**Title of the course : WS Hydrology**

**Class : B. Tech. II year, II semester, 2019-20**

**Title of the Topic : Tutorial 2 on Areal aspects of WS**

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**Solved Tutorials 2:**

**All students of B. Tech II year, II semester 2019-20 are directed to write these solved tutorials in assignment copy.**

**Tutorial 11.**  A tinny watershed is having an area of 6 ha & watershed length of 325 m. Calculate the Form factor of watershed.

**Solution 11:** We have given:

The Area of watershed (Aw) = 6 ha

The Length of watershed (Lw) = 325 m

Form factor (Rf) is defined as the ratio of Watershed area (Aw) to square of watershed length (Lw). It is a dimensionless number and will always be less than 1.

Form factor Rf = Aw / (Lw)2

Hence Form factor Rf = 6 ha / (325 m)2

= (6 X 10,000 m2) / (325 m X 325 m)

 = 0.59

**Answer 11:**

The Form factor is 0.59

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**Tutorial 12.**  Work out the Form factor of a watershed if its area & watershed length are 13 ha & 522 m respectively.

**Solution 12:** We have given:

The Area of watershed (Aw) = 13 ha or 130000 m2 (1 ha = 10,000 m2)

The Length of watershed (Lw) = 522 m

Form factor Rf = Aw / (Lw)2

Hence Form factor Rf = 130000 m2 / 522 X 522 m2

= 0.48

**Answer 12:**

The Form factor is 0.48

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**Tutorial 13.**  A micro watershed is having an area of 54 ha & length of flow path is 1473 m. Determine the Shape factor of watershed.

**Solution 13:** We have given:

The Area of watershed (Aw) = 54 ha or 540000 m2

The Length of flow path (Lf) = 1473 m

Shape Factor (RS) is defined as the ratio between watershed area (Aw) and the square of main flow path (Lf). It is a dimensionless number and will always be less than 1.

Shape factor RS = Aw / (Lf)2

Hence Shape factor RS = 540,000 m2 / (1473 m)2

= 540,000 m2 / (1473 m X 1473 m)

 = 0.25

**Answer 13:**

The Shape factor is 0.25

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**Tutorial 14.**  Calculate the Shape factor if watershed area & length of flow path are 8 ha & 438 m respectively.

**Solution 14:** We have given:

The Area of watershed (Aw) = 8 ha or 80000 m2

The Length of flow path (Lf) = 438 m

Shape factor RS = Aw / (Lf)2

Hence Shape factor RS = 80,000 m2 / (438 m X 438 m)

= 0.42

**Answer 14:**

The Shape factor is 0.25

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**Tutorial 15.**  An agricultural watershed is having an area of 27 ha, watershed length of 652 m & length of flow path is 711 m. Calculate the Form factor & Shape factor of watershed.

**Solution 15:** We have given:

The Area of watershed (Aw) = 27 ha or 270,00 m2

The Length of watershed (Lw) = 652 m

The Length of flow path (Lf) = 711 m

Form factor Rf = Aw / (Lw)2

Hence Form factor Rf = 270,000 m2 / 652X652 m2

= (6 X 10,000 m2) / (325 m X 325 m)

 = 0.64

Shape factor RS = Aw / (Lf)2

Hence Shape factor RS = 270,000 m2 / 711 m X 711 m

= 0.53

**Answer 15:**

1. The Form factor is 0.64
2. The Shape factor is 0.53

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**Tutorial 16.**  A wasteland watershed is having an area of 22 ha & watershed length of 652 m. Calculate the Elongation ratio of watershed.

**Solution 16:** We have given:

The Area of watershed (Aw) = 22 ha or 220,000 m2

The Length of watershed (Lw) = 652 m

Elongation ratio (Re) is defined as the ratio of diameter of a circle of the same area as the watershed to the watershed length. The numerical value varies from 0 (in highly elongated shape) to 1 (in circular shape).

We know:

Area of circle Ac = ϖ d2 / 4 or 0.786 d2

 d2 = Ac / 0.786

d = √ (Ac / 0.786)

If a circle has the same area as watershed (Aw = Ac) than its diameter will be

d = √ (220,000 m2 / 0.786)

 = √ (279898.2 m2)

 = 529 m

Hence Elongation ratio (Re) = d / Lw

 = 529 m / 652 m

 = 0.81

**Answer 16:**

The Elongation ratio is 0.81

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**Tutorial 17.**  A watershed is having an area of 15 ha & watershed length of 568 m. Workout the Elongation ratio & also specify the shape of watershed

**Solution 17:** We have given:

The Area of watershed (Aw) = 15 ha or 150,000 m2

The Length of watershed (Lw) = 568 m

Note: Elongation ratio (Re) is defined as the ratio between diameter of a circle having same area as the watershed and the watershed length. The numerical value varies from 0 (in highly elongated shape) to 1 (in circular shape). These values can be grouped as:

