

Commonwealth of Pennsylvania
Department of Environmental Protection
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Subject: Aquatic Biology Investigation
Case: Shull Farm FPR Operation
UNT Geddes Run
Plumstead Township, Bucks County

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Introduction

On April 30, 2026, an aquatic biology investigation was conducted on an unnamed tributary (UNT) to Geddes Run in Plumstead Township, Bucks County (Figure 1). The survey was conducted by the writer and Steven Unger (Aquatic Biologist Supervisor). The purpose of the survey was to examine potential instream water quality impacts in UNT Geddes Run associated with the storage and application of food processing residuals (FPRs) originating from Kingdom Provisions LLC animal processing facility. Geddes Run is designated as Cold Water Fishes (CWF) in the area of the survey. Aquatic life use in the area of the survey is supporting based on a 2016 ICE survey. The UNT that directly receives the discharge from the facility is not mapped by USGS as an NHD flowline but had continuous flow to Geddes Run at the time of the survey. Land use in the small watershed (2.7 square miles) is largely agricultural mixed with low density residential and about 32% forested land. Surficial materials in the area of the survey consist of argillite, shale, mudstone and siltstone.

Methods

Observations were made in the immediate vicinity of the property and to an extent downstream regarding, among other things, floating solids and substances that form deposits. Field measurements were taken just downstream of the impoundments and at the three survey stations: one approximately 400m downstream from the impoundments on the receiving stream and two on Geddes Run approximately 100m upstream and downstream of the confluence with the receiving stream (Figure 1). Water quality parameters were recorded at mid-channel at each location. Discrete water chemistry samples were taken at each station in accordance with the

Discrete Water Chemistry Data Collection Protocol (Shull and Arnold, 2023). Stream habitat was evaluated at each macroinvertebrate station following the Stream Habitat Data Collection Protocol (Lookenbill, 2017). Benthic macroinvertebrates were collected following the Wadeable Riffle-Run Stream Macroinvertebrate Data Collection Protocol (Shull, 2017) compiling six one-minute kicks within a 100-meter reach using a 500 micron D-framed net. Macroinvertebrate samples were identified and subsampled following the Macroinvertebrate Laboratory Subsampling and Identification Protocol (Brickner, 2020). For comparison purposes, IBI scores were determined for each macroinvertebrate sample using the Wadeable Freestone Riffle-Run Stream Macroinvertebrate Assessment Method (Shull, 2023).

Results

Station 1: Geddes Run Upstream

Latitude: 40.415818

Longitude: -75.087786

STA1 was selected as an upstream reference station on Geddes Run (Figure 1). The station was located approximately 100m above the confluence with the UNT receiving flow from seeps near the base of the lagoons and adjacent fields where FPRs were applied. Conditions seemed as expected with no abnormal odor, color, turbidity, deposits, or foam observed. Field chemistry results were normal with pH and dissolved oxygen within specific water quality criteria (Table 1). Specific Conductivity was typical of streams in the region. Results from samples sent to the lab showed elevated total phosphorus, typical of the region, and metals and other parameters within specific water quality criteria and criteria for toxic substances (Table 2). Nitrogen and phosphorous were slightly lower at STA1 than STA3.

Results of the habitat evaluation were highest at STA1 compared with STA2 and STA3 (Table 3). Instream parameters related to macroinvertebrate habitat, such as epifaunal substrate, velocity depth regime, and riffle frequency, were in the optimal range. (Table 3). Condition of banks and sediment deposition scored in the marginal to suboptimal range indicating erosion and sedimentation typical of streams influenced by agriculture. Macroinvertebrate sampling reflects a community typical of streams impacted by agricultural and developed land use and did not support the current attaining status for aquatic life use with an IBI score of 40.7. The sample was dominated by small minnow mayflies, nemourid stoneflies, non-biting midges and scuds. 16 total taxa were identified, with 8 EPT taxa (insect orders which are generally considered sensitive to pollution) (Table 4).

