Perception	Risk / Longevity	Risk / Longevity
Internal	good	fair	good	good	poor - fair	poor
External	fair	good	poor - fair	fair - good	poor - fair	poor
Relocation	fair	varies	good	good	good	fair - good
Restoration	poor	poor	good	good	good	good

5. Recommendations

Decision steps, assuming known stream/asset non-emergency conflict(s)

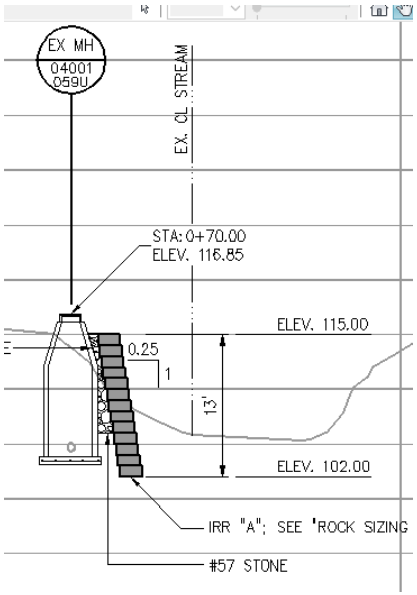
1. Determine asset remaining life (50 – 100 years)
2. Review planned system upgrades
3. Determine long-term stream stability
4. Is a short-term fix (external) adequate?
5. Look into internal repair and asset relocation
6. Look into stream restoration
7. Use multiple approaches when possible

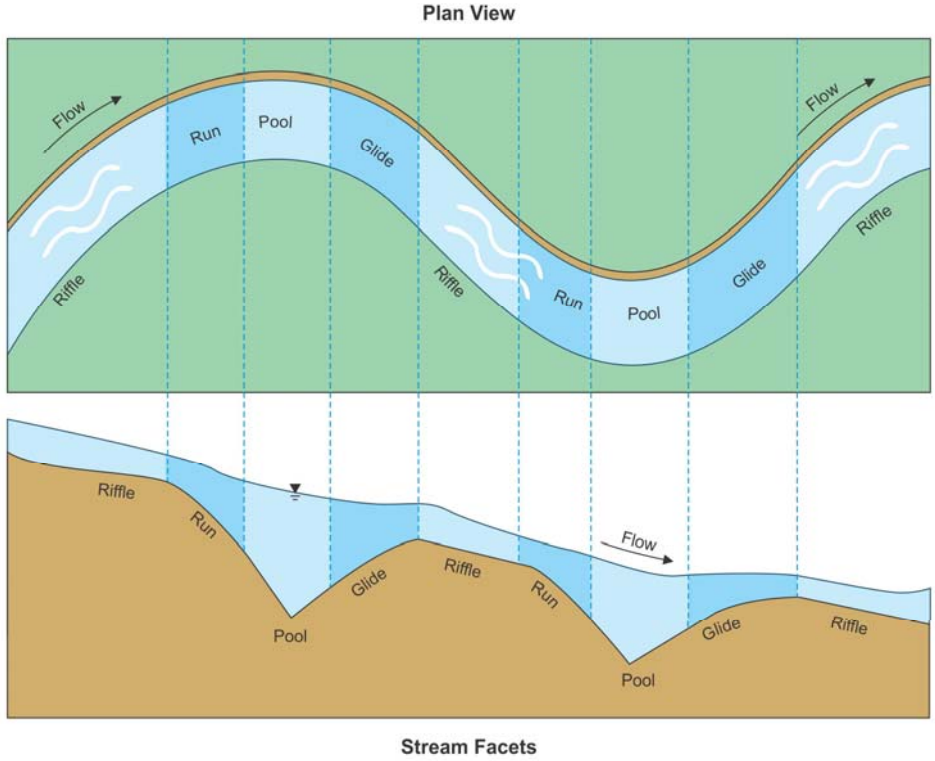
"We're not in the stream restoration business."

Recommendations

Pursue stream restoration (plan, dimension, profile) design if:

