

LECTURE #7

Mapping Freiburg – Quantifying spatial relationships



OBJECTIVE

- COMPUTE THE AREA OF SPATIAL FEATURES IN QGIS
- CALCULATE THE AREA AFFECTED BY A PROXIMITY BUFFER (E.G., WITHIN 50 M OF WATER)
- DETERMINE THE PERCENTAGE OF A NEIGHBORHOOD AFFECTED BY A SPATIAL CONDITION
- GENERATE CENTROIDS FROM BUILDING POLYGONS FOR POINT-BASED ANALYSIS
- COUNT FEATURES INSIDE POLYGONS (E.G., NUMBER OF BUILDINGS PER NEIGHBORHOOD)
- ANSWER QUANTITATIVE SPATIAL QUESTIONS USING GIS OPERATIONS

1. AREA CALCULATION

WHAT IS THE TOTAL AREA WITHIN 50 M OF WATER IN FREIBURG?

TO ANSWER THIS QUESTION, WE NEED TO:

- PREPARE THE BUFFER LAYER (FROM LAST CLASS);
- CLIP THE BUFFER TO THE FREIBURG BOUNDARY;
- CALCULATE THE BUFFER AREA:

OPEN ATTRIBUTE TABLE

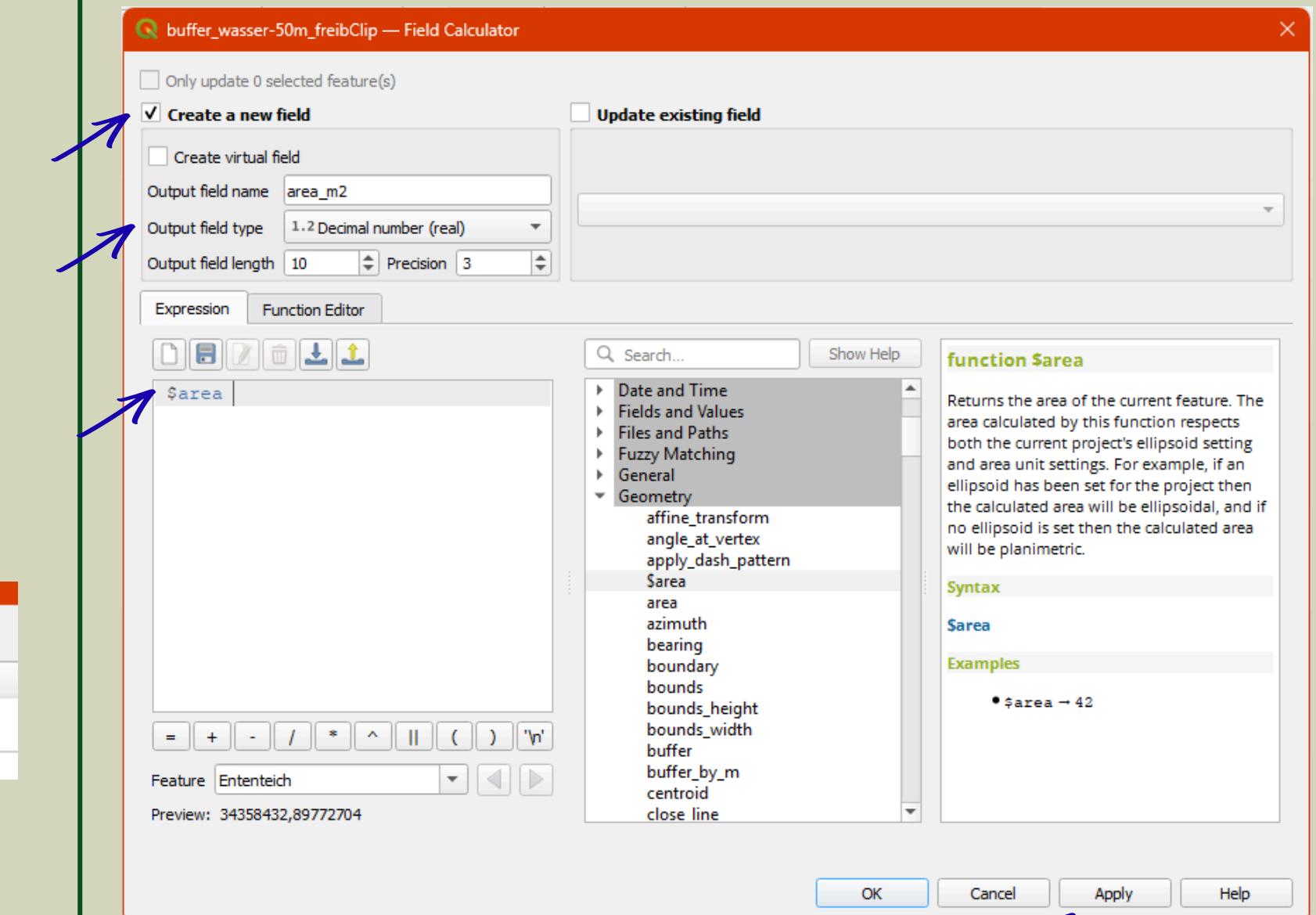
The screenshot shows the QGIS attribute table for a layer named "buffer_wasser-50m_freibClip". The table has columns: osm_id, code, fclass, name, osm_id_2, code_2, and fclass_2. A row is selected for a feature with osm_id 12812629, which is highlighted with a green border. The feature details are: code 8200, fclass water, name Ententeich, osm_id_2 78071772, code_2 8102, and fclass_2 stream.

