#### OWQ- WATERSHED ASSESSMENT & PLANNING BRANCH IDEM/OWQ/WAPB/WM VIRTUAL FILE CABINET INDEX FORM

*Program:	Water Monitoring
*Document Type:	Reference
*Document Date:	11/1/2024
*Security:	Public
*Reference Type:	SOP
*Project Type:	All Projects

\_\_\_\_\_

Reference Title: Calculation of Drainage Area

Document Control #: B-005-OWQ-WAP-XXX-24-T-R2

County:

Cross Reference ID: N/A

Technical Standard Operating Procedure (TSOP): Comments: Calculation of Drainage Area

Redaction Reference ID:



### Purpose

This technical standard operating procedure (TSOP) provides instructions in using the United States Geological Survey's (USGS's) StreamStats web application to compute the drainage area of sampling sites. Drainage area of a stream at a specified location is the area measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream. Drainage area calculations are used in several water quality models and indices.

### Scope

This TSOP applies to agency staff in the Office of Water Quality (OWQ) Watershed Assessment and Planning Branch (WAPB) who are responsible for calculating drainage areas and performing quality control (QC) of the measurements.

This document was originally authored by Scott Zello-Dean, Environmental Manager, Probabilistic Monitoring Section, and revised by Paula Kaszynski, Environmental Manager, Probabilistic Monitoring Section.

### **Authorizing Signatures**

I approve and authorize this technical standard operating procedure:

Paula Kaszynski

Paula Kaszynski, Environmental Manager Office of Water Quality, Probabilistic Monitoring Section

Came Ca

Cameron Yeakle, Environmental Manager Office of Water Quality, Targeted Monitoring Section

Stacey Sobat, Section Chief Office of Water Quality, Probabilistic Monitoring Section

David Tsetse, Section Chief Office of Water Quality, Technical and Logistical Services Section

Kristen Arnold, Branch Chief Da Office of Water Quality, Watershed Assessment and Planning Branch

This TSOP is consistent with agency requirements.

Coles

Quality Assurance Staff Office of Program Support

<u>11/27/2024</u> Date

<u>12/9/2024</u> Date

<u>11/27/2024</u> Date

<u>11/27/2024</u> Date

11/27/2024\_\_\_\_

Date

12/10/24

Date

# **Table of Contents**

Se	1
)	1
rizing Signatures	2
Overview Flowchart	4
Procedure	5
Procedural Flowchart	5
Procedural Steps	5
Related Technical Issues	11
Roles	12
Required Forms, Equipment, or Software List	12
Records Management	13
Definitions	13
Quality Assurance and Quality Control	14
References	14
Appendices	15
	se rizing Signatures Overview Flowchart Procedure Procedural Flowchart Procedural Steps Related Technical Issues Roles Required Forms, Equipment, or Software List Records Management Definitions Quality Assurance and Quality Control References Appendices

### 1.0. Overview Flowchart



### 2.0. Procedure

#### 2.1. Procedural Flowchart



#### 2.2. Procedural Steps

Step 1. A WAPB staff member completes all steps. Query the following site data from the Assessment Information Management System (AIMS): <u>Latitude</u>, <u>Longitude</u>, <u>L-Site</u>, <u>Waterbody\_Name</u>, <u>Description</u>, <u>Site Number</u>, <u>UTM\_EAST</u>, and <u>UTM\_NORTH</u>. Save the unaltered queried data using a filename which includes the year and sampling basin, such as 2024UpperWabash GradientDrainageArea GIS.

**Note:** Check with other staff to see whether this document has been created earlier, to eliminate duplicating an existing file.

Step 2. Create a new Microsoft Excel spreadsheet with the column headers <u>SiteID</u>, <u>Waterbody\_Name</u>, <u>L-Site</u>, <u>Site Description</u>, <u>Latitude</u>, <u>Longitude</u>, <u>UTM\_EAST</u>, and <u>UTM\_NORTH</u> for sites approved through site reconnaissance (Appendix A). Save the file in the project folder on the shared drive using a filename which includes the year and sampling basin, such as 2024 Upper Wabash Gradient and Drainage Area.

