ONE-PAGE PLACE ASSESSMENT: MASHHAD, IRAN

LOCATED IN THE KASHAF RIVER SUBWATERSHED WITHIN THE HARI RIVER WATERSHED

CLIMATE ⚐1

AVERAGE HIGH & LOW TEMPERATURES[1] — 1951 – 2005

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
°C HIGH	7.2	9.2	13.9	20.8	26.6	32.2	34.4	33.0	28.9	22.3	15.4	9.7	21.1
°C LOW	-3.8	-2.1	2.6	8.2	12.2	16.2	18.5	16.2	11.5	6.1	1.7	-1.9	7.1
°F HIGH	45.0	48.6	57.0	69.4	79.9	90.0	93.9	91.4	84.0	72.1	59.7	49.5	70.0
°F LOW	25.2	28.2	36.7	46.8	54.0	61.2	65.3	61.2	52.7	43.0	35.1	28.6	44.8

RECORD HIGH[2]: 43.8° C | 111° F | July 18, 1979

RECORD LOW[2]: -30.0° C | -22° F | November 7, 1977

SUN ⚐2

LATITUDE: 36.3°

ELEVATION: 982 m / 3,221 FT

	MAR 21	JUN 21	SEP 21	DEC 21
DEGREES N or S of DUE EAST THE SUN RISES[3]	0°	30°N	0°	29°S
DEGREES N or S of DUE WEST THE SUN SETS[3]	0°	30°N	0°	29°S
SOLAR-NOON ALTITUDE ANGLE (ABOVE HORIZON)[a,3,4]	54°	77°	54°	30°

SOLAR-NOON WINTER-SOLSTICE SHADOW RATIO[b]: 1 : 1.71 ...AND AZIMUTH[c]: 0°

9AM & 3PM WINTER-SOLSTICE SHADOW RATIO[b,3]: 1 : 3.32 ...AND AZIMUTH[c,3]: 43°

WIND ⚐3

PREVAILING WIND DIRECTION[d,2] & AVERAGE SPEED[1]

MAX SPEED: km/h | MPH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	S	S	S	S	S	E	E	E	S	S	S	S	
km/h	5.2	6.9	8.7	8.7	8.5	9.6	10.4	9.1	7.8	6.5	5.0	4.6	7.6
MPH	3.2	4.3	5.4	5.4	5.3	6.0	6.5	5.7	4.8	4.0	3.1	2.9	4.7

WATER ⚐4

AVERAGE PRECIPITATION (GAIN)[1] — 1951 – 2005

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
mm	33.0	35.2	55.6	46.3	27.6	4.2	1.1	0.8	1.7	8.6	16.4	24.7	255.2
INCHES	1.30	1.39	2.19	1.82	1.09	0.17	0.04	0.03	0.07	0.34	0.65	0.97	10.05

AVERAGE PAN EVAPORATION (POTENTIAL LOSS)[e,5] — 1983 – 2013

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
mm	19.2	21.1	34.9	57.8	98.6	155.7	211.5	198.7	143.3	82.2	47.0	24.9	1,094.9
INCHES	0.76	0.83	1.37	2.28	3.88	6.13	8.33	7.82	5.64	3.24	1.85	0.98	43.11

WETTEST YEAR'S RAIN[6]: | DRIEST YEAR'S RAIN[6]:

LONGEST PERIOD WITH NO MEASURABLE PRECIPITATION[2]: 161 DAYS: June 6 – November 13, 1993

RAINFALL INCOME[f]: 214 lpcd / 57 GPCD

AREA[g,7]: 850 km² / 328 SQ MILES

POPULATION[g,7]: 2,772,287 (2011)

UTILITY-WATER USE[h,8,9]: 246 lpcd / 65 GPCD

DEPTH TO GROUNDWATER[i,10]:

CURRENT GROUNDWATER EXTRACTION: | NATURAL GROUNDWATER RECHARGE[j,11]:

WATERGY ⚐5

of AVG [REGION] HOMES THAT COULD BE POWERED W/ ENERGY USED TO MOVE & TREAT [CITY'S] WATER[12]:

TOTEM SPECIES ⚐6

FISH: MAMMAL:

PLANT: BIRD: REPTILE:

AMPHIBIAN:

FOR MORE INFORMATION & HOW TO APPLY IT

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

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

⚐**3.** For more WIND information, see chapters 2 & 4 and appendices 5 & 9

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

⚐**5.** For more WATERGY information, see chapters 2 & 4 and appendix 9

⚐**6.** 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.

MASHHAD'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 December 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 south) 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 south at those times (±3 hours from solar noon) on December 21.

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

e. An evaporation pan holds water whose depth is measured daily as water evaporates. These data allow us to determine evaporation rates at a given location. Compare average rainfall (water gain) to potential water loss via evaporation by looking up pan-evaporation rates for your area. According to one definition, if pan-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.

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

g. City proper

h. National average of municipal water withrawn, calculated with national municipal water withdrawal of 6.2 billion cubic meters in 2004 (ref. 8) x 1000 liters/cubic meter ÷ national population in 2004 of 69,018,930 people (ref. 9) ÷ 365 days/year.

i.

j.

CREDITS: Brad Lancaster, Resource concept | **Dr. Javad T. Yazdi & Mr. Ahad Tavasoli,** Research **| Megan Hartman,** Resource creation, research

MASHHAD'S PLACE-ASSESSMENT REFERENCES

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2. Mashhad Shahid Hashemi Nejad Int'l Airport station #32820, 1973–1980 & 1989–2013, Weatherspark.com, accessed 2/16/2014

3. Rainwater Harvesting for Drylands & Beyond, Vol 1, or esrl.noaa.gov/gmd/grad/solcalc, accessed 2/14/2014

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. I.R. of Iran Meteorological Organization, Mashhad, via email from Mr. Ahad Tavasoli, Faculty of Natural Resources, Hormozgan University, www.razavimet.gov.ir, 2/16/2014

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7. Wikipedia, en.wikipedia.org/wiki/Mashhad, accessed 2/15/2014

8. FAO Aquastat Database, www.fao.org/nr/water/aquastat/data/query/index.html, accessed 2/15/2014

9. Index Mundi, www.indexmundi.com, accessed 2/15/2014

10.

11.

12.