osm_id	code	fclass	name	osm_id_2	code_2	fclass_2
12812629	8200	water	Ententeich	78071772	8102	stream

TOGGLE EDITION

FIELD CALCULATOR

OPEN ATTRIBUTE TABLE → TOGGLE EDITION MODE → FIELD CALCULATOR



TOGGLE EDITION AFTER CALCULATION

1. AREA CALCULATION

ANSWER:

area_m2	area_km2
34358433	34,358

CREATE A NEW FIELD (COLUMN)

NAME: AREA_M2

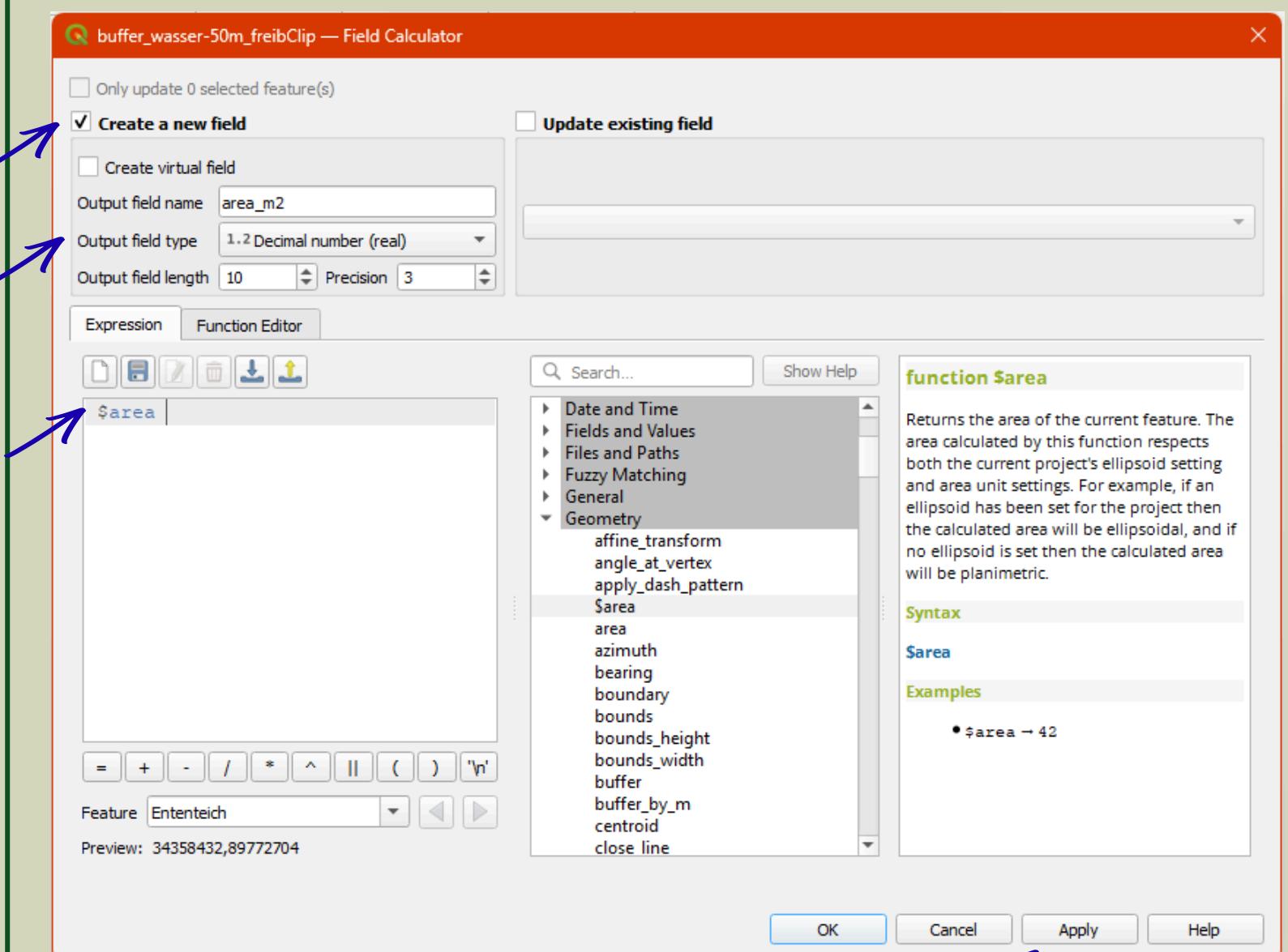
FIELD TYPE: DECIMAL (LENGH 10 | PRECISION:3)