1. Two meander wavelengths
2. Acceptable stream valley width
3. Appropriate vertical tie-ins (particularly downstream)



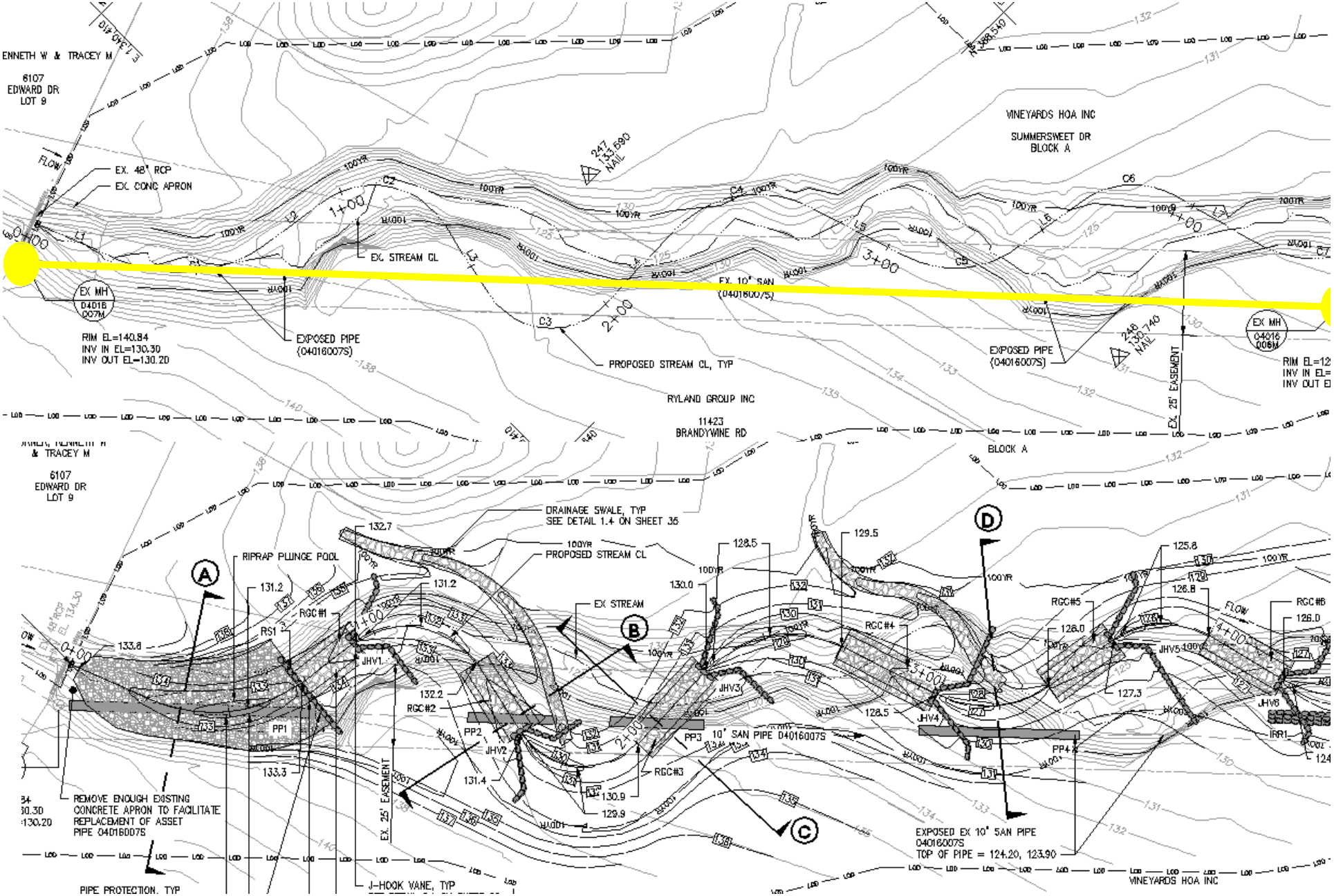


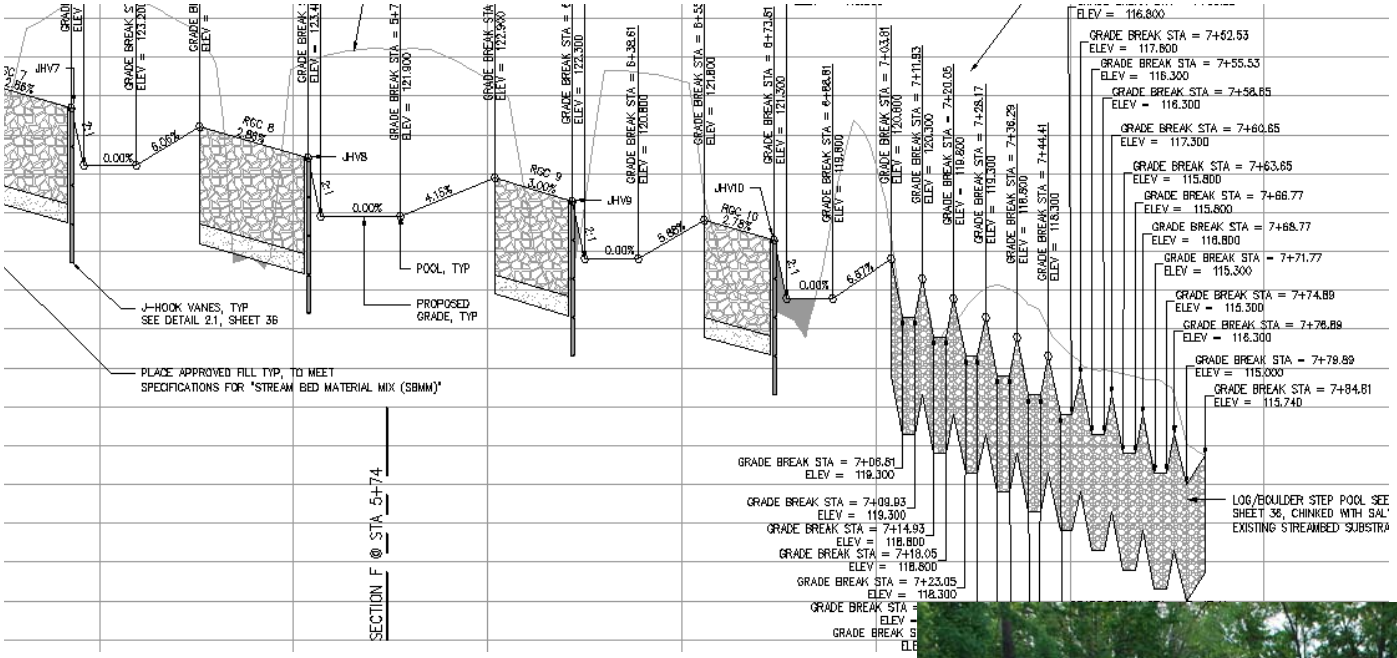
Recommendations

Pursue stream restoration (plan, dimension, profile) design if:

1. Cover is key (> 1’ min)
2. Cross linear assets at riffles
3. Protect linear assets with downstream grade control
4. Protect manholes by distance from stream; use bank protection at meanders if necessary

“Cross it, (grade) control it - run it, restore it”


ENNETH W & TRACEY M
6107
EDWARD DR
LOT 9
VINEYARDS HOA INC
SUMMERSWEET DR
BLOCK A
EX. 48" RCP
EX. CONC APRON
EX. STREAM CL
EX MH
04016
007M
RIM EL=140.84
INV IN EL=130.30
INV OUT EL=130.20
EXPOSED PIPE
(04016007S)
EX. 10" SAN
(04016007S)
PROPOSED STREAM CL, TYP
RYLAND GROUP INC
11423
BRANDYWINE RD
EX. 25' EASEMENT
DRAINAGE SWALE, TYP
SEE DETAIL 1.4 ON SHEET 35
RIPRAP PLUNGE POOL
PROPOSED STREAM CL
EX STREAM
RGC#1
RGC#2
RGC#3
RGC#4
RGC#5
RGC#6
RS1
JHV1
JHV2
JHV3
JHV4
JHV5
JHV6
IRR1
PP1
PP2
PP3
PP4
10" SAN PIPE 04016007S
REMOVE ENOUGH EXISTING
CONCRETE APRON TO FACILITATE
REPLACEMENT OF ASSET
PIPE 04016007S
PIPE PROTECTION, TYP
J-HOOK VANE, TYP
EXPOSED EX 10" SAN PIPE
04016007S
TOP OF PIPE = 124.20, 123.90