Station 2: UNT Geddes Run

Latitude: 40.417354

Longitude: -75.086879

STA2 was located on the receiving channel on the farm property approximately 100 meters upstream of the confluence with Geddes Run (Figure 1). This station was selected to represent conditions below the impacts from the FPR composting area, manure storage, and runoff from fields where FPRs are applied. Observations were made starting at the beginning of the channel

below the lagoons downstream to STA2 (Photo 1). Dark colored seeps were seen beginning near the base of the lagoons along with a pooled area with two corrugated pipes (Photo 2). The seeps led to a continuous channel containing undesirable algal growth including gray filamentous material indicative of sewage fungus (*Sphaerotilus*) (Photo 3). A sharp drop in DO was documented by field meter upstream of a substantial grade control feature at the upstream extent of STA2 (Table 1). Below the grade control feature, flow increased and channel substrates were a mix of bedrock, cobble, and gravel. Seeps with clear water in areas away from the base of the lagoons were observed contributing to flow in the channel.

Field chemistry results at STA2 were within specific water quality criteria, with slightly lower pH and DO than Geddes Run (Table 1). Chemistry samples taken at STA2 show elevated levels of nitrogen and phosphorus (Table 2). Both were an order of magnitude greater than EPA recommended limits for ecoregion IX (EPA 822-B-00-019) for total nitrogen (0.690 mg/L) and total phosphorus (0.037 mg/L). Metal concentrations were either below detection limits or well below water quality criteria for toxic substances.

Results of the habitat evaluation were lowest at STA2 (Table 3). Instream parameters related to macroinvertebrate habitat, such as epifaunal substrate, velocity depth regime, and riffle frequency, were in the suboptimal to optimal range. (Table 3). Scores related to the quality of the riparian zone were in the suboptimal range due to the proximity of agricultural fields. Macroinvertebrate sampling results were consistent with small headwater streams impacted by high nutrient loads. The sample was dominated by scuds, biting and non-biting midges, and segmented worms. Eighteen total taxa were identified, including 2 EPT taxa (insect orders which are generally considered sensitive to pollution) (Table 4). Many species identified are highly tolerant genera that can be found in both lentic and lotic environments. The IBI score at this station was much lower at this station (27.6) than the two stations on Geddes Run.

UNT Geddes Run is not mapped as an NHD flowline, however the stream bed and banks were obvious and continued the length of the reach. A substantial grade control feature was present near the upstream extent of the reach, beyond which flow increased and channel substrates were a mix of bedrock cobble and gravel. Linear units of mapped hydric soils can act as an indicator of flowing streams. A continuous line of soils along the channel at STA1 have a higher hydric rating (85%) than the surrounding area (5%) according to the USDA Web Soil Survey. The observed hydrology, geomorphology and biology indicate that the channel is at least intermittent and contains aquatic life that should be protected.

Station 3: Geddes Run Downstream

Latitude: 40.414508

Longitude: -75.085579

STA3 was selected to assess downstream impacts (Figure 1). The station was located approximately 100m below the confluence with the receiving stream. No abnormal odor, color, turbidity, deposits, or foam were observed. Field chemistry results were similar to STA1 (Table 1). Water chemistry results showed total phosphorus and nitrogen were slightly elevated compared to STA1 but not as high as STA2. Phosphorus and nitrogen remained slightly higher

than EPA recommended limits for ecoregion IX (EPA 822-B-00-019). Metals were below criteria for toxic substances (Table 2).

STA3 scored slightly lower than STA1 in the rapid bioassessment habitat protocol. Epifaunal substrate and frequency of riffles scored lower due to the prevalence of bedrock in the stream bed (Table 3). The macroinvertebrate community was similar to STA1, with an IBI score of 41.18. Thirteen total taxa were identified, with 9 EPT taxa present (Table 4). The sample was dominated by small minnow mayflies and nemourid stoneflies.

