



GATEWAY

On Call. On Time. On Target.

Agenda

- Goal
- Challenges
- Common Solutions
- Natural Solutions
- Case Studies
- Q&A



How do streams become unstable?

- Dredging
- Channel Straightening
- Berms
- Disconnecting floodplain from the channel
- Development on the floodplain



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Challenges – Bank Erosion

- Bank Erosion



Challenges – Flooding

- Flooding



Common Solutions – Hard Armoring

Acts as a Band Aid. Not a long term fix.

Types of Hard Armoring:

Gabion Walls – Requires maintenance and has a short life span.

Durahold Retaining Wall – Expensive/disconnects natural floodplain.

Rip Rap – Has a short lifespan.



Common Solutions – Dredging

Does more harm than good.

- Dredging can disconnect a stream from its floodplain causing down-cut to begin leading to taller, steeper, and more unstable stream banks.



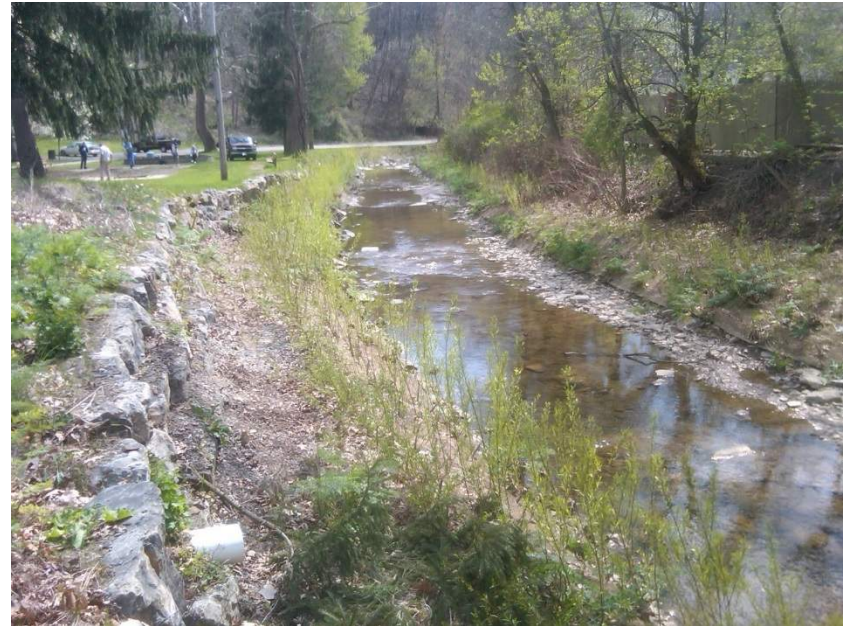
Natural Solutions – Reconnection to the Floodplain

- Redirect the thalweg to the center of the stream to protect the streambanks from erosion
- Control and direct stream velocities into areas that allow natural dissipation without impacts. Such as: bedrock stream beds, pools, rock outcrop
- Use natural materials to provide better aquatic habitat



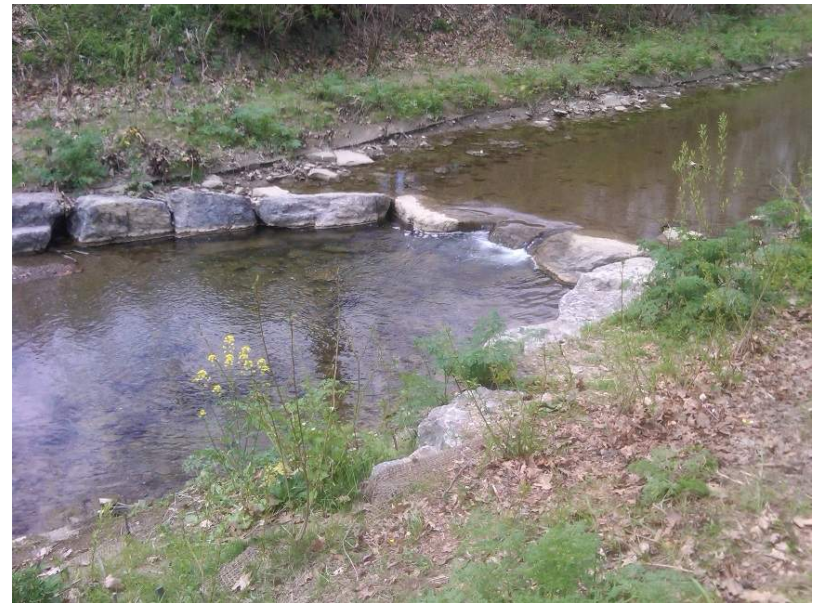
Natural Solutions – Reconnection to the Floodplain