**Notes:** Spreadsheet created to record <u>drainage area (mi<sup>2</sup>)</u> values is the same spreadsheet used to record <u>gradient</u> values. Check with other staff to see whether this document has been created to eliminate duplicating an existing file.

- Step 3. Add columns for <u>Gradient</u>, <u>Gradient QC1</u>, <u>Gradient QC2</u>, <u>Drainage Area (mi<sup>2</sup>)</u>, <u>Drainage Area QC1</u>, and <u>Drainage Area QC2</u>. Directly underneath the list of sites, add a row for <u>Initial/Date</u>. Staff filling in the <u>Drainage Area (mi<sup>2</sup>)</u> and QC columns will initial and date the completed columns in the <u>Initials/Date</u> cell below the last calculation. Each set of columns should include three different initials.
- Step 4. Open a web browser and navigate to USGS's <u>Stream Stats</u> website.
- Step 5. Copy and paste latitude and longitude information for the approved site into the <u>Find a place</u> search bar. A dropdown menu with the coordinate will appear. Click the coordinates which appear in the <u>Results</u> box (Figure 1). StreamStats will then zoom in on the coordinates. The coordinates are marked with a red dot.





Step 6. Click <u>Indiana</u> under the <u>Click to select a State or Regional Study</u> <u>Area</u> heading (Figure 2). Always click Indiana even if another state appears as an option.



Figure 2

Step 7. Zoom In (±) on the map so the blue stream grid cells representing the streams appear.Confirm the coordinates are on or near the specified waterbody (Figure 3). For example, to ensure the computed drainage area is for a site located on main stem Indian Creek and not tributary of Indian Creek. Toggle to an aerial base map for additional accuracy if needed.



Figure 3

Step 8. Under the <u>IDENTIFY A STUDY AREA</u> menu, click on the <u>Delineate</u> button. After clicking the button, the <u>Delineate</u> button will turn red, and the cursor will be a crosshair. Use the tool to click on a stream grid cell (the blue boxes which represent the stream path) which is closest to the site. Click a point along the grid line that the site lands on but not on the red dot. StreamStats will take a couple of minutes to delineate the drainage boundary. The drainage area will be displayed on the map in a yellow opaque color (Figure 4). Be sure to thoroughly check the delineated basin for accuracy before clicking the <u>Continue</u> button. You can pan the map by left clicking and moving the mouse. You can also Zoom In (+) and Zoom Out (-) to check whether all the drainage area is captured in the area highlighted for delineation.





Step 9. Under the <u>SELECT SCENARIOS</u> menu, click on the <u>Basin</u> <u>Characteristics</u> heading. In this menu, select white box left of the DRNAREA parameter. When selected, a checkmark will appear in the white box in the Select column (Figure 5). Click the <u>Continue</u> button at the bottom of the menu to obtain drainage area.

#### Calculation of Drainage Area B-005-OWQ-WAP-XXX-24-T-R2 November 1, 2024



Figure 5

Step 10. Under the <u>BUILD A REPORT</u> menu, click the <u>Open Report</u> button under the <u>Select available reports to display</u> heading. A popup containing the <u>StreamStats Report</u> will appear. Scroll down to the <u>Basin Characteristics</u> box. Drainage area is displayed in square miles, which is exactly as expected result (Figure 6). Copy and paste the value into the appropriate cell in the spreadsheet.



Step 11. Repeat Steps 8 to 11 for the remaining approved sites. To start over, click the <u>SELECT A STATE/REGION</u> heading. Copy and paste latitude and longitude information for the additional approved site into the <u>Find a place</u> search bar (Figure 7).