Conclusions

1. Based on sampling in Geddes Run bracketing the confluence with UNT Geddes Run, it does not appear that FPR composting and storage is degrading the macroinvertebrate community in Geddes Run. Total taxa and EPT abundance were similar downstream of the confluence with the receiving tributary compared to the upstream station.
2. Total nitrogen and phosphorus are higher than the federally recommended ambient water quality criteria for this ecoregion (EPA 822-B-00-019) in UNT Geddes Run, however, higher nutrients from the UNT are not reflected in the downstream station on Geddes Run.
3. The UNT contains aquatic life that should be protected in the FPR management plan for the facility. The results of this survey indicate that UNT Geddes Run is an intermittent stream that should be protected by a 100ft setback.
4. Increased organic and nutrient load originating from seeps at the base of the storage lagoons are likely the cause of undesirable biofilm and algal growth throughout most of UNT Geddes Run and reduced dissolved oxygen before the change in grade.

Recommendations

1. The entire length of UNT Geddes Run should be included in the FPR waste management plan as a stream requiring minimum setback distances.
2. FPR storage structures, including the clay lined lagoons, should be inspected for seepages and integrity to prevent pollution of local water resources and avoid creating nuisance conditions.



Figure 1. Aerial imagery showing station locations. Solid blue lines are NHD Plus V2 flowlines. Dashed blue line added by author.



Photo 1: Beginning of channel behind impoundments

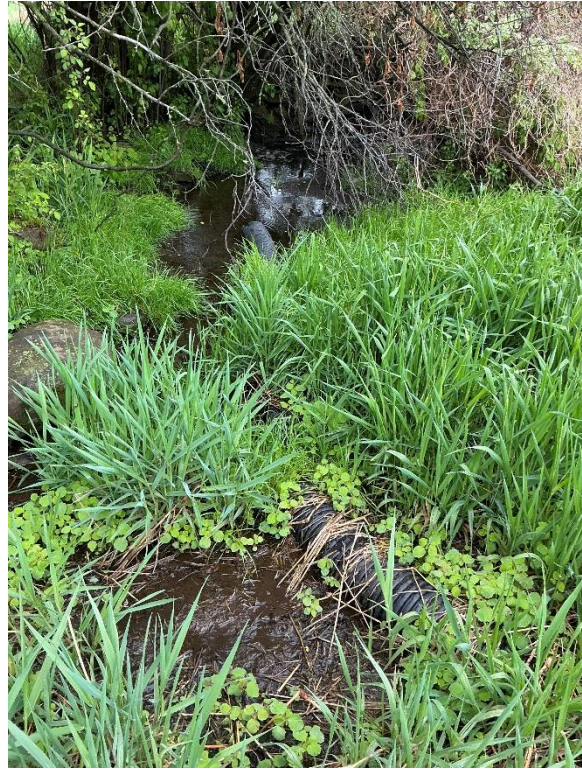


Photo 2: Corrugated pipes near beginning of UNT Geddes Run



Photo 3: Undesirable algal growth in channel



Photo 4: STA2 downstream view

Table 1. Field chemistry results

	Temp °C	pH	Sp. Cond. µs/cm	DO mg/L	DO%
Below impoundments	11.6	7.11	580	3.20	30.0
STA1	12.3	7.93	443.1	10.95	104.2
STA2	11.6	7.63	492.8	10.00	93.3
STA3	12.2	7.97	432.3	10.84	102.8

