

Creating a One-Page Place Assessment: Tucson

Here we outline where we found the information used to compile the Tucson One-Pager, and offer tips for using these resources and suggestions for how you might track down the data to complete your own One-Pager. The resources for different cities and regions will, of course, vary; these are given as examples of what to look for and how to evaluate the data you find. CITE YOUR SOURCES!

1. Subwatershed & Watershed

Every site is located in multiple nested watersheds, ranging from the ultra-local (based on the small neighborhood wash or creek into which your site drains), on up to the regional level (based on the major river or sea into which your local waterway eventually drains).

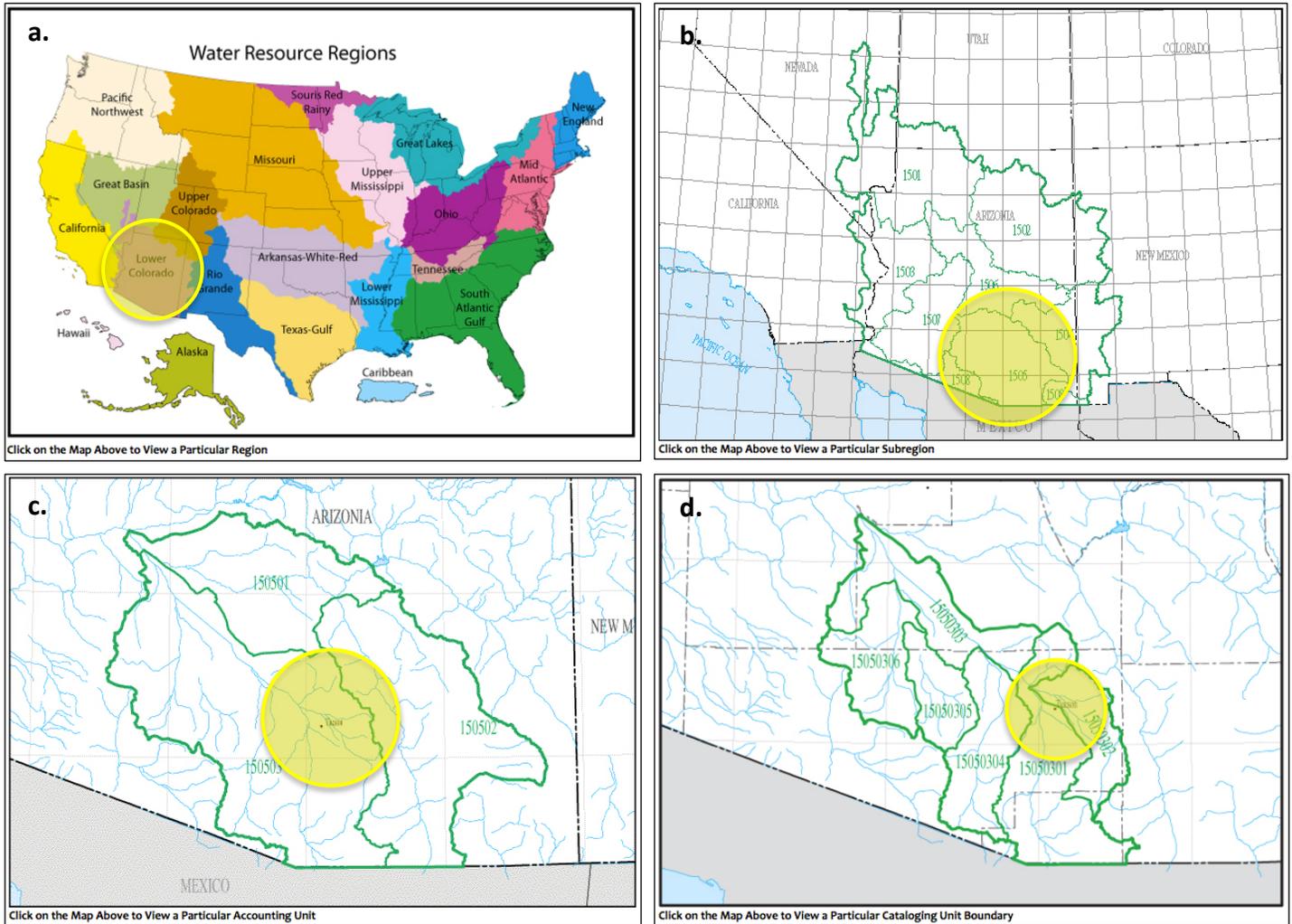
Using local resources, we know that Brad’s property drains to West University Wash, but as the One-Pager is for all of Tucson, we zoom out to see what larger river receives the water that drains from *all* of Tucson. If you are not very familiar with the geographic context in which your city or town is located, you might want to start with EPA’s How’s My Waterway <https://www.epa.gov/waterdata/how-s-my-waterway> (Fig. 1.1), which accepts multiple input options to identify your site’s watershed (e.g., ZIP code, city name, state, etc). Otherwise, if you *can* find your location on a sparsely labeled map, you can skip to the USGS resource farther below.

