ONE-PAGE PLACE ASSESSMENT: MUTARE, ZIMBABWE

LOCATED IN THE LOWER ODZI SUB-BASIN WITHIN THE SAVE RIVER BASIN

CLIMATE ⚐1

AVERAGE HIGH & LOW TEMPERATURES[1] *1982 – 2012*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
°C HIGH	27.6	26.9	26.2	25.9	23.9	20.9	21.1	23.1	26.2	28.7	27.8	27.6	25.5
°C LOW	17.0	16.9	16.0	14.2	10.7	8.4	8.2	9.5	12.2	14.8	16.1	16.6	13.4
°F HIGH	81.7	80.4	79.2	78.6	75.0	69.6	70.0	73.6	79.2	83.7	82.0	81.7	77.9
°F LOW	62.6	62.4	60.8	57.6	51.3	47.1	46.8	49.1	54.0	58.6	61.0	61.9	56.1

RECORD HIGH[2]	39.0° C	102.2° F	*October/November*	RECORD LOW[2]	0.0° C	32.0° F	*July*

SUN ⚐2

LATITUDE -19.0°

ELEVATION 1,087 m / 3,565 FT

	MAR 21	JUN 21	SEP 21	DEC 21
DEGREES N or S of DUE EAST THE SUN RISES[3]	0°	25° S	0°	25° N
DEGREES N or S of DUE WEST THE SUN SETS[3]	0°	25° S	0°	25° N
SOLAR-NOON ALTITUDE ANGLE (ABOVE HORIZON)[a,3,4]	71°	48°	71°	94°

SOLAR-NOON WINTER-SOLSTICE SHADOW RATIO[a] 1 : 0.91 ...AND AZIMUTH[c] 0°

9AM & 3PM WINTER-SOLSTICE SHADOW RATIO[b,3] 1 : 1.80 ...AND AZIMUTH[c,3] 48°

WIND ⚐3

PREVAILING WIND DIRECTION[d] & AVERAGE SPEED[2] MAX SPEED[5] 0 (m/s / MPH)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	ESE	ESE	ESE	E	ESE	ESE	E	E	E	E	E	E	E
m/s	2.2	2.1	2.0	1.9	1.7	1.5	1.9	2.5	3.3	3.7	3.0	2.4	2.3
MPH	4.9	4.7	4.5	4.3	3.8	3.4	4.3	5.6	7.4	8.3	6.7	5.4	5.1

WATER ⚐4

AVERAGE PRECIPITATION (GAIN)[e,6] *1900 – 2012*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
mm	319.81	243.48	196.69	57.12	21.05	13.01	16.82	9.44	18.78	53.27	132.04	247.95	1,329.46
INCHES	12.59	9.59	7.74	2.25	0.83	0.51	0.66	0.37	0.74	2.10	5.20	9.76	52.34

AVERAGE POTENTIAL EVAPORATION (LOSS)[f,2]

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
mm	110.0	95.0	91.0	75.0	54.0	39.0	38.0	50.0	69.0	102.0	105.0	107.0	935.0
INCHES	4.33	3.74	3.58	2.95	2.13	1.54	1.50	1.97	2.72	4.02	4.13	4.21	36.81

WETTEST YEAR'S RAIN[7] DRIEST YEAR'S RAIN[7]

LONGEST PERIOD WITH NO MEASURABLE PRECIPITATION[8] RAINFALL INCOME[8] 3,712 lpcd / 981 GPCD

AREA[h,9] 191.2 km² / 73.9 SQ MILES POPULATION[h,9] 187,621 *2012* UTILITY-WATER USE[i,10] 125 lpcd / 33 GPCD

DEPTH TO GROUNDWATER[j,11]

CURRENT GROUNDWATER EXTRACTION NATURAL GROUNDWATER RECHARGE[k,12]

WATERGY ⚐5

of AVG ZIMBABWE HOMES THAT COULD BE POWERED W/ ENERGY USED TO MOVE & TREAT MUTARE'S WATER[l,13]

TOTEM SPECIES ⚐6

FISH: MAMMAL:

PLANT: BIRD: REPTILE:

AMPHIBIAN:

FOR MORE INFORMATION & HOW TO APPLY IT

P1. For more CLIMATE information, see the introduction and chapters 1, 2, & 4 of *Rainwater Harvesting for Drylands and Beyond (RWHDB), Volume 1, 2nd Edition*

P2. For more SUN information, see chapters 2 & 4 and appendices 5 & 7

P3. For more WIND information, see chapters 2 & 4 and appendices 5 & 9

P4. For more WATER information, see the introduction, chapters 1–4, and appendices 1–5

P5. For more WATERGY information, see chapters 2 & 4 and appendix 9

P6. For more TOTEM SPECIES information: the ethics, principles, and strategies throughout *RWHDB* help us shift from a negative to a positive impact on these species and their habitats and ecosystems, on which our quality of life also depends.