- High waters need to be connected to their natural floodplains
- Provide benches or multi-stage channels



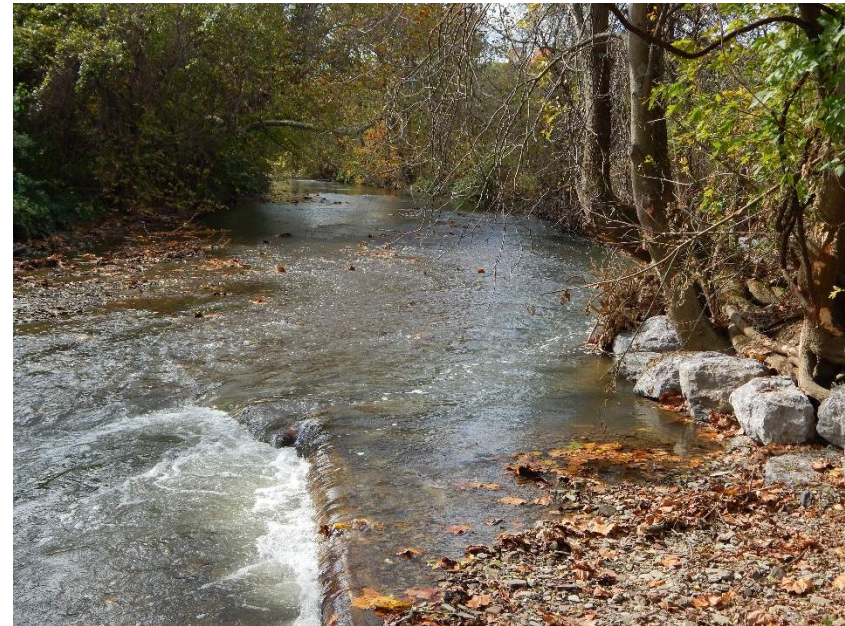
Natural Solutions – In-stream Structures

- Rock Cross Vane
 - Long-term maintenance is typically little to nothing



Natural Solutions – In-stream Structures

- Log Vane



Natural Solutions – In-stream Structures

- Branch Layering



Natural Solutions – In-stream Structures

- Vegetation
 - Vegetation holds the stream banks together (Permanent Stabilization)
 - Grass will provide short-term stability and prevent fine sediment runoff
 - Woody vegetation will provide long-term stability



Natural Solutions – In-stream Structures

- Gravel bar removal
 - Bars can be removed but should be in conjunction with stream structures that will help prevent future deposits and bank erosion



Natural Solutions – In-stream Structures

- Plantings and Rootwads



Getting Started – Routine Storm Maintenance

- What can be done without a permit by public works?
 - Clear debris jams: fallen trees, branches, and litter
 - Plantings on a stable bank
 - If you are working within 50 feet of the top of the stream bank, you may need a permit...check with your engineer.