#### 2.3. Related Technical Issues

- A. Health and Safety Warnings
  Not applicable. This TSOP does not involve travel or field work. All steps are to be completed in an office setting on a computer workstation.
- B. Cautions
  - 1. Do not use StreamStats if the status window indicates whether technical difficulties or incorrect outputs exists. Check back later.
  - 2. Enter coordinates for each site accurately into StreamStats, ensuring coordinates are for the appropriate site and not for the one above or below in the spreadsheet.
  - 3. Enter the drainage area for each site accurately on the spreadsheet, ensuring the area corresponds to the appropriate coordinates.
  - 4. Be mindful of where the point to delineate the drainage basin is placed. Zoom in to select the closest stream grid to the site of interest. Delineating the drainage basin on a larger scale may result in incorrect boundaries. Selecting a stream grid which is upstream or downstream of the site of interest may also result in incorrect boundaries. For example, if the site of interest is downstream of a tributary and the point to delineate the drainage basin is placed upstream of the tributary, this will result in a smaller drainage basin

and drainage area. If the point to delineate the drainage basin is placed downstream of the site of interest, this will result in a larger drainage basin and drainage area.

- 5. Only perform drainage area calculations on sites with confirmed coordinates. Latitude and longitude can change following GPS verification and can result in incorrect drainage area calculations.
- C. Interferences Not applicable.
- D. Calibration

Staff are not responsible for calibrating StreamStats which is maintained by USGS. However, staff should stay updated on which version of StreamStats is available and read the appropriate literature on USGS's website prior to using the web application.

- E. Troubleshooting
  - 1. Read the literature provided on USGS's website.
  - 2. Visit USGS's StreamStats Troubleshooting webpage for further assistance.

### 3.0. Roles

- 3.1. Responsibilities
  - A. WAPB staff member
    - 1. Reviews and follows this TSOP.
    - 2. Prepares the Gradient and Drainage Area spreadsheet.
    - 3. The staff member assigned to Drainage Area QC Round 2 will discuss value discrepancies with staff who performed calculations and finalize which drainage area calculations to enter into AIMS.
- 3.2. Training requirements
  - A. USGS StreamStats
    - 1. WAPB staff member
  - B. AIMS database management
    - 1. WAPB staff member

### 4.0. Required Forms, Equipment, or Software List

- 4.1. Forms
  - A. Gradient and Drainage Area Spreadsheet

- 4.2. Equipment
  - A. Computer workstation
- 4.3. Software
  - A. Internet capabilities
  - B. USGS StreamStats
  - C. AIMS database

### 5.0. Records Management

Information recorded in the Gradient and Drainage Area Spreadsheet is entered into the AIMS database. The Gradient and Drainage Area Spreadsheet is stored electronically in the project folder on the shared drive.

### 6.0. Definitions

- 6.1. "Agency staff" Any employee or representative of Indiana Department of Environmental Management (IDEM) including regular employees, temporary employees, contractors, and interns.
- 6.2. "Assessment Information Management System database (AIMS database)" IDEM database containing information related to water chemistry, aquatic habitat, macroinvertebrate, fish, algae communities, fish tissue analyses, sediments, and *E. coli* bacteria data collected by agency staff from watershed sampling events.
- 6.3. "L-Site" A unique site ID generated by the AIMS database for each sampling site, and is linked with location information (stream name, description, latitude, longitude, county, HUC12, HUC14, etc.,).
- 6.4. "Quality control" The overall system of technical activities which measures the attributes and performance of a process, item, or service against defined standards to verify they meet the stated requirements established by the customer; operational techniques and activities used to fulfill requirements for quality. In other words, QC involves measuring the "thing produced" against a standard to ensure it is a quality product meets the identified need.
- 6.5. "Reconnaissance" Obtaining information about a site through visual observations and investigating routes to safely access the site, as well as gathering property owner information and access permission if private property is involved.
- 6.6. "Site number" The designated program area specific numeral given to an environmental location of interest.

6.7. "Technical standard operating procedure (TSOP)" – A standard operating procedure involving environmental data generation, manipulation, or compilation of an analytical process.