Fig. 1.1. EPA’s How’s My Waterway

The screenshot displays the EPA's How's My Waterway interface. On the left, a search bar contains "Tucson, Arizona" with "Go" and "Use My Location" buttons. Below is a map of Tucson, Arizona, with a dashed black outline indicating the watershed boundary. The map includes labels for Oro Valley, Casas Adobes, Catalina Foothills, Tucson, Tucson Estates, Drexel Heights, and Tanque Verde. A scale bar shows 6 km and 4 mi. On the right, the "Overview" section for "Tucson, Arizona" (Watershed: Arroyo Chico-Santa Cruz River (150503010906)) is shown. It features a navigation menu with tabs for Overview, Swimming, Eating Fish, Aquatic Life, Drinking Water, and Monitoring. The "Overview" tab is active, displaying "Your Waters: What We Know" and a summary of water quality monitoring. The summary includes a disclaimer and three key metrics: 1 Waterbody, 367 Monitoring Locations, and 3 Permitted Dischargers. Below this, a legend for "Waterbody Conditions" shows Good (green circle), Impaired (red circle), and Condition Unknown (purple triangle). At the bottom, a list of waterbodies includes "Santa Cruz River, from Roger Rd WTP outfall to RILLITO CREEK" with State Waterbody ID: AZ15050301-003B_00.

When we enter Tucson into the search function, as shown above in Fig. 1.1, the results show that Tucson is part of the Santa Cruz River watershed. Although we know that our specific site is in the Upper Santa Cruz, we want this resource to reflect the watershed for the whole city. What is the next larger watershed that contains both the Rillito and the Upper Santa Cruz? The EPA resource does not provide this information, so equipped the watershed names it gave us, we head to USGS's Science in Your Watershed, at http://water.usgs.gov/wsc/map_index.html (Fig. 1.2).

Fig. 1.2a–d. USGS's Science in Your Watershed



When we first arrive, we see the map shown above in Fig. 1.2a. We know we are in the Lower Colorado region, so we click there, and see a view of the Lower Colorado broken up into its subwatersheds (see Fig. 1.2b). We're familiar enough with where Tucson is located within the state to know we are in area 1505 which, when we hover over it with our cursor, we see is called the Middle Gila. We want to hone in a bit closer on Tucson's local watershed, so we click on Middle Gila and are taken to a view of *its* subwatersheds (Fig. H.2c). When we hover over the labeled dot representing Tucson, we learn that this watershed is the Santa Cruz. It seems to be one level up from the Upper Santa Cruz and Rillito on the EPA website, but to be sure, we click on the Santa Cruz; as shown in Fig. 1.2d, when we hover over its subwatersheds, they indeed include the Upper Santa Cruz and the Rillito, with the boundary between the two running through Tucson.