Getting Started – MS4 Requirements

- New MS4 permit requires sediment reductions of 10%. The permit time frame begins in 2018 and lasts five years
- Stream restoration is an approved structural best management practice, no credit for rip-rap or hard armor
- The number one source of sediment in a stream is stream bank or stream bed erosion



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Getting Started – Permitting

- General Permits have become easier to apply for and less costly to obtain
- Permit review and approval for most general permits can be issued by County Conservation District, instead of PaDEP in the past
- Typical review time for general permits is generally 2-3 months to acquire permits vs. 12 months plus, minimum, for Joint Permit applications



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Getting Started – Grant Opportunities

- Growing Greener Grant – sponsored by PA DEP
- Greenways, Trails, and Recreation Program (GTRP) – Sponsored by PA DCNR
- Park Rehabilitation and Development – sponsored by PA DCNR
- Flood Mitigation (FM) – sponsored by Commonwealth Financing Authority (ACT 13 - up to \$500k + 15% match required)



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Getting Started – Selecting a Qualified Contractor

Natural Channel construction is an art, examples of failed stream structure installation



Constructed from riprap, created 2 streams, rock unstable and pushed downstream after a storm

Log vane out of the stream, no diversion



Case Studies

Opinion of Probable Construction Cost for Sanitary Sewer Repairs - Hard Armor

Description	Units	Unit Price	Quantity	Cost
Access to Project Site	L.S.	\$1,500.00	1	\$1,500.00
Erosion & Sedimentation Controls, incl. fence and dam, CIP	L.S.	\$5,000.00	1	\$5,000.00
Excavation of Embankment and Streambed, CIP	TON	\$40.00	60	\$2,400.00
Installation of Geotextile Fabric, Class 1, CIP	S.Y.	\$10.00	200	\$2,000.00
Installation of Structural Geogrid Fabric, CIP	S.Y.	\$10.00	35	\$350.00
Placement of R-7 Rip-Rap, CIP	TON	\$100.00	250	\$25,000.00
Placement of R-5 Rip-Rap, CIP	TON	\$75.00	40	\$3,000.00
Grouting of placed Rip-Rap, CIP	TON	\$130.00	40	\$5,200.00
Restoration and Clean-up of Repair and Access Area, CIP	L.S.	\$2,500.00	1	\$2,500.00
Mobilization/Demobilization	L.S.	\$5,000.00	1	\$5,000.00
			TOTAL CONSTRUCTION	\$51,950.00

Opinion of Probable Construction Cost for Sanitary Sewer Repairs - Natural Channel Design

Description	Units	Unit Price	Quantity	Cost
Access to Project Site	L.S.	\$1,500.00	1	\$1,500.00
Erosion & Sedimentation Controls, incl. fence and dam, CIP	L.S.	\$5,000.00	1	\$5,000.00
Clearing & Grubbing, CIP	LS	\$650.00	1	\$650.00
Log Vanes with Rock J-Hook, CIP	EA	\$1,500.00	2	\$3,000.00
Log Cross Vanes w/ Rock, CIP	EA	\$2,750.00	1	\$2,750.00
12" Coir Logs (2 Layers), CIP	LF	\$65.00	160	\$10,400.00
4' Branch Layering (2 Layers), CIP	LF	\$46.00	160	\$7,360.00
Dirt Backfill, CIP	CY	\$50.00	100	\$5,000.00
Restoration and Clean-up of Repair and Access Area, CIP	L.S.	\$2,500.00	1	\$2,500.00
Mobilization/Demobilization	L.S.	\$5,000.00	1	\$5,000.00
			TOTAL CONSTRUCTION	\$43,160.00



Case Studies

- Crouse Run Case Study - Pre-Construction



Cost Associated with Designs

- Crouse Run Case Study - Contract Costs

Crouse Run Stream Restoration Project					
Item No.	Item	Unit	Quantity	Unit Price	Amount
1	Site Preparation, complete in place	LS	1	\$ 1,000.00	\$ 1,000.00
2	E&S Control Measures, complete in place	LS	1	\$ 1,450.00	\$ 1,450.00
3	Diversion and Dewatering Measures, complete in place	LS	1	\$ 950.00	\$ 950.00
4	Excavation & Gravel Bar Removal, complete in place	LS	1	\$ 1,000.00	\$ 1,000.00
5	Log Cross Vane w/rock invert, complete in place	EA	1	\$ 8,000.00	\$ 8,000.00
6	Log Vane, complete in place	EA	5	\$ 4,000.00	\$ 20,000.00
7	J-Hook Log Vane combo, complete in place	EA	1	\$ 4,800.00	\$ 4,800.00
8	Rootwads, complete in place	EA	3	\$ 2,000.00	\$ 6,000.00
9	12" Standard Coir Log, complete in place	LF	275	\$ 45.00	\$ 12,375.00
10	Branch Layering (2 layers), complete in place	LF	275	\$ 45.00	\$ 12,375.00
11	Landscaping, Seeding & Site Restoration, complete in place	LS	1	\$ 2,000.00	\$ 2,000.00
				Bid Total	\$ 69,950.00