### 7.0. Quality Assurance and Quality Control

New WAPB staff should review this TSOP prior to calculating drainage areas. Before entering data into the AIMS database quality checks are performed. Assign a WAPB staff member to perform Drainage Area QC Round 1 by going through Steps 3 to 12 of Section 2.2. Follow with a different WAPB staff member, experienced in utilizing StreamStats, performing Drainage Area QC Round 2 by first going through Steps 3 to 12 of Section 2.2. Then discuss value discrepancies with staff who performed calculations. When all discrepancies are resolved and drainage area values are finalized, enter the data into the AIMS database. Following data entry, perform two rounds of quality control on the database entries to ensure they reflect the Gradient and Drainage Area Spreadsheet. As necessary, perform additional rounds of quality control. When quality control on the database entries is complete, the data are available for use in other work products.

### 8.0. References

- 8.1. USGS
  - A. Stream Stats
- 8.2. Other Guidance
  - A. Hoggatt, R.E. 1975. <u>Drainage areas of Indiana streams</u>. U.S. Geological Survey, Indianapolis, Indiana.

## 9.0. Appendices

Appendix A – Example of a Gradient and Drainage Area Spreadsheet

A II	8	C C	U	E	۲	6	н		1	K.	L	M	N	U	۴	u	×
1 SiteID	WATERBODY_NAME	L-Site	Site Description	Latitude	Longitude	UTM_EAST	UTM_NORTH	Gradient	Gradient QC1	Gradient QC2	*RPD of Calculation and QC1	*RPD of Calculation and QC2	*RPD of QC1 and QC2	Average Gradient	Drainage Area (sq. mi)	Drainage Area QC1	Drainage Area QC2
2 INR819-002	Silver Creek	05K-08-0014	Gutford Road	38.31291184	-85.7935054	EXAMPLE	EXAMPLE	5.665	5.672	5.657	0.113	0.256	0.270	5.665			
3 INR824-001	Tippecanoe River	WTI-06-0020	Pulaski	41.0794	-86.5832	535037.17	4547655.81	1.462	0.000	0.000	200.000	n/a	n/a	0.731			
4 INR824-003	Flat Creek	WUW-11-0013	Wels	40.8822	-85.3134	642091/08	4527040.39	6.803	0.000	0.000	200.000	n/a	n/a	3.401			
5 INR824-004	Salamonie River	WSA-03-0009	Wells	40.6343	-85.3689	637938.97	4499423.59	2.326	0.000	0.000	200.000	n/a	n/a	1.163			
6 INR824-009	Tippecanoe River	WTI-02-0075	Kosciusko	41.2735	-85.8641	595162.01	4569681.95	5.181	0.000	0.000	200.000	n/a	n/a	2.591			
7 INR824-011	Wheeler Creek	WAE-04-0012	Wabash	41.0439	-85.7169	607816.48	4544429.74	4.000	0.000	0.000	200.000	n/a	n/a	2.000			
8 INR824-017	Uttle Indian Creek	WTI-08-0007	Cass	40.8799	-86.5619	536911.64	4525529.78	2,451	0.000	0.000	200.000	n/a	n/a	1.225			
9 INR824-018	Bachelor Run	WDE-05-0013	Carroll	40.5551	-86.5239	540316.57	4489491.64	4.367	0.000	0.000	200.000	n/a	n/a	2.183			
10 INR824-019	Lagro Creek	WUW-14-0029	Wabash	40.8848	-85.0936	610131.65	4520537.31	14.925	0.000	0.000	200.000	n/a	n/a	7,453			