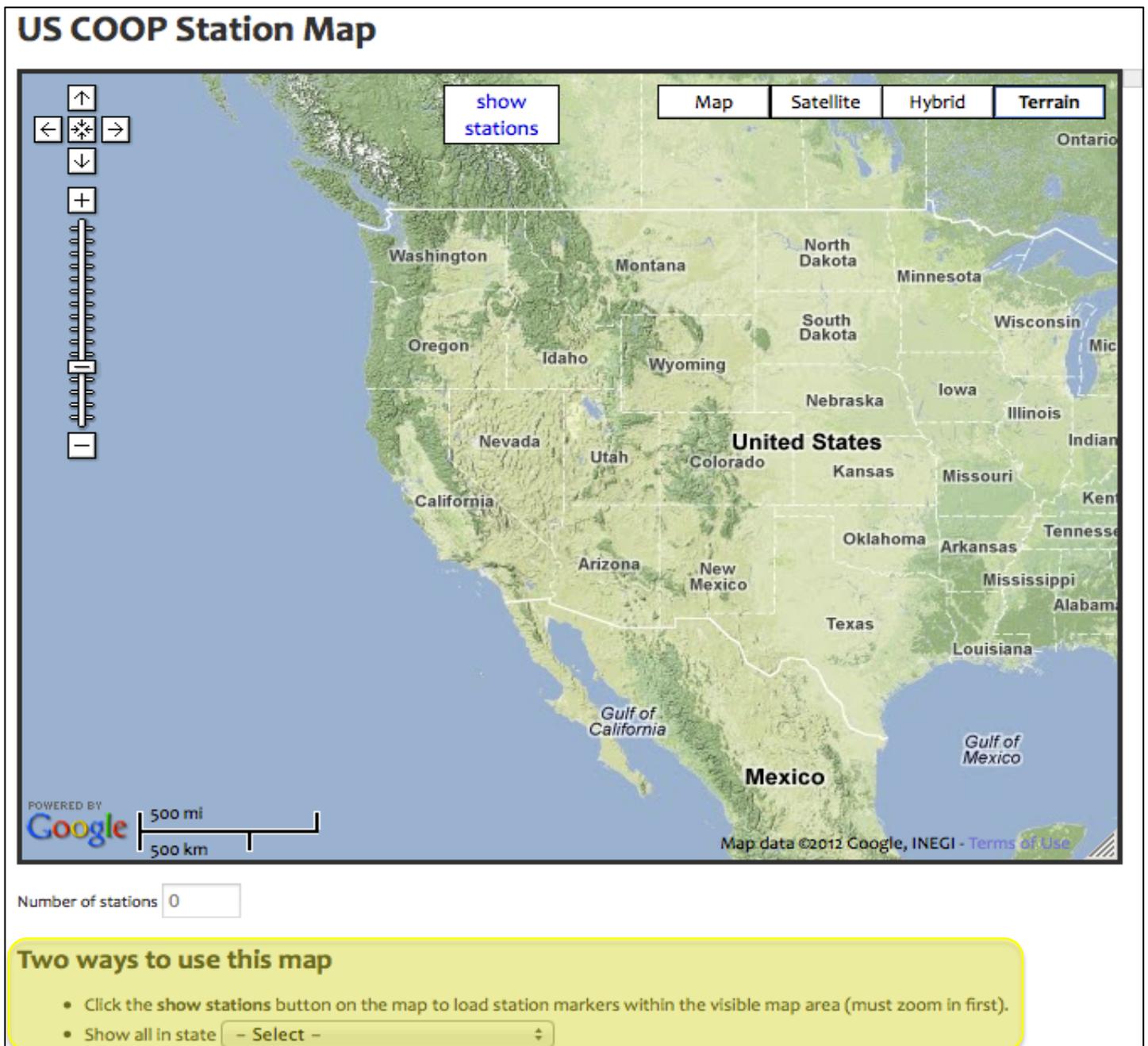
Another resource, which has a lot of potential if developed further, can be found at <http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd>. A plus is that you can enter a street address and see

that specific spot on the map—choosing views such as topo, satellite imagery, place names, etc—and zoom in/out to see the watersheds' boundaries within which the spot is located. Weaknesses include that the interface is very clunky and unintuitive, and rather than watershed names, it numbers all the watersheds without indicating how to translate these into watershed names.

2. Average High & Low Temperatures (CLIMATE), Record High & Record Low Temperatures (CLIMATE), Average Rainfall (WATER), Wettest Year's Rain & Driest Year's Rain (WATER), Longest Period with No Measurable Precipitation (WATER)

A great historical-climate-data resource, especially for western U.S. states, is the Western Regional Climate Center. Their U.S. COOP Station Map is at <http://www.wrcc.dri.edu/coopmap/> (Fig. 2.1).