Case Studies

- Crouse Run Case Study - Post-Construction



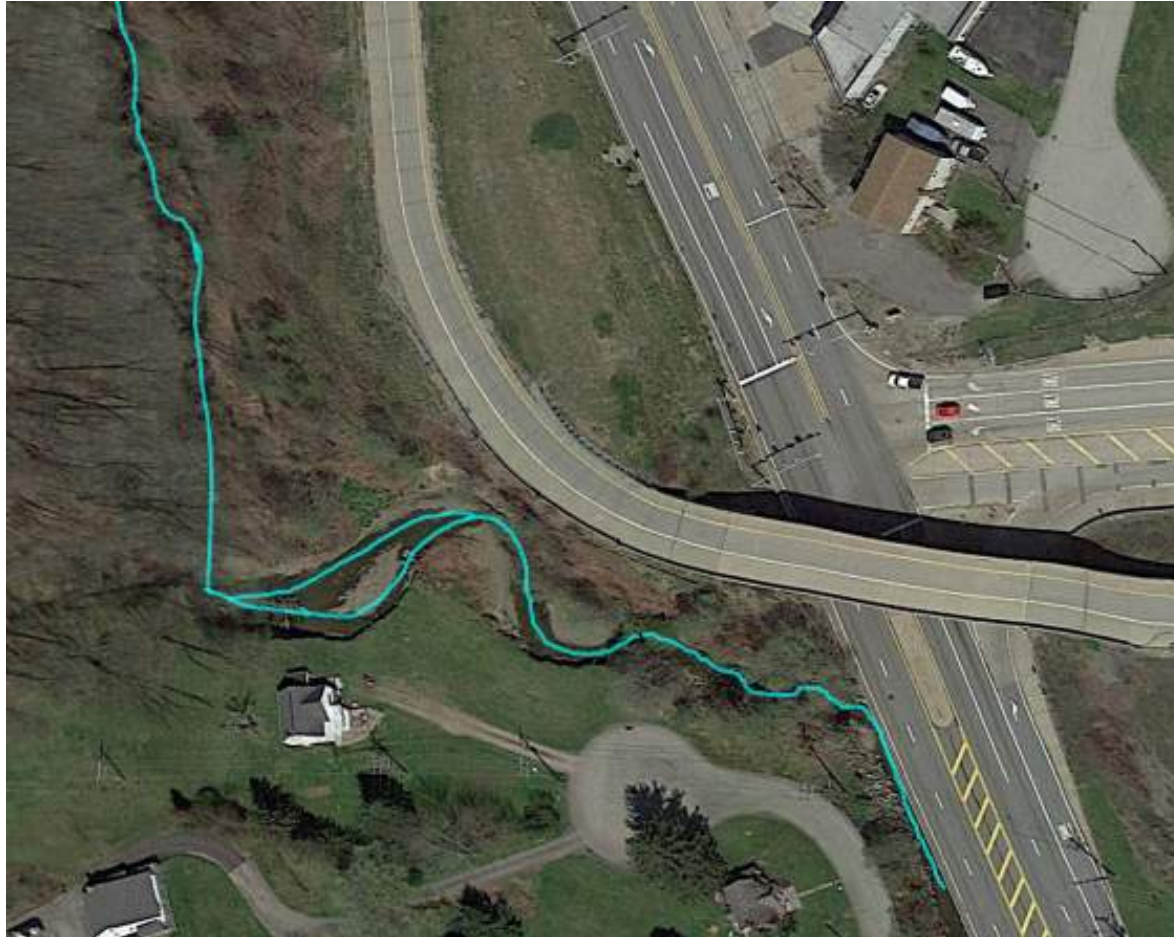
Case Studies

- Lewis Run Case Study - Pre-Construction



Case Studies

- Lewis Run Case Study - Aerial (4/16/2016 Google Earth)