11 INR824-020	Mississinewa River	WMI-05-0026	Grant	40.5565	-85.6469	614441.49	4490101.81	1.389	0.000	0.000	200.000	n/a	n/a	0.694			
12 INR824-021	Weesau Creek	WAE-06-0005	Mami	40.9156	-86.1270	573515.56	4529753.87	18.182	0.000	0.000	200.000	n/a	n/a	9.091			
13 INR824-025	Tippecanoe River	WTI-06-0021	Fulton	41.1321	-86.3937	550893.15	4553568.51	0.813	0.000	0.000	200.000	n/a	n/a	0.407			
14 INR824-027	Squaw Creek	WUW-10-0012	Allen	41,0446	-85.3216	641069.50	4545071.59	22.727	0.000	0.000	200.000	n/a	n/a	11.364			
15 INR824-029	Lauramie Creek	WAW-03-0043	Tippecanoe	40.2889	-86.7574	520621.60	4459849.84	11.561	0.000	0.000	200.000	n/a	n/a	5.780			
16 INR824-034	Kokomo Creek	WAW-01-0004	Howard	40,4478	-86.0451	580975.44	4477888.99	3.774	0.000	0.000	200.000	n/a	n/a	1.887			
17 INR824-037	Eel River	WAE-06-0006	Miami	40.8561	-86.0036	584014.08	4523288.76	2.179	0.000	0.000	200.000	n/a	n/a	1.089			
18 INR824-038	Wildcat Creek	WAW-04-0007	Carroll	40,4864	-86.4012	550732.31	4481898.31	3.759	0.000	0.000	200.000	n/a	n/a	1.880			
19 INR824-040	Grant Creek	WMI-06-0011	Wabash	40.6724	-85.7223	607926.43	4503179.42	17.544	0.000	0.000	200.000	n/a	n/a	8.772			
20 INR824-046	Tributary of Wabash River	WDE-01-0009	Cass	40.7204	-86.3983	550824.21	4507887.03	27.211	0.000	0.000	200.000	n/a	n/a	13.605			
21 INR824-048	Bear Creek	WUW-04-0006	Jay	40.5134	-84.9721	671806.19	4486709.50	5.236	0.000	0.000	200.000	n/a	n/a	2.618			
22 INR824-051	Majenica Creek	W5A-04-0019	Huntington	40.7682	-85.5393	623274.71	4514049.00	5.917	0.000	0.000	200.000	n/a	n/a	2.959			
23 INR824-057	Tributary of Wildcat Creek	WAW-04-0006	Tippecanoe	40,4543	-86.7707	519441.21	4478223.17	51.724	0.000	0.000	200.000	n/a	n/a	25.862			
24 INR824-058	South Fork Deer Creek	WDE-04-0007	Cass	40.5984	-86.2205	565481.28	4494875.86	5.208	0.000	0.000	200.000	n/a	n/a	2.604			
25 INR824-059	Wabash River	WUW-08-0007	Wells	40.7624	-85.1892	652841.43	4513969.91	0.654	0.000	0.000	200.000	n/a	n/a	0.327			
26 INR824-060	Halfway Creek	WMI-02-0026	Jay	40.3378	-85.1497	656916.41	4466907.69	7.813	0.000	0.000	200.000	n/a	n/a	3.905			
27 INR824-062	Clear Creek	WUW-12-0003	Huntington	40.9615	-85.5199	624562.23	4535543.65	4.975	0.000	0.000	200.000	n/a	n/a	2.488			
28 INR824-065	East Branch Twelve Mile Creek	WAE-07-0006	Cass	40.8492	-86.1841	568772.91	4522349.16	8.000	0.000	0.000	200.000	n/a	n/a	4.000			
29 INR824-068	Mill Creek	WUW-14-0032	Wabash	40,7408	-85.8755	594936.30	4510585.66	28.302	0.000	0.000	200.000	n/a	n/a	14.151			
30 INR824-069	Hog Run	WAW-02-0003	Cânton	40.3775	-86.6837	526812.14	4469697.41	23.810	0.000	0.000	200.000	n/a	n/a	11.905			
31 INR824-074	Talbert Ditch	WAW-03-0040	Clinton	40.2959	-86.3985	551111.97	4460780.49	6.579	0.000	0.000	200.000	n/a	n/a	3.289			
32 INR824-081	Aberger Ditch	W4E-05-0041	Mami	40.9567	-85.0112	583254.05	4534441.46	22.222	0.000	0.000	200.000	n/a	n/a	11.111			