Fig. 2.1. U.S. COOP Station Map

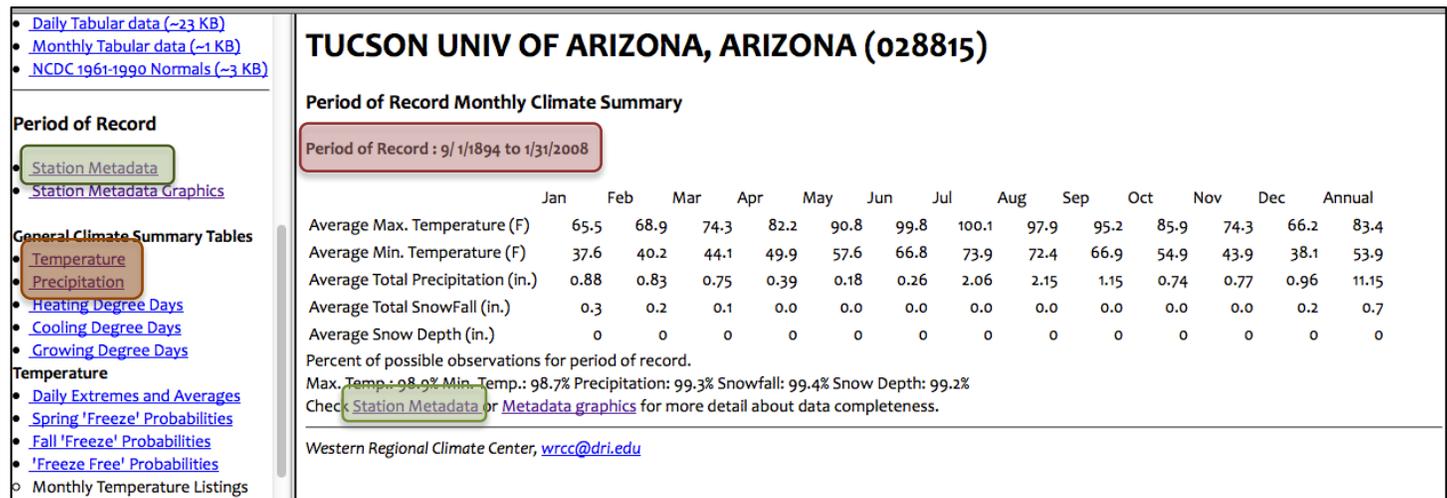


Choose one of the methods highlighted above in Fig. 2.1 to locate possible weather stations for your One-Pager.

Note: If you live in a metropolitan area, you will likely have more than one station from which to choose—see below for tips on how to pick one. If you live in a small town, you might have to look at nearby stations if your town does not have its own. In this case, try to choose the station whose location and topography are the most similar to your site's. For example, if your site is in a mountainous region and the closest station as the crow flies is on the *other* side of a significant ridge or at a much different elevation, a more distant station on the *same* side of the ridge at a similar elevation will likely yield better data. If you need help with station selection, call the service climatologists at WRCC—they have on occasion helped us with this.

When you click on a station, you'll get information similar to what is shown below in Fig. 2.2:

Fig. 2.2. Individual weather-station monthly climate summary



In addition to location, when deciding whether to use a particular station's data, you'll want to consider the following:

- **Period of record.** The longer the period of record, the more accurate the average data will be. Here the period of record is over 100 years, which sounds promising. Now check the station's metadata.
- **Station metadata.** Here's where you check to make sure that the actual period of record is as stated, and that there aren't too many holes in the data for it to be accurate. To do this, scroll down to Statistics by Observation (see Fig. 1.3, below). Check the actual period of record by looking at the **START** and **END** dates, listed in yyyyymmdd format. Check the completeness of the data by looking at:

- **POSBL**—Possible number of observations between START and END date,
- **PRSNT**—Number of days present in record,
- **LNGPR**—Largest number of consecutive observations,
- **MISSG**—Total number of missing days (no observation), and
- **LNGMS**—Largest number of consecutive missing observations.

Here we have 40,818 out of 41,425 possible observations, or 98.5% complete data.
(Calculation: 40,818 ÷ 41,425 = 0.985, or 98.5%).

Note: If you are a more visual person, you can click on Station Metadata Graphics (in the left-hand sidebar, below Station Metadata; see Fig. 2.2) to view the graphics for the elements you need (typically min and max temperature and precipitation). You won't be able to calculate percentage of data completeness, but you'll still get a good sense of the station's data's viability for your One Pager.

[continued...]

Fig. 2.3. Statistics by Observation

Statistics by observation

(From WRCC data archives)
Last Compiled on Apr.23, 2009.

Dates are format of YYYYMMDD. Numbers represent one day and one day is considered present if any element is reported.