Table 2. Water chemistry results for survey stations

	STA1	STA2	STA3
Date	2026-04-30	2026-04-30	2026-04-30
Time	12:10	10:25	11:30
METALS AND IONS			
ALUMINUM DISSOLVED ug/l	<15	<15	<15
ALUMINUM T ug/l	141.602	83.798	128.719
ANTIMONY T ug/l	<2	<2	<2
BARIUM T ug/l	28.293	29.437	25.903
BORON T ug/l	<200	<200	<200
BROMIDE T mg/l	<0.2	<0.2	<0.2
CADMIUM DISSOLVED ug/l	<0.2	<0.2	<0.2
CADMIUM T ug/l	<0.2	<0.2	<0.2
CALCIUM T mg/l	28.2	32.1	27.7
CHLORIDE T mg/l	67.9	46.4	64.2
CHROMIUM T ug/l	<4	<4	<4
COBALT T ug/l	<1	<1	<1
COPPER DISSOLVED ug/l	1.902	3.358	1.924
COPPER T ug/l	2.145	3.222	2.033
IRON DISSOLVED ug/l	<100	<100	<100
IRON T ug/l	188	179	183
LEAD DISSOLVED ug/l	<1	<1	<1
LEAD T ug/l	<1	<1	<1
LITHIUM DISSOLVED ug/l	<25	<25	<25
LITHIUM T ug/l	<25	<25	<25
MAGNESIUM T mg/l	11.4	19.9	11.4
MANGANESE DISSOLVED ug/l	<2	47.105	<2
MANGANESE T ug/l	4.156	171.923	5.982
MERCURY T ug/l	<0.2	<0.2	<0.2
NICKEL DISSOLVED ug/l	<8	<8	<8
NICKEL T ug/l	<8	<8	<8

	STA1	STA2	STA3
POTASSIUM DISSOLVED mg/l	2.83	13.7	3.03
POTASSIUM T mg/l	2.92	14.3	3.11
SELENIUM DISSOLVED ug/l	<4	<4	<4
SELENIUM T ug/l	<4	<4	<4
SILVER T ug/l	<0.4	<0.4	<0.4
SODIUM T mg/l	43.1	32.4	41.3
STRONTIUM T ug/l	195	178	192
SULFATE T mg/l	19.04	35.25	19.25
THALLIUM T ug/l	<2	<2	<2
VANADIUM T ug/l	<13	<13	<13
ZINC DISSOLVED ug/l	<5	<5	<5
ZINC T ug/l	<5	<5	<5
NUTRIENTS			
AMMONIA AS N DISSOLVED mg/l	<0.02	0.277	0.038
AMMONIA AS N T mg/l	<0.02	0.25	<0.02
NITRATE + NITRITE AS N DISSOLVED mg/l	0.09	3.21	0.31
NITRATE AS N T mg/l	0.09	3.16	0.3
NITRITE AS N T mg/l	<0.01	0.07	<0.01
NITROGEN DISSOLVED mg/l	0.504	4.824	0.738
NITROGEN T mg/l	0.5	4.71	0.75
ORTHOPHOSPHATE DISSOLVED mg/l	0.021	0.741	0.038
ORTHOPHOSPHATE T mg/l	0.023	0.734	0.045
PHOSPHORUS DISSOLVED mg/l	0.037	0.802	0.047
PHOSPHORUS T mg/l	0.044	0.829	0.054
BACTERIA			
E. COLI cf/100ml	365.4	81.3	187.2
FECAL COLIFORM cf/100ml	387.3	83.6	195.6
PHYSICAL/OTHER			
ALKALINITY mg/l	91.8	129	89
CARBON T ORGANIC mg/l	5.13	9.38	4.88
HARDNESS T mg/l	117	162	116
OSMOTIC PRESSURE mosm/kg	9	7	6
PH ph units	7.6	7.6	7.6
SPECIFIC COND us/cm	448	491	438
TDS mg/l	250	304	244
TSS mg/l	<8	<8	<8

Table 3. Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers Habitat Assessment Scores

Habitat Parameter	STA 1	STA2	STA3
Instream Cover (Fish)	18	16	18
Epifaunal Substrate	16	14	9
Embeddedness	16	13	15
Velocity/Depth Regimes	17	14	16
Channel Alteration	15	15	17
Sediment Deposition	14	15	13
Frequency of Riffles	18	17	15
Channel Flow Status	16	18	15
Condition of Banks	10	16	17
Bank Vegetative Protection	16	17	19
Grazing or other Disruptive Pressure	17	12	17
Riparian Vegetative Zone Width	18	12	15
Total Score	191	179	186