MUTARE'S PLACE-ASSESSMENT NOTES

a. The solar-noon altitude angle (a.k.a., solar-noon elevation angle) refers to the number of degrees the sun is located above the equator-facing horizon at solar noon on the given date. In the northern hemisphere, the equator-facing horizon is to the south. In the southern hemisphere, the equator-facing horizon is to the north.

b. The solar-noon winter-solstice shadow ratio is the object's height **:** length of object's shadow cast on June 21 at noon (the longest noontime shadow of the year). The ratio is 1 : x, where x = 1 ÷ tangent (90 - (latitude + 23.44)).

c. Azimuth is the angle formed between a reference direction (here, due north) to the point on the horizon directly below a given object. Solar noon is the time on any day when the sun's azimuth is 0°. The 9 am & 3 pm winter-solstice azimuth indicates the sun's deviation, in degrees, east/west of due north at those times (±3 hours from solar noon) on June 21.

d. The direction of a prevailing wind is the direction *from* which the wind blows.

e. Precipitation refers to the liquid equivalent of all types of precipitation, falling in both liquid and frozen forms. Newly fallen snow is first measured using a snow ruler. At most ordinary stations the liquid equivalent of snowfall is estimated by dividing the measured amount by ten. At principal stations it is usually determined by melting the snow that falls into Nipher gauges.

f. Potential evaporation is defined as the amount of water that could be evaporated were it available. It is a function of surface and air temperatures, insolation, and wind, all of which affect water-vapor concentrations immediately above the evaporating surface. Compare average rainfall (water gain) to potential water loss via evaporation by looking up potential evaporation (or pan-evaporation) rates for your area. According to one definition, if potential evaporation rates exceed rainfall rates, you are in a dryland environment. Another definition states that drylands are "land areas where the mean annual precipitation is less than two thirds of potential evapotranspiration (potential evaporation from soil plus transpiration by plants), excluding polar regions and some high mountain areas which meet this criterion but have completely different ecological characteristics" (Greenfacts.org). The higher the ratio of potential evaporation to rainfall, the more important evaporation-reducing strategies such as mulch, windbreaks, shading, and covered water storage become.

g. Rainfall income calculated in situ w/ average rainfall, area, & population.

h. Urban Mutare

i. Converted from 2002 national statistic of 589,000,000 cubic meters/year for domestic use. 589,000,000 cubic meters x 1,000 liters/cubic meter ÷ stated national population of 12,932,000 people ÷ 365 days/year = 125 liters/person/day (ref. 10).

j.

k.

l.

CREDITS: Brad Lancaster, Resource concept | **Megan Hartman,** Resource creation, research

MUTARE'S PLACE-ASSESSMENT REFERENCES

1. Climate-Data.org, Climate: Mutare, Climate Table, en.climate-data.org/location/3059, accessed 25 March 2016

2. *Selected climatic data for a global set of standard stations for vegetation science,* M.J. Muller, Springer Science & Business Media, 2012. Data for Umtali Station (prior name of Mutare), accessed 25 March 2016 via Google Books

3. Rainwater Harvesting for Drylands & Beyond, Vol 1, or esrl.noaa.gov/gmd/grad/solcalc, accessed 24 March 2016

4. RWHDB Vol 1, or Mar 21 = 90–latitude, Jun 21 = 90–(latitude–23.44), Sep 21 = 90–latitude, Dec 21 = 90–(latitude+23.44)

5.

6. Climate Change Knowledge Portal, Average Monthly Temperature and Rainfall for Zimbabwe at Location (-18.98, 32.65) from 1900-2012, sdwebx.worldbank.org/climateportal, accessed 25 March 2016

7.

8.

9. Mutare Urban (Urban District) Population, www.citypopulation.de/php/zimbabwe-admin.php?adm2id=121, accessed 25 March 2016

10. Fao.org/nr/water/aquastat/countries_regions/zimbabwe/zimbabwe_cp.pdf, accessed 11 January 2014

11.

12.

13.