EXPRESSION: \$AREA

**IF YOU WANT AREA IN KM_2
THE EXPRESSION IS:**

\$AREA/1000000

OPEN ATTRIBUTE TABLE → TOGGLE EDITION MODE → FIELD CALCULATOR



TOGGLE EDITION AFTER CALCULATION

1. AREA CALCULATION

WHAT IS THE AREA OF EACH NEIGHBORHOOD IN FREIBURG?

OPEN ATTRIBUTE TABLE → TOGGLE EDITION MODE → FIELD CALCULATOR

REPEAT THE PROCESS FROM PREVIOUS SLIDES

...AND YOU GET THE ATTRIBUTE TABLE UPDATED WITH NEIGHBOHOODS AREA

NEXT QUESTION: WHAT IS THE TOTAL AREA OF FREIBURG?

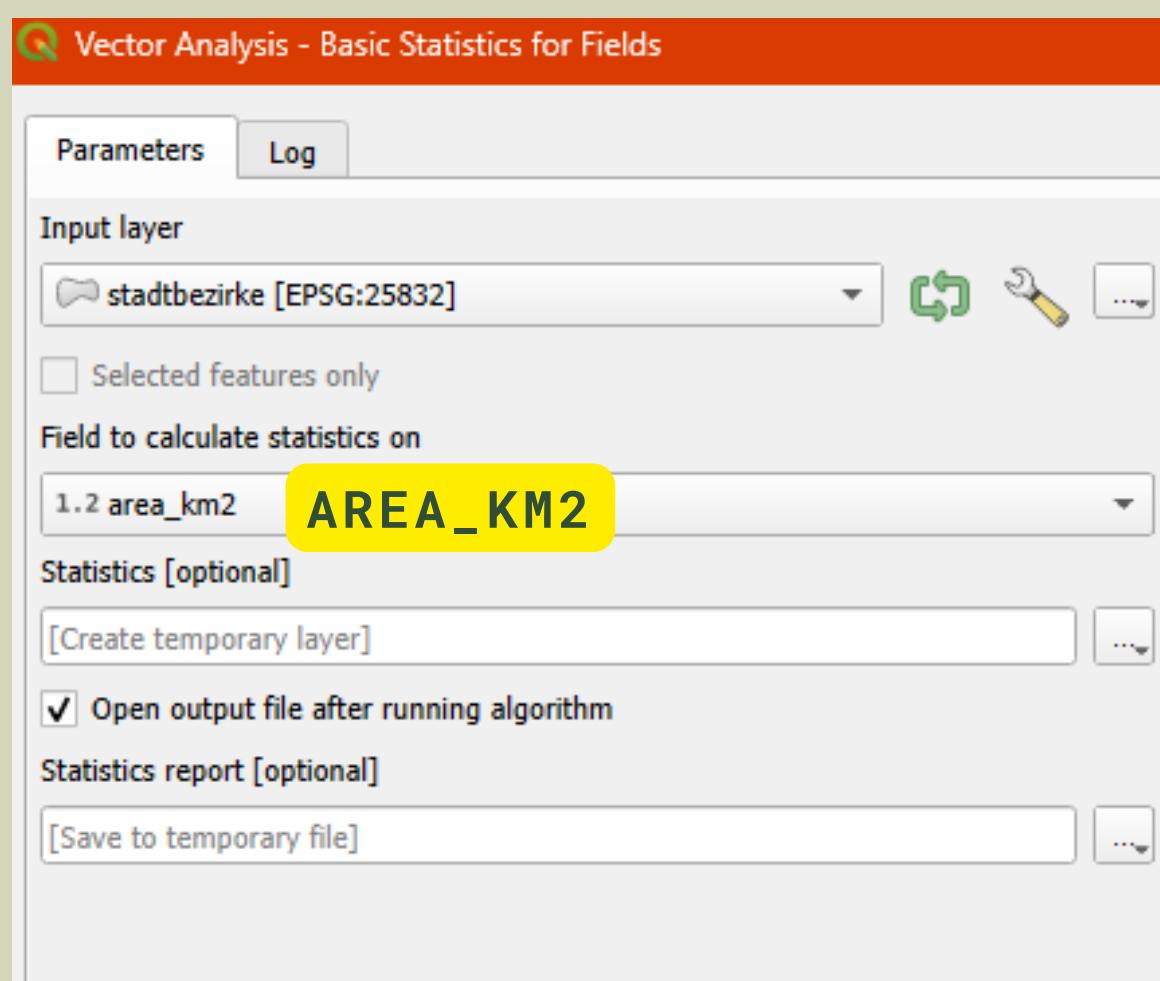
name	bezeichnung	flaeche	umfang	area_m2	area_km2
Brühl-Beurbar...	233 / Brühl-Beu...	513240,748969...	3243,80482423...	513146,942	0,513
Günterstal	430 / Günterstal	15103407,6537...	26520,0611888...	15100897,586	15,101
Kappel	340 / Kappel	13821536,5290...	19022,7794496...	13819323,348	13,819
Brühl-Industrie...	232 / Brühl-Ind...	10065375,4979...	15639,9745309...	10064789,302	10,065
Waltershofen	560 / Waltershof...	7583373,83357...	19386,2140290...	7580590,167	7,581
Opfingen	630 / Opfingen	14624327,1860...	23011,7583862...	14620600,243	14,621