Cost Associated with Designs

- Lewis Run Case Study - Contract Costs

Item No.	Item	Unit	Quantity	Unit Price	Amount
1	Site Preparation, complete in place	LS	1	\$ 1,000.00	\$ 1,000.00
2	E&S Control Measures, complete in place	LS	1	\$ 1,000.00	\$ 1,000.00
3	Diversion and Dewatering Measures, complete in place	LS	1	\$ 1,000.00	\$ 1,000.00
4	In-stream Excavation & Gravel Bar Removal, complete in place	LS	1	\$ 10,000.00	\$ 10,000.00
5	Concrete Endwall, complete in place	EA	1	\$ 200.00	\$ 200.00
6	15" ADS N-12 storm sewer, complete in place	LF	30	\$ 20.00	\$ 600.00
7	Pre-Cast Storm Sewer Inlet with Frame, and Grate, complete in place	EA	1	\$ 500.00	\$ 500.00
8	J-Hook Log Vane combo, complete in place	EA	1	\$ 10,000.00	\$ 10,000.00
9	Log Vane, Complete in Place	EA	1	\$ 10,000.00	\$ 10,000.00
10	R-7 Rip-Rap, complete in place	TON	15	\$ 50.00	\$ 750.00
11	12" Standard Coir Log, complete in place	LF	130	\$ 30.00	\$ 3,900.00
12	Branch Layering (2 layers), complete in place	LF	130	\$ 50.00	\$ 6,500.00
13	Erosion control blanket, complete in place	LS	1	\$ 4,000.00	\$ 4,000.00
14	Landscaping, seeding & site restoration, complete in place	LS	1	\$ 2,000.00	\$ 2,000.00
15	Grading & Restoration of Borrow Area, complete in place	LS	1	\$ 2,000.00	\$ 2,000.00
16	Placement of Fill Material, complete in place	CY	250	\$ 10.00	\$ 2,500.00
				Bid Total	\$ 55,950.00



Case Studies

- Lewis Run Case Study - Post-Construction



Case Studies

- Peters Creek Phase 5 Case Study - Pre-Construction



Cost Associated with Designs

- Peters Creek Phase 5 Case Study - Contract Costs

Item No.	Item	Unit	Quantity	Unit Price	Amount
1	Site Preparation	LS	1	\$ 2,000.00	\$ 2,000.00
2	E&S Control Measures	LS	1	\$ 4,000.00	\$ 4,000.00
3	Excavation	LS	1	\$ 10,000.00	\$ 10,000.00
4	Bankful Benches	LF	500	\$ 25.00	\$ 12,500.00
5	Rock Cross Vane	EA	2	\$ 10,000.00	\$ 20,000.00
6	Modified Rock Cross Vane	EA	1	\$ 10,000.00	\$ 10,000.00
7	Stream Diversion Piping	LS	1	\$ 2,000.00	\$ 2,000.00
8	Log Vanes	EA	3	\$ 5,000.00	\$ 15,000.00
9	Rootwads	EA	2	\$ 2,500.00	\$ 5,000.00
10	Rock Toe	LF	60	\$ 200.00	\$ 12,000.00
11	Woody toe protection	LF	120	\$ 100.00	\$ 12,000.00
12	12" Standard Coir Log	LF	350	\$ 50.00	\$ 17,500.00
13	Branch Layering (1 layer)	LF	120	\$ 40.00	\$ 4,800.00
14	E&S Blanket	LS	1	\$ 10,000.00	\$ 10,000.00
15	Coir Mat 700 matting	LS	1	\$ 10,000.00	\$ 10,000.00
16	R-5 Rip Rap apron	LS	1	\$ 10,000.00	\$ 10,000.00
17	Seeding & Site Restoration	LS	1	\$ 10,000.00	\$ 10,000.00
18	Containerized Shrubs	EA	150	\$ 30.00	\$ 4,500.00
19	3' Live Stakes	EA	2500	\$ 10.00	\$ 25,000.00
20	Work Zone Protection	LS	1	\$ 5,000.00	\$ 6,000.00
21	Boulder Wall	SFF	150	\$ 135.00	\$ 20,250.00
				Bid Total	\$ 222,550.00