A
B
C
D


JHV7
JHV8
JHV9
JHV10
POOL, TYP
PROPOSED GRADE, TYP
J-HOOK VANES, TYP
SEE DETAIL 2.1, SHEET 36
PLACE APPROVED FILL TYP, TO MEET
SPECIFICATIONS FOR "STREAM BED MATERIAL MIX (SBMM)"
SECTION F @ STA 5+74
GRADE BREAK STA = 7+62.53
ELEV = 117.800
GRADE BREAK STA = 7+55.53
ELEV = 116.300
GRADE BREAK STA = 7+58.65
ELEV = 116.300
GRADE BREAK STA = 7+60.65
ELEV = 117.300
GRADE BREAK STA = 7+63.65
ELEV = 115.800
GRADE BREAK STA = 7+66.77
ELEV = 115.800
GRADE BREAK STA = 7+68.77
ELEV = 116.800
GRADE BREAK STA = 7+71.77
ELEV = 115.300
GRADE BREAK STA = 7+74.89
ELEV = 116.300
GRADE BREAK STA = 7+76.89
ELEV = 116.300
GRADE BREAK STA = 7+79.89
ELEV = 115.000
GRADE BREAK STA = 7+84.81
ELEV = 115.740
LOG/BOULDER STEP POOL SEE
SHEET 36, CHINKED WITH SAL
EXISTING STREAMBED SUBSTRA
GRADE BREAK STA = 7+06.81
ELEV = 119.300
GRADE BREAK STA = 7+09.93
ELEV = 119.300
GRADE BREAK STA = 7+14.93
ELEV = 118.800
GRADE BREAK STA = 7+18.05
ELEV = 118.800
GRADE BREAK STA = 7+23.05
ELEV = 118.300

Piscataway Creek, Maryland

Breakdown of internal, external, relocation and restoration; 77 assets

Method	#	Percent
Internal	73	95%
External	51	66%
Relocation	4	5%
Restoration	22	29%

Thank you

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