STATION	NAME	START	END	POSBL	PRSNT	LNGPR	MISSG	LNGMS
028815	TUCSON UNIV OF ARIZONA	18940901	20080131	41425	40818	11412	607	214

Once you've determined that you've found the best station for your assessment, use the average monthly min & max temperatures and rainfall from the page like the one featured in Fig. 2.2.

Climate & Rainfall Extremes: Return to the WRRC page shown in Fig. 2.2, and in the sidebar on the left, under General Climate Summary Tables, start by clicking on either **Temperature** or **Precipitation**. See Fig. 2.4 and the tips below on how to glean **Record High** and **Record Low** temperatures for the CLIMATE section and, similarly, when you click on Precipitation, the **Wettest Year's Rain** and **Driest Year's Rain** for the WATER section.

Fig. 2.4. General Climate Summary—Temperature

SC ACIS

Product selection

- Single-Station Products
- Multi-Station Products
- Gridded Data Products
- Other Products

Options selection

Station/Area selection

Go

Almanac Data for a Day

Time Series for a Day

Daily Data for a Month

Daily Data Listing

Calendar Day Summaries

Monthly Summarized Data

Seasonal Time Series

Extremes

Consecutive Days

First/Last Dates

Daily/Monthly Normals

Temperature Graph

Accumulation Graph

Multi-Station Graph

Station:(028815) TUCSON UNIV

From Year=1894 To Year=

	Monthly Averages			Daily Extremes				High Me
	Max.	Min.	Mean	High	Date	Low	Date	
	F	F	F	F	dd/yyyy or yyyymmdd	F	dd/yyyy or yyyymmdd	
January	65.5	37.6	51.5	90	19/1971	6	07/1913	6
February	68.9	40.2	54.6	93	14/1957	17	07/1899	6
March	74.3	44.1	59.2	98	26/1988	22	19/1897	6
April	82.2	49.9	66.0	104	21/1965	28	05/1901	7
May	90.8	57.6	74.2	111	29/1910	32	03/1899	8
June	99.8	66.8	83.3	115	19/1960	43	04/1908	9
July	100.1	73.9	87.0	115	28/1995	49	03/1911	9
August	97.9	72.4	85.2	112	04/1944	55	20/1917	9
September	95.2	66.9	81.1	112	01/1950	42	30/1965	8
October	85.9	54.9	70.4	104	11/1950	39	28/1897	7
November	74.3	43.9	59.2	94	01/1924	9	19/1921	6
December	66.2	38.1	52.2	88	06/1970	0	14/1901	6
Annual	83.4	53.9	65.7	115	19600619	6	19130107	7

To get the **Longest Period With No Measurable Precipitation**, start by going to the NOAA Regional Climate Centers' SC ACIS tool at <http://scacis.rcc-acis.org/>.

Under **Product selection**, choose **Single-Station Products** and, under that, **Consecutive Days**.

The screenshot shows the 'Options selection' panel in the SC ACIS tool. It includes the following settings:

- Output:** HTML CSV
- Year range:** por - 2017
- Criteria:** Precipitation < 0.01
- Report content:**
 - Top 10 longest runs
 - All runs >= [] days
- Additional options:**
 - Include start date in results
 - Set max missing values in run
 - Allowable missing days: 5

Under **Options selection**, set **Output** to HTML (unless you prefer CSV).

For **Year range**, to search the entire *period of record*, use **por – [current year]**.

Under **Criteria**, select **Precipitation < 0.01**. This is the standard threshold for *no measurable precipitation*.

Under **Report content**, check the box to “**Include start date in results**,” and **Set max missing values in run** to a small value, like 5 (per a staff member at WRCC). Feel free to play around with the max missing values option to see how (if at all) it changes your output.

The screenshot shows the 'Station/Area selection' panel in the SC ACIS tool. It includes the following settings:

- ID:** 028815
- Type:** Coop
- Go** button

Under **Station/Area selection**, click **ID** and enter station ID below in the ID field. For Tucson's University of Arizona, the station ID is 028815. If the **Type** field doesn't automatically populate when you enter the ID number, try manually setting **Type** to *Any*.

Click **Go** and your chart of results will appear in the pane to the right.

If for any reason you are not successful in finding what you need with this tool, you can call the WRCC service climatologists for assistance (have your station ID(s) handy).