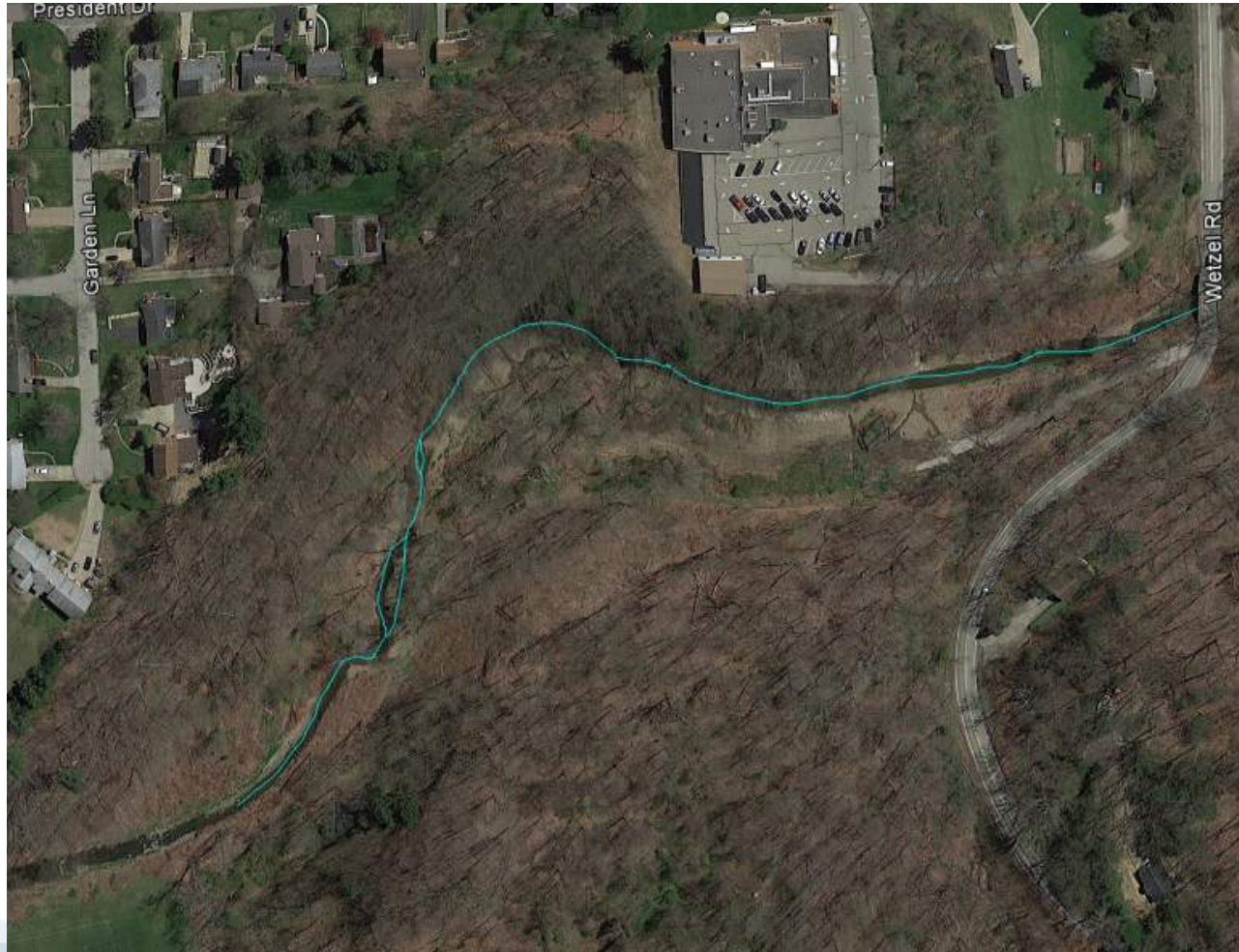
Case Studies

- Peters Creek Phase 5 Case Study - Post-Construction



Case Studies

- Fawcett Park Case Study - Aerial (4/17/2016 Google Earth)



