Supplementary Table S1: Land/ crop management data field wise

Table a: J1 63 (Example)

	Year	Date	Operation	Amount
2012	1	10/11/2012	Chisel plow or Disk	Cross Slope
2012	1	NA	Planted Wheat	20% Residue after Planting
2012	1	11/7/2012	Fertilizer application (method: Surface Broadcast) DRY	250 lb/ac (N:5%, P205:26% and K20:30%)
2013	2	5/22/2013	Fertilizer application (method: Surface Broadcast) DRY	290lb/ac (N:38%, P205:0% and K20:3.7%)
2013	2	7/16/2013	Harvest and Kill	Wheat: yield 110bu/ac
2013	2	NA	Fertilizer application	
2013	2	9/21/2013	Chisel plow or Disk	primary tillage
2014	3	5/9/2014	Fertilizer application (method: Surface Broadcast) DRY	290lb/ac (N:30%, P205:7% and K20:3.14%)
2014	3	5/20/2014	Planted Cron	20% Residue after Planting
2014	3	5/20/2014	Fertilizer application (method: Surface Broadcast) DRY	427 lb/ac (N:15.7%, P205:17.5% and K20:0%)
2014	3	10/10/2014	Harvest and Kill	Cron (110bu/ac)
2014	3	10/16/2014	Fertilizer application (method: Surface Broadcast), Dry	200 lb/ac (N:5%, P205:26% and K20:30%)
2014	3	10/17/2014	Chisel plow or Disk	Cross Slopee
2015	4	5/15/2015	Planted soybean	
2015	4	NA	Fertilizer application (method: Surface Broadcast), liquid	NA
2015	4	9/15/2015	Harvest and Kill	Soybean (57bu/ac)
2015	4	9/15/2015	Chisel Plow or disk	primary tillage
2015	4	9/15/2015	Fertilizer application (method: Surface Broadcast), dry	250 lb/ac (N:5%, P205:26% and K20:30%)
2015	4	10/5/2015	planted Wheat	

2016	5	5/20/2016	Fertilizer application (method: Surface Broadcast), dry	290 lb/ac (N:38%, P205:0% and K20:3.7%)
2016	5	7/20/2016	Harvest and Kill	Wheat (110 bu/ac)
2016	5	9/16/2016	Chisel plow or Disk	primary tillage (Cross slope)
2016	5	9/15/2016	Cron	
2016	5	9/16/2016	Fertilizer application (method: Surface Broadcast), Dry	427 lb/ac (N:30%, P205:7% and K20:14%)
2017	6	5/21/2017	Fertilizer application (method: Surface Broadcast), liquid	170 lb/ac (N:15.7%, P205:17.5% and K20:0%)
2017	6	8/16/2017	Harvest and Kill	Cron (110 bu/ac)

Table b: J2 38 (Example)

	Year	Date	Operation	Amount
2012	1	10/20/2012	Fertilizer application (method:Surface Broadcast) DRY	250 lb/ac (N:0%, P205:40% and K20:60%)
2013	2		No till	
2013	2	5/10/2013	Fertilizer application (method:Surface Broadcast) Dry	250 lb/ac (N: 21%, P205: 0% and K20: 0%)
2013	2	5/12/2013	Planted Corn	
2013	2	6/5/2013	Fertilizer application (method:Surface Broadcast) Liquid	51 lgal/ac (N: 165%, P205: 0% and K20: 0%)
2013	2	11/20/2013	Harvest and Kill	Corn: yield NA
2014	3		No till	
2014	3	5/15/2014	Plant Soybean	
2014	3		No Fertilizer	
2014	3		Harvest and Kill	Soybean: NA
2015	4		No till	
2015	4	5/15/2015	Plant Soybean	
2015	4		No Fertilizer	
2015	4		Harvest and Kill	Soybean: NA
2015	4		No till	
2015	4	10/25/2015	Plant Winter wheat	
2016	5		No Fertilizer	