Optimal: 20-16

Suboptimal: 15-11

Marginal: 10-6

Poor: 5-0

Table 4. Macroinvertebrate Taxa List

Taxa	Organic Pollution Tolerance	Functional Feeding Group	STA1	STA2	STA3
Clitellata (segmented worms)					
Clitellata	10	CG	3	27	
Platyhelminthes (flatworms)					
Platyhelminthes	9	PR			1
Physidae (physid snails)					
Physidae	8	SC		2	
Planorbidae (ramshorn snails)					
Planorbidae	6	SC		1	
Asellidae (isopods)					
<i>Caecidotea</i>	6	CG		1	
Gammaridae (scuds)					
<i>Gammarus</i>	8	CG	7	52	9
Cambaridae (crayfish)					
<i>Cambarus</i>	6	CG	1		
Gerridae (water strider)					
<i>Gerris</i>	8	PR		1	
Baetidae (small minnow mayflies)					
<i>Baetis</i>	6	CG	70		97
Heptageniidae (flathead mayflies)					
<i>Maccaffertium</i>	3	SC	1		9
<i>Stenacron</i>	4	SC	5		
Perlidae (common stoneflies)					
<i>Perlesta</i>	4	PR	15		2
Perlodidae (perlodid stoneflies)					
<i>Isoperla</i>	2	PR			3
Nemouridae (spring stoneflies)					
<i>Amphinemura</i>	3	SH	36		59
Dytiscidae (Predaceous Diving Beetles)					
<i>Agabus</i>	5	PR		1	
<i>Cybister</i>	5	PR		2	
Dytiscidae sp.	5	PR		1	
Psephenidae (water pennies)					
<i>Psephenus</i>	4	SC	6		16
Elmidae (riffle beetles)					
<i>Stenelmis</i>	5	SC	1		
Hydropsychidae (net-spinning caddisflies)					
<i>Cheumatopsyche</i>	6	FC	1		2
<i>Diplectrona</i>	0	FC	1		5
<i>Hydropsyche</i>	5	FC			3
Hydroptilidae (micro caddisflies)					
<i>Dibusa</i>	4	FC	1		
Limnephilidae (northern caddisflies)					

<i>Isonychia</i>	3	SH		1	
Philopotamidae (finger-net caddisflies)					
<i>Chimarra</i>	4	FC			1
Polycentropodidae (trumpetnet caddisflies)					
<i>Ceratomyia</i>	6	PR		1	
Psychodidae (drain flies)					
<i>Psychoda</i>	10	CG		1	
<i>Ceratopogonidae</i> (biting midges)					
<i>Culicoides</i>	10	PR		21	
Chironomidae (non-biting midges)					
Chironomidae	6	CG	29	33	13
Culicidae (mosquitoes)					
<i>Culex</i>	8	FC		1	
Ephydriidae (shore flies)					
<i>Scatella</i>	6	PI		2	
<i>Scatophila</i>	6	PI		1	
Simuliidae (black flies)					
<i>Prosimulium</i>	2	FC	1		
Tipulidae (crane flies)					
<i>Tipula</i>	4	SH	4		1
Total Taxa Richness			16	18	13
EPT Richness (PTV 0-4)			6	2	6
Becks Index (version 3)			4	0	4
Hilsenhoff Biotic Index			3.92	4.49	3.70
% Intolerant Individuals (PVT 0-3)			18.8	0.65	34.6
Shannon Diversity			1.94	1.87	1.67
IBI Score			40.7	27.3	41.18

Functional Feeding Group, where :

SH = shredder

FC = filter/collector

CG = collector/gatherer

SC = scraper

PR = predator