 Elongation Ratio Shape of Watershed

 Less than 0.7…………………. Elongated Shape

 0.7 to less than 0.8……….. Less elongated shape

 0.8 to less than 0.9……….. Oval shape

 0.9 & above …………………… Circular shape

We know:

Area of circle Ac = ϖ d2 / 4 or 0.786 d2 (ϖ = 22/7)

 d2 = Ac / 0.786

d = √ (Ac / 0.786)

If a circle has the same area as watershed (Aw = Ac) than its diameter will be

d = √ (150,000 m2 / 0.786)

 = √ (190839.7 m2)

 = 437 m

Hence Elongation ratio (Re) = d / Lw

 = 437 m / 568 m

 = 0.77

We know that if elongation ratio is 0.7 to less than 0.8 than watershed will be of Less elongated shape. Hence shape of given watershed is less elongated.

**Answer 17:**

1. The Elongation ratio is 0.77
2. Shape of Watershed is Less elongated.

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**Tutorial 18.**  A hilly watershed is having an area of 32 ha & watershed length of 769 m. Find out the Form factor, Elongation ratio & also determine the shape of watershed

**Solution 18:** We have given:

The Area of watershed (Aw) = 32 ha or 320,000 m2

The Length of watershed (Lw) = 769 m

Form factor Rf = Aw / (Lw)2

Hence Form factor Rf = 320,000 m2 / 769 m X 769 m

= 0.54

We know:

Area of circle Ac = ϖ d2 / 4 or 0.786 d2 (ϖ = 22/7)

 d2 = Ac / 0.786

d = √ (Ac / 0.786)

If a circle has the same area as watershed (Aw = Ac) than its diameter will be

d = √ (320,000 m2 / 0.786)

 = 638 m

Hence Elongation ratio (Re) = d / Lw

 = 638 m / 769 m

 = 0.83

We know that if elongation ratio is 0.8 to less than 0.9 than watershed will be of oval shape. Hence shape of given watershed is oval.

**Answer 18:**

1. The Form factor is 0.54
2. The Elongation ratio is 0.83
3. Shape of Watershed is Oval.

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**Tutorial 19.**  The area of a micro watershed is 53 ha. The watershed length & main stream length are 870 m & 905 m respectively. Calculate the Form factor, Shape factor, Elongation ratio & shape of watershed.

**Solution 19:** We have given:

The Area of watershed (Aw) = 53 ha or 530,000 m2

The Length of watershed (Lw) = 870 m

The Length of main flow (Lf) = 905 m

Form factor Rf = Aw / (Lw)2

Hence Form factor Rf = 530,000 m2 / 870 m X 870 m

 = 0.70

Shape factor RS = Aw / (Lf)2

Hence Shape factor RS = 530,000 m2 / 905 m X 905 m

= 0.65

We know:

Area of circle Ac = ϖ d2 / 4 or 0.786 d2 (ϖ = 22/7)

 d2 = Ac / 0.786

d = √ (Ac / 0.786)

If a circle has the same area as watershed (Aw = Ac) than its diameter will be

d = √ (530,000 m2 / 0.786)

 = 821 m

Hence Elongation ratio (Re) = d / Lw

 = 821 m / 870 m

 = 0.94

We know that if elongation ratio is 0.9 & above than watershed will be of circular shape. Hence shape of given watershed is circular.

**Answer 19:**

1. The Form factor is 0.70
2. The Shape Factor is 0.65
3. The Elongation ratio is 0.94
4. Shape of Watershed is Circular.

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**Tutorial 20.**  An forest watershed is of 12 ha area. The watershed length is 697 m. The length of main stream is 733 m. Determine the Form factor, Shape factor, Elongation ratio & shape of watershed

**Solution 20:** We have given:

The Area of watershed (Aw) = 12 ha or 120,000 m2

The Length of watershed (Lw) = 697 m

The Length of main flow (Lf) = 733 m

Form factor Rf = Aw / (Lw)2

Hence Form factor Rf = 120,000 m2 / 697 m X 697 m

 = 0.25

Shape factor RS = Aw / (Lf)2

Hence Shape factor RS = 120,000 m2 / 733 m X 733 m

= 0.22

We know:

Area of circle Ac = ϖ d2 / 4 or 0.786 d2 (ϖ = 22/7)

 d2 = Ac / 0.786

d = √ (Ac / 0.786)

If a circle has the same area as watershed (Aw = Ac) than its diameter will be

d = √ (120,000 m2 / 0.786)

 = 391 m

Hence Elongation ratio (Re) = d / Lw

 = 391 m / 697 m

 = 0.56

We know that if elongation ratio is less than 0.7 than watershed will be of elongated shape. Hence shape of given watershed is elongated.

**Answer 20:**

1. The Form factor is 0.25
2. The Shape Factor is 0.22
3. The Elongation ratio is 0.56
4. Shape of Watershed is Elongated.

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