2016	5	7/20/2016	Harvest and Kill	Winter Wheat : 102 bu/ac
2016	5	10/20/2016	Fertilizer application (method:Surface Broadcast), Dry	200 lb/ac (N:0%, P205:40% and K20:60%)
2017	6		No till	
2017	6	5/10/2017	Fertilizer application (method:Surface Broadcast), Dry	250 lb/ac (N:21%, P205:0% and K20:0%)
2017	6	5/15/2017	Plant Cron	Residue after planting 60% min
2017	6	6/5/2017	Fertilizer application (method:Surface Broadcast), liquid	51 lgal/ac (N:165%, P205:0% and K20:0%)
2017	6	8/15/2017	Harvest and Kill	Cron (NA)

Table S2. Field-wise description of existing non-structural land management BMPs in 2016-2017 with their modification parameters applied in the Jeannette Creek watershed SWAT model.

BMP	Modifications	Fields
P banding	FRT_SURF =0 .01 a) Fertilizer application efficiency assigned by user. (ferteff). b) Reduction in amount of fertilizer C) Date or length of timing of the operation	For J1 watershed: 2016: J166, J176 and J177. 2017: J150, J154, J156, J158, J168, J171, J172, J174, J178, J185, J186, J187, J190. For J2 watershed: For 2016-17 this BMP is applied to all the fields except five fields (J2E4, J204, J205, J206, J224) where phosphorous is incorporated.
P incorporation	FRT_SURF =0.10 a) Fertizer application efficiency assigned by user. (ferteff). b) Reduction in amount of fertilizer. C) Date or length of timing of the operation.	For J1 watershed: 2016: J151, J152, J153, J157, J159, J160, J161, J162, J163, J165, J174, J179, J180, J181, J182, J183 J190, J198.2017: J160, J163, J165, J173, J169, J175, J179, J180, J181, J182, J183, J188, J198, J173. For J2 watershed: 2016: J224, J205. 2017: J2E4, J204, J205, J206, J224.
Variable rate of P	Change the timing of fertilizer, duration (days),	For J1 watershed: only applied 2016

BMP	Modifications	Fields
	Application frequency, amount of fertilizer	J150, J156, J158, J168, J169
Variable rate of P+ P incorporation	Reduction P rate by 10%	For J2 watershed: applied in 2017 J139, J141 and J232
Vegetative Buffer Strips	Change the scheduled Management Operations (.ops) file a) FILTER_RATIO = 40 b) FILTER_CON = 0.5 c) FILTER_CH = 0	For J1 watershed: applied in 2016 Two field coded as J156.
No-Till (possible BMP)	a) CN2 * 1 = CNOP (presented table 7) b) BIO MIX = 0.5 c) OV_N = 0.3 d) Update efficiency of the harvest operation	Applied in all the field to check the No Tillage BMP effectiveness.
Below Canopy application of P	Reduction in Phosphorous application	For J2 watershed: applied in 2016 Only in one field J238,
Cover Crop (Cereal Rye/Red Clover)	Add cover crop after harvesting; a) Reduction in Nitrogen application (because cover crop take nitrogen from air). b) Update the CNOP c) update the initial leaf area index (Range:0-8) and Initial dry wt biomass (Range 0-800)	For J1 watershed: applied In 2016: Two fields of J169. In 2017: J161, J162, J165, J169 For J2 watershed: In 2016: J232, J234, J238.In 2017: J207, J214, J215, J222, J232, J238, J239.
Conservation Tillage	a) Tillage operation is Change in Generic conservation b) The timing of the operation c) CN2 * 1.04= CNOP (presented table 7) d) BIOMIX = 0.4 e) OV_N = 0.2	For J1 watershed: In 2016: J161, J162, J166, J168, For J1 watershed: In 2017: J157, J159, J161, J162, J169, J180, J181, J182 For J2 watershed: applied in 2017 J212, J213, J204