33 INR824-063	Loon Creek	WUW-13-0015	Huntington	40.8499	-85.5811	619603.80	4523055.84	7.937	0.000	0.000	200.000	n/a	n/a	3.968			
34 INR824-092	Tributary of Rees Creek	WMI-04-0021	Delaware	40.3400	-85.3394	641039.07	4466802.62	19.048	0.000	0.000	200.000	n/a	n/a	9.524			
35 INR824-094	Little Deer Creek	WUW-15-0013	Cass	40.7128	-86.2053	567125.24	4507183.60	14.925	0.000	0.000	200.000	n/a	n/a	7.463			
36 INR824-099	Salamonie River	W5A-04-0020	Huntington	40.7438	-85.5272	624405.58	4511387.20	3.745	0.000	0.000	200.000	n/a	n/a	1.873			
37 INR824-101	Minnow Ditch	WTI-05-0027	Fulton	41.0733	-86.2274	564898.B2	454717B.25	4.762	0.000	0.000	200.000	n/a	n/a	2.381			
38 INR824-102	Middle Fork Wildcat Creek	WAW-02-0005	Carroll	40.4430	-86.5032	542159.71	4477058.96	5.155	0.000	0.000	200.000	n/a	n/a	2.577			
39 INR824-105	Wildcat Creek	WAW-04-0010	Tippecanoe	40.4307	-86.8148	515684.05	4475660.30	4.032	0.000	0.000	200.000	n/a	n/a	2.016			
40 INR824-107	Johnson Ditch	WUW-09-0008	Wells	40.9181	-85.2881	644161.09	4531055.96	9.259	0.000	0.000	200.000	n/a	n/a	4.630			
41 INR824-108	Mississinewa River	WMI-02-0029	Delaware	40.2888	-85.2235	651011.56	4461349.64	3.534	0.000	0.000	200.000	n/a	n/a	1.767			
42 INR824-111	Richland Creek	W5A-04-0024	Huntington	40.7038	-85.5688	620900.76	4506871.41	8.696	0.000	0.000	200.000	n/a	n/a	4.348			
43 INR824-112	Stony Creek	WUW-01-0001	Jay	40.3989	-84.8106	685791.92	4474292.36	10.050	0.000	0.000	200.000	n/a	n/a	5.025			
44 INR824-113	Big Monon Ditch	WTI-10-0014	White	40.8680	-86.7791	518630.34	4524119.57	0.583	0.000	0.000	200.000	n/a	n/a	0.291			
45 INR824-117	Mud Branch	WAE-07-0007	Cass	40.8158	-86.2523	563047.53	4518567.48	25.862	0.000	0.000	200.000	n/a	n/a	12.931			
40 INR824-119	Simonton Creek	WAE-04-0016	whitley	41.0049	-85.6814	610890.79	4540136.14	11.765	0.000	0.000	200.000	n/a	n/a	5.882			
47 INR824-121	Tippecanoe River	WTI-03-0021	KOSCIUSKO	41.2470	-85.9123	591142.31	4566722.82	2.278	0.000	0.000	200.000	n/a	n/a	1.139			
48 INR824-122	Tributary of Wabash River	WUW-16-0005	Mami	40.7340	-86.0316	581781.39	4509672.89	34.188	0.000	0.000	200.000	n/a	n/a	17.094			
49 INR824-124	Mississinewa River	WMI-04-0022	Deraware	40.2743	-85.2956	644931.50	4459584.68	3.005	0.000	0.000	200.000	n/a	n/a	1.502			
50 INR824-126	Sugar Creek	WUW-15-0018	Mami	40.5845	-85.9396	589743.08	4493160.36	6.098	0.000	0.000	200.000	n/a	n/a	3.049			
51 INR824-128	Salamonie River	W5A-02-0009	Brackford	40.5246	-85.2054	651977.76	4467513.33	2.024	0.000	0.000	200.000	n/a	n/a	1.012			
52 INR824-129	Isig Monon Ditch	WTF10-0015	P08881	41/0777	-86.7973	517031.52	4547381.17	2.857	0.000	0.000	200.000	n/a	n/a	1.429			
Initials/date->											*Calculation uses whole						
53											number.						

#### Calculation of Drainage Area B-005-OWQ-WAP-XXX-24-T-R2 November 1, 2024