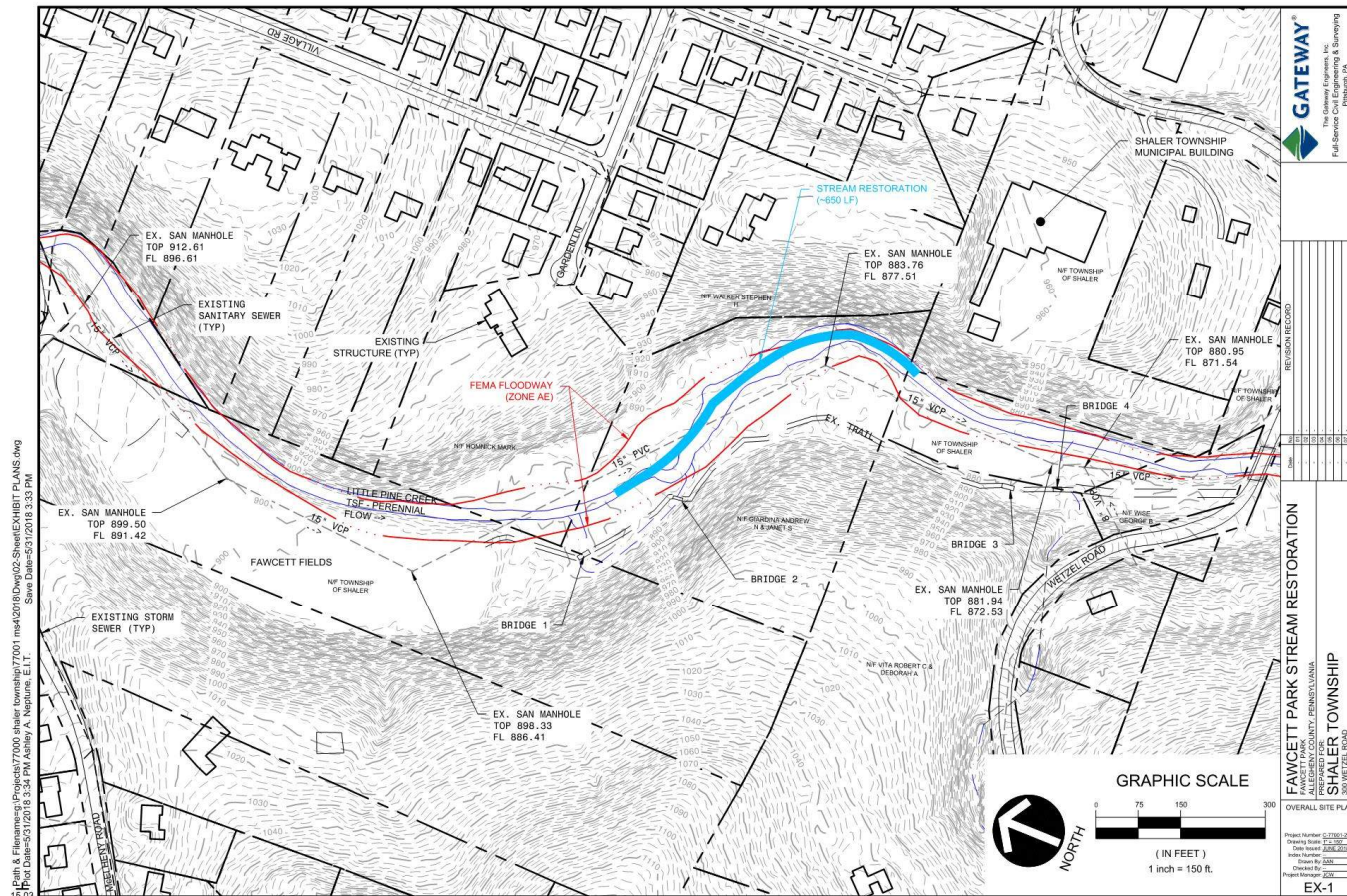
Case Studies

- Fawcett Park Case Study - Pre-Construction



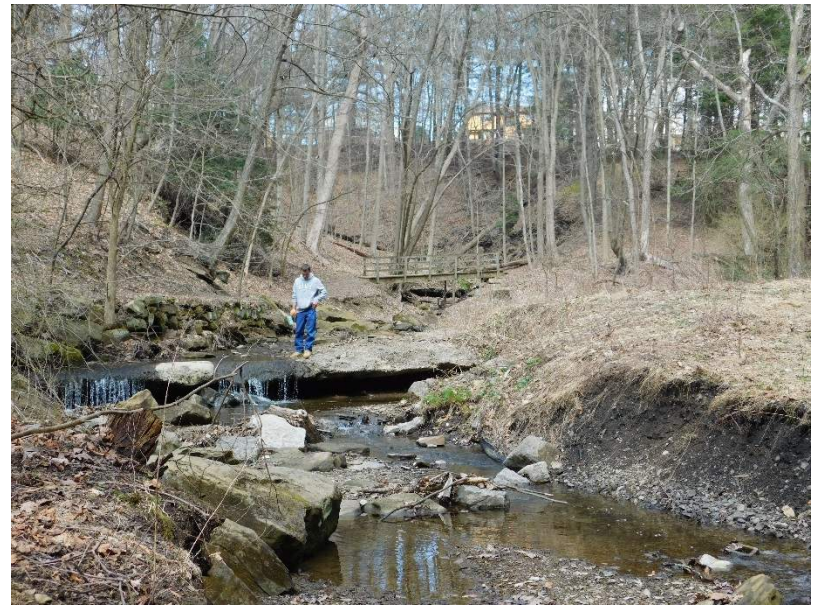
Case Studies

- Fawcett Park Case Study - Design Concept



Case Studies

- Fall Run Case Study - Pre-Construction



Cost Associated with Designs

- Fall Run Case Study - Contract Costs

Item No.	Item	Unit	Quantity	Unit Price	Amount
1	Mobilization and Bond	LS	1	\$ 46,000.00	\$ 46,000.00
2	Rock Construction Entrance	EA	3	\$ 1,700.00	\$ 5,100.00
3	Clearing and Grubbing	LS	1	\$ 7,000.00	\$ 7,000.00
4	Erosion Control and Dewatering	LS	1	\$ 70,000.00	\$ 70,000.00
5	Excavation	LS	1	\$ 45,000.00	\$ 45,000.00
6	Log Vane	EA	16	\$ 2,400.00	\$ 38,400.00
7	Rootwad	EA	12	\$ 2,600.00	\$ 31,200.00
8	Rock Cross Vane	EA	5	\$ 3,200.00	\$ 16,000.00
9	Rock Step Pool	EA	2	\$ 1,955.00	\$ 3,910.00
10	Rock Toe	LF	680	\$ 80.00	\$ 54,400.00
11	Rock Wall	SFF	300	\$ 45.00	\$ 13,500.00
12	12" Coir log	LF	30	\$ 60.00	\$ 1,800.00
13	4' branch layering (2 layers)	LF	570	\$ 70.00	\$ 39,900.00
14	Coir Matt 700 and Bank Seeding	SY	223	\$ 12.00	\$ 2,676.00
15	Landscaping, Seeding & Site Restoration	LS	1	\$ 28,000.00	\$ 28,000.00
17	Abandoned Sewer Removal	LF	70	\$ 30.00	\$ 2,100.00
				Total Stream Work \$	408,886.00

Case Studies

- Fall Run Case Study - Post-Construction



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Question & Answer

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