BMP	Modifications	Fields
	d) Update efficiency of the harvest operation (harveff)	

Table S3. Calibrated Flow, Sediment and Phosphorous parameters for the Jeannette Creek watershed SWAT modelling

Parameter	File Type	Description	Default Value	Model Range	J1		J2	
					Best value	Sensitivity	Best value	Sensitivity
SMTMP	.bsn	Snow melt base temperature (°C)	0.5	-2 to 2	-1.38	Moderate	-0.6	Moderate
SFTMP	.bsn	Snowfall temperature (°C)	1	-2 to 2	0.06	Moderate	0.6	Moderate
SMFMX	.bsn	Maximum melt factor for snow on June 21 (mm H2O $°C^{-1}$ day^{-1})	4.5	3 to 5	4.67	High	4.5	High
SMFMN	.bsn	Minimum melt factor for snow on December 21 (mm H_2O $°C^{-1}$ day^{-1})	4.5	3 to 5	3.09	Moderate	3.7	Moderate
TIMP	.bsn	Snow pack temperature lag factor	1	0.5 to 1	0.8275	Moderate	0.875	Moderate
CN2	.mgt	Initial SCS curve number for moisture condition II	Varies	-2 to 2*	0.06	Moderate	-0.02	Moderate
ESCO	.hru	Soil Evaporation compensation factor	0.95	0.9 to 1	0.9795	High	0.955	High
CH_N2	.rte	Manning's coefficient	0.014	-0.01 to 0.1	0.07255	Moderate	0.0865	Moderate

		for the main channel						
CH_K2	.rte	Effective hydraulic conductivity in main channel alluvium (mm/hr)	0	0 to 10	9.45	High	7.5	High
SURLAG	.hru	Surface runoff lag coefficient	2	1 to 4	1.075	High	1.15	High
GWQMN	.gw	Threshold depth of water in the shallow aquifer required for return flow to occur (mm H_2O)	1000	800 to 1200	1042	Moderate	860	Moderate
GW_DELAY	.gw	Groundwater delay time (days)	31	25 to 50	32.875	Moderate	36.25	Moderate
GW_REVAP	.gw	Groundwater "revap" coefficient	0.02	0.01 to 0.03	0.0167	Moderate	0.025	Moderate
ALPHA_BF	.gw	Baseflow alpha factor	0.048	0.01 to 0.1	0.01675	Moderate	0.0955	Moderate
REVAPMN	.gw	Threshold depth of water in the shallow aquifer for “revap” or percolation to the deep aquifer to occur (mm H_2O)	750	400 to 600	427	Moderate	430	Moderate
SOL_AWC	.sol	Available water capacity of the soil layer (mm	Varies	-0.2 to 0.2*	0.058*	High	0.18	High

		H_2O/mm soil)						
SOL_K	.sol	Saturated hydraulic conductivity (mm/hr)	varies	-0.2 to 0.2*	-0.038*	Moderate	-0.02	Moderate
RES_K	.res	Hydraulic conductivity of the reservoir bottom (mm/hr)	0	0.1 to 1	0.549	Moderate	0.595	Moderate

Sediment parameters for the (J1 &J2)

Parameter	File Type	Description	Default Value	Model Range	J1		J2	
					best value	Sensitivity	best value	Sensitivity
SPCON	.bsn	Linear parameter for calculating the maximum amount of sediment that can be reentrained during channel sediment routing	0.0001	0.0001 to 0.01	0.00707	Moderate	0.008	Moderate
SPEXP	.bsn	Exponent parameter for calculating sediment reentrained in channel sediment routing	1	1.0 to 1.5	1.1175	High	1.022	Moderate
ADJ_PKR	.bsn	Peak rate adjustment factor for sediment routing in the subbasin (tributary channels)	1	0.5 to 2	1.46	Moderate	1.827	Moderate
PRF_BSN	.bsn	Peak rate adjustment factor for sediment routing in the main channel	1	0 to 2	1.97	Moderate	0.75	Moderate