3. Latitude, Elevation, Degrees N or S of Due East or West the Sun Rises and Sets, Solar-Noon Altitude Angle (Above Horizon), Solar-Noon and 9am & 3pm Winter-Solstice Shadow Ratios and Azimuths (SUN)

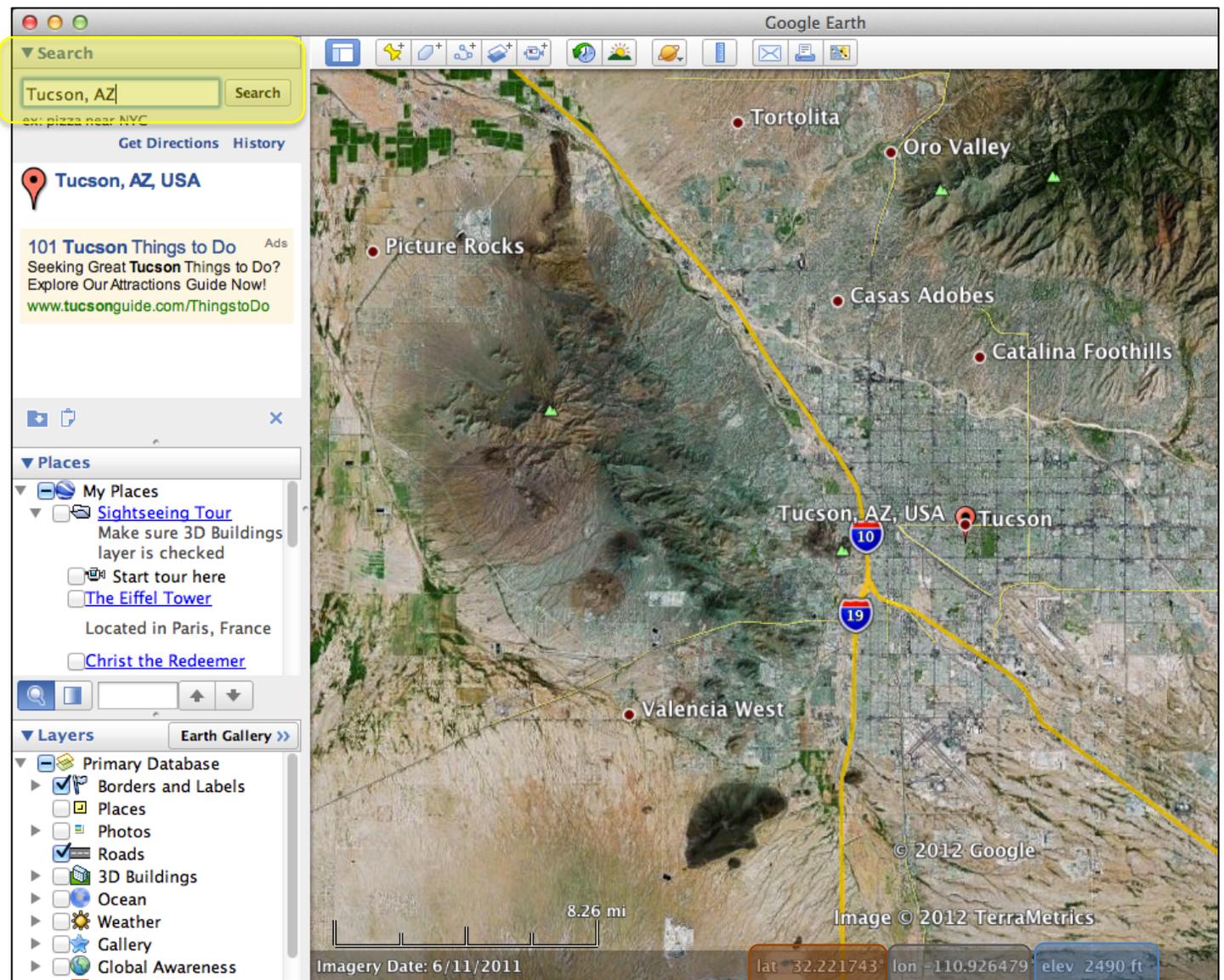
Latitude (and longitude—which you'll indirectly need later): Run a web search (we use Google) for “[Your City, ST] latitude and longitude” or use Google Earth. For Google Earth, which will also deliver **Elevation**, enter

“[Your City, ST]” in the search bar, hit Enter, and check the bottom edge of the screen for “lat,” “lon” and “elev” (Fig. 3.1).

Note: The latitude and longitude shown in Google Earth depend on the current or most-recent