Unterwihre-Süd	424 / Unterwie...	1914685,58153...	6502,87310379...	1914344,385	1,914
Herdern-Nord	212 / Herdern...	1431989,18383...	5101,26502,873...	8799917772,924	1,432
St. Georgen-Süd	622 / St. Georg...	2545402,54099...	7827,39041...	2545884,164	2,546
Vauban	680 / Vauban	412814,513817...	297,41834763...	412799,915	0,413
Herdern-Süd	211 / Herdern...	286279,00571...	9501,77991682...	2861908,257	2,862
Alt-Betzenhausen	532 / Alt-Betze...	798023,793315...	5021,52731244...	4822002,47791...	4,821
Mittelwihre	422 / Mittelwih...	1362133,81605...	5927,07273127...	570028,091620...	0,57
Alt-Stühlinger	513 / Alt-Stühli...	837999,297458...	3986,36698807...	659556,226759...	0,659
Altstadt-Ring	112 / Altstadt-R...	617913,651668...	4216,49596228...	659432,747	0,659
Unterwihre-N...	423 / Unterwie...	782465,383203...	4116,76120453...	1361888,755	1,362
Neuburg	120 / Neuburg	1636432,60775...	7141,30579814...	837842,958	0,838
				797869,291	0,798
				617800,753	0,618
				782321,275	0,782
				1636141,667	1,636
				• • •	

1. AREA CALCULATION

QUICK TUTORIAL

WHAT IS THE TOTAL AREA OF FREIBURG?

VECTOR → ANALYSIS TOOLS → BASIC
STATISTICS FOR FIELDS



COUNT: 42
UNIQUE: 42
EMPTY: 0
FILLED: 42
MIN: 0.413
MAX: 15.101
CV: 1.1134624536400204
SUM: 153.04699999999997
MEAN: 3.64397619047619
STD_DEV: 4.057430670053432
RANGE: 14.688
MEDIAN: 1.5474999999999999
MINORITY: 0.413
MAJORITY: 0.413
FIRSTQUARTILE: 0.9
THIRDQUARTILE: 4.821
IQR: 3.921



1. AREA CALCULATION

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WHAT IS THE PERCENTAGE OF FREIBURG
WITHIN 50 M OF ANY WATER BODY?

$$\frac{\text{AREA_BUFFER_WATER_50M}}{\text{AREA_FREIBURG}} \times 100$$

$$\frac{34.358 \text{ KM}^2}{153.047 \text{ KM}^2} \times 100$$

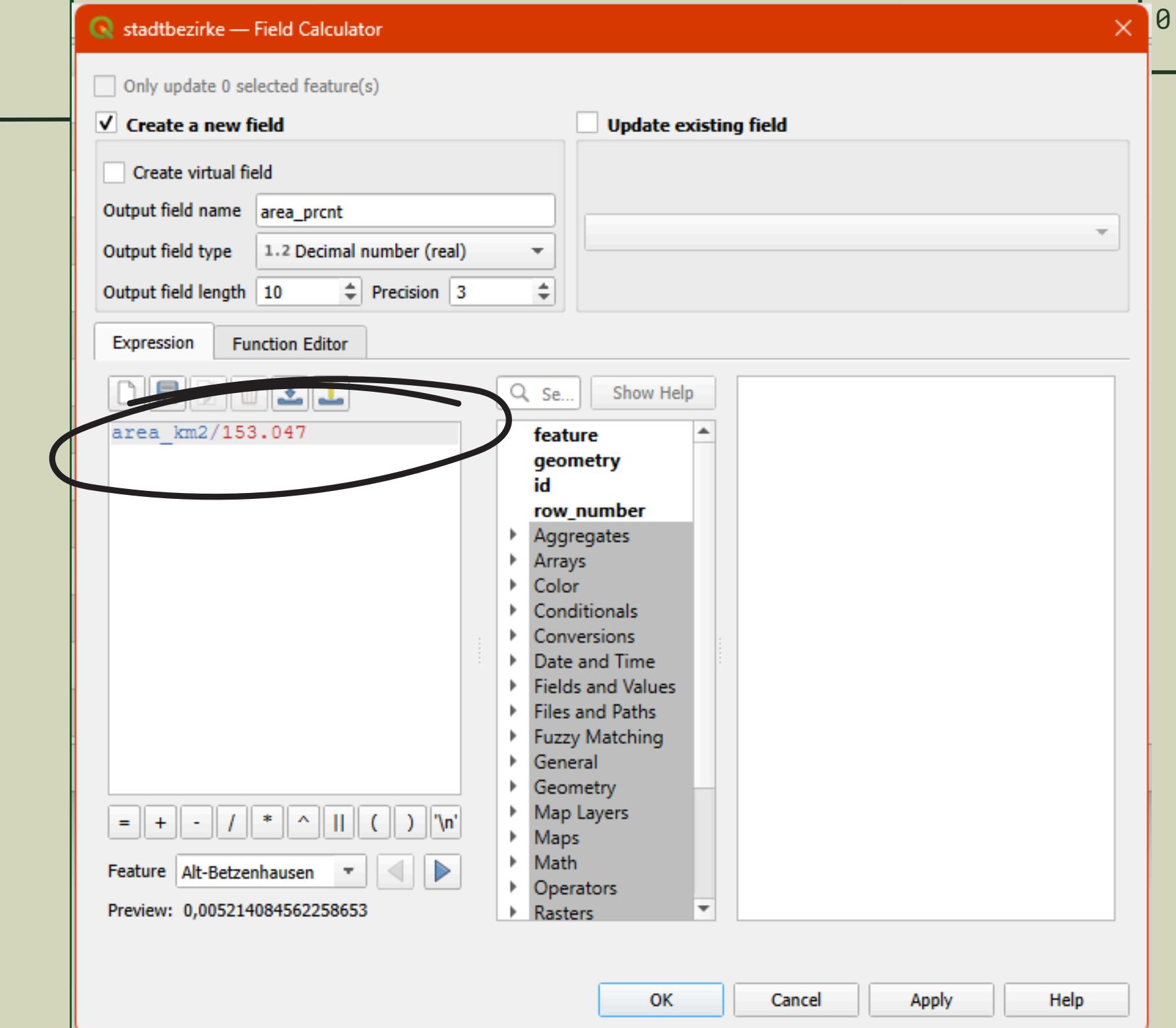
 = 22.45%

1. AREA CALCULATION

WHAT IS THE AREA PERCENTAGE OF EACH NEIGHBORHOOD IN FREIBURG?

$$\frac{\text{AREA_NEIGHBORHOOD}}{\text{AREA_FREIBURG}} \times 100$$

AREA_FREIBURG
AREA_FREIBURG = 153.047 KM²



1. COUNTING QUANTITIES

QUICK TUTORIAL

WHAT IS THE QUANTITY OF BUILDINGS IN FREIBURG?

IS THE QUANTITY (COUNT) OF LINES IN THE ATTRIBUTE TABLE (SHAPE BUILDINGS)

WHAT IS THE QUANTITY OF APARTMENTS IN FREIBURG?

IS THE QUANTITY (COUNT) OF LINES IN THE ATTRIBUTE TABLE (SHAPE BUILDINGS WITH FIELD 'TYPE' FILTERED TO APARTMENTS)

VECTOR → ANALYSIS TOOLS → BASIC STATISTICS FOR FIELDS

BUILDINGS (WITHOUT FILTER)

```
COUNT: 57463
UNIQUE: 57463
EMPTY: 0
FILLED: 57463
MIN: 1000071563
MAX: 999985672
MIN_LENGTH: 4
MAX_LENGTH: 10
MEAN_LENGTH: 8.926631049544925
MINORITY: 1000071563
MAJORITY: 1000071563
```

APARTMENT (FILTERED)

```
COUNT: 8038
UNIQUE: 8038
EMPTY: 0
FILLED: 8038
MIN: 100015755
MAX: 99480450
MIN_LENGTH: 7
MAX_LENGTH: 10
MEAN_LENGTH: 8.834660363274446
MINORITY: 100015755
MAJORITY: 100015755
```

$$(8038 / 57463) * 100 = 14\%$$

1. COUNTING QUANTITIES

WHAT IS THE QUANTITY OF BUILDINGS IN EACH NEIGHBORHOOD?

STEPS:

1. CONVERT BUILDINGS (POLYG.) TO CENTROIDES (POINTS);

- VECTOR > GEOMETRY TOOLS > CENTROIDS

1. COUNT POINTS IN POLYGON.

- VECTOR → ANALYSIS TOOLS → COUNT POINTS IN POLYGON

2 LAYERS:
BUILDINGS AS POLYGONS
BUILDINGS AS POINT (CENTROID)



1. COUNTING QUANTITIES

WHAT IS THE QUANTITY OF BUILDINGS IN EACH NEIGHBORHOOD?

STEPS:

1. CONVERT BUILDINGS (POLYG.) TO CENTROIDES (POINTS);
 - VECTOR > GEOMETRY TOOLS > CENTROIDS

1. COUNT POINTS IN POLYGON.
 - VECTOR → ANALYSIS TOOLS → COUNT POINTS IN POLYGON



09 X

Vector Analysis - Count Points in Polygon

Parameters Log

Polygons
stadtbezirke [EPSG:25832]

Selected features only

Points
Centroids [EPSG:25832]

Selected features only

Weight field [optional]

Class field [optional]

Count field name
NUMPOINTS

Count
[Create temporary layer]

Open output file after running algorithm

0%

Count points in polygon

This algorithm takes a points layer and a polygon layer and counts the number of points from the first one in each polygons of the second one.

A new polygons layer is generated, with the exact same content as the input polygons layer, but containing an additional field with the points count corresponding to each polygon.

An optional weight field can be used to assign weights to each point. If set, the count generated will be the sum of the weight field for each point contained by the polygon.

Alternatively, a unique class field can be specified. If set, points are classified based on the selected attribute, and if several points with the same attribute value are within the polygon, only one of them is counted. The final count of the point in a polygon is, therefore, the count of different classes that are found in it.

Both the weight field and unique class field cannot be specified. If they are, the weight field will take precedence and the unique class field will be ignored.

1. COUNTING QUANTITIES

WHAT IS THE QUANTITY OF BUILDINGS IN EACH NEIGHBORHOOD?

STEPS:

1. CONVERT BUILDINGS (POLYG.) TO CENTROIDES (POINTS);

- VECTOR > GEOMETRY TOOLS > CENTROIDS

1. COUNT POINTS IN POLYGON.

- VECTOR → ANALYSIS TOOLS → COUNT POINTS IN POLYGON



A NEW POLYG. LAYER IS CREATED (NAMED 'COUNT') WITH A FIELD 'NUMPOINTS' - QUANTITY OF BUILDINGS IN EACH NEIGHBORHOOD.

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Count — Features Total: 42, Filtered: 42, Selected: 0

nr	gid	name	bezeichnung	flaeche	umfang	area_m2	area_km2	area_prcnt	NUMPOINTS
1	233,000000000...	9 Brühl-Beurb...	233 / Brühl-Beu...	513240,748969...	3243,80482423...	513146,942	0,513	0,003	327
2	430,000000000...	20 Günterstal	430 / Günterstal	15103407,6537...	26520,0611888...	15100897,580	15,101	0,099	956
3	340,000000000...	14 Kappel	340 / Kappel	13821536,5290...	19022,7794496...	13819323,340	13,819	0,09	1271
4	232,000000000...	8 Brühl-Indust...	232 / Brühl-Ind...	10065375,4979...	15639,9745309...	10064789,300	10,065	0,066	1447
5	560,000000000...	29 Waltershofen	560 / Waltersho...	7583373,83357...	19386,2140290...	7580590,167	7,581	0,05	1400
6	630,000000000...	37 Opfingen	630 / Opfingen	14624327,1860...	23011,7583862...	14620600,240	14,621	0,096	2244
7	424,000000000...	19 Unterwiedre-Süd	424 / Unterwie...	1914685,58153...	6502,87310379...	1914344,385	1,914	0,013	1726
8	212,000000000...	5 Herdern-Nord	212 / Herdern...	1431989,18383...	5101,23849894...	1431808,924	1,432	0,009	1711
9	622,000000000...	36 St. Georgen-Süd	622 / St. Georg...	2545402,54099...	7837,75159041...	2545884,164	2,546	0,017	960
10	680,000000000...	42 Vauban	680 / Vauban	412814,513817...	2979,41834763...	412799,915	0,413	0,003	508
11	211,000000000...	4 Herdern-Süd	211 / Herdern...	2862793,60571...	9501,77991682...	2861908,257	2,862	0,019	1283
12	310,000000000...	11 Waldsee	310 / Waldsee	4822002,47791...	12239,9166475...	4821186,097	4,821	0,032	2212
13	111,000000000...	1 Altstadt-Mitte	111 / Altstadt...	570028,091620...	3087,20053596...	569925,337	0,57	0,004	1098
14	522,000000000...	24 Mooswald-Ost	522 / Mooswal...	659556,226759...	3708,85509023...	659432,747	0,659	0,004	945
15	422,000000000...	17 Mittelwiedre	422 / Mittelwie...	1362133,81605...	5927,07273127...	1361888,755	1,362	0,009	992
16	513,000000000...	22 Alt-Stühlinger	513 / Alt-Stühli...	837999,297458...	3986,36698807...	837842,958	0,838	0,005	1183
17	532,000000000...	26 Alt-Betzenhausen	532 / Alt-Betze...	798023,793315...	5021,52731244...	797869,291	0,798	0,005	1054
18	112,000000000...	2 Altstadt-Ring	112 / Altstadt-R...	617913,651668...	4216,49596228...	617800,753	0,618	0,004	860
19	423,000000000...	18 Unterwiedre-N...	423 / Unterwie...	782465,383203...	4116,76120453...	782321,275	0,782	0,005	1076
20	120,000000000...	3 Neuburg	120 / Neuburg	1636432,60775...	7141,30579814...	1636141,667	1,636	0,011	925
21	231,000000000...	7 Brühl-Güterbah...	231 / Brühl-Güt...	900034,954494...	4039,23334973...	899872,313	0,9	0,006	863
22	521,000000000...	23 Mooswald-West	521 / Mooswal...	968797,148604...	4031,36407260...	968612,582	0,969	0,006	2247

LECTURE #7

Mapping Freiburg – Quantifying spatial relationships



EXERCISE

CHOOSE ONE NEIGHBORHOOD IN FREIBURG AND
ANSWER:

- WHAT IS THE NEIGHBORHOOD'S AREA?
- WHAT PERCENTAGE OF THIS NEIGHBORHOOD LIES WITHIN 50 M OF ANY WATER BODY?
- HOW MANY APARTMENTS ARE LOCATED IN THIS NEIGHBORHOOD?