CH_COV1	.rte	Channel erodibility factor	0	-0.05 to 0.6	0.369	Moderate	0.401	High
CH_COV2	.rte	Channel cover factor	0	-0.001 to 1	0.174	High	0.564	Moderate
USLE_K	.sol	USLE equation soil erodibility (K) factor	Varies	-0.1 to 0.1*	0.077	High	0.113	High
USLE_C	.plant	Minimum value of USLE C factor for water erosion applicable to the land cover/plant	Varies	-0.1 to 0.1*	0.101	Moderate	0.073	Moderate
USLE_P	.mgt	USLE support practice factor	0.6	0. to 1	0.225	Moderate	0.345	Moderate
RES_NSED	.res	Equilibrium sediment concentration in the reservoir (mg/l)	100	1 to 300	83.22	High	150.5	High
RES_D50	.res	Median particle diameter of sediment (µm)	10 µm	0 to 5	4.875	High	3.875	High

Phosphorus parameters for J1 and J2 watershed

Parameter	**File Type**	**Description**	**Unit**	**Model Range**	**J1**		**J2**	
					best value	**Sensitivity**	**best value**	**Sensitivity**
PPERCO	.bsn	Phosphorus percolation coefficient	10 m^3/Mg	10 to 17.5	15.9	High	12.70	High
PSP	.bsn	Phosphorus availability index	---	0.1 to 0.7	0.4	High	0.3	High
PHOSKD	.bsn	Phosphorus soil partitioning coefficient	M^3/Mg	100-200	147.5	Moderate	194.20	High
ERORGP	.hru	Organic P enrichment ratio	---	0.00	0.00	----	0.00	----
P_UPDIS	.bsn	Phosphorus uptake distribution parameter	----	0 to 100	84.5	Moderate	62.25	Moderate

Table S4. Model performance for streamflow simulation at dauphin and deary pump outlet of J1 and J2 (Jeannette Creek) watershed monitoring stations

Station	Period	P-stat	r-stat	PBias	R^2	NSC
J1 pump outlet	1/1/2016-31/1/2017	0.33	0.28	48.20%	0.33	0.23
J2 pump outlet	1/1/2016-31/1/2017	0.3	0.12	9.00%	0.71	0.6

Table S5. Model performance for sediment simulation at dauphin and deary pump outlet and also at upstream outlet of J1 and J2 (Jeannette Creek) watershed monitoring stations

Station	P-stat	r-stat	Item	Sample	PBias	R^2	NSC
J1 pump outlet	0.44	1.05	Concentration	71	-5.5	0.14	0.1
J2 pump outlet	0.87	1.35	Concentration	85	8.3	0.14	0.13
J2 upstream just before the pump outlet	0.82	2.62	Concentration	45	22.8	0.08	0.04
J2 upstream (middle of the watershed)	0.14	0.41	Concentration	29	15.6	0.01	-0.3

Table S6. Model performance for phosphorus (organic and Mineral) calibration at dauphin and deary pump outlet of J1 and J2 (Jeannette Creek) watershed monitoring stations

Organic P								
Station	**Period**	**Item**	**Samples (in day)**	**P-stat**	**r-stat**	**Bias**	**NSC**	**R^2**
J1 Pump outlet	1/1/2016-31/1/2017	Concentration	71	0.42	1.04	15.7	-0.12	0.01
J2 Pump outlet	1/1/2016-31/1/2017	Concentration	52	0.62	1.82	6	0.15	0.16
Mineral P								
Station	**Period**	**Item**	**Samples**	**P-stat**	**r-stat**	**Bias**	**NSC**	**R^2**
J1 Pump outlet	1/1/2016-31/1/2017	Concentration	71	0.48	1.18	-17.4	0.12	0.14
J2 Pump outlet	1/1/2016-31/1/2017	Concentration	52	0.77	85	22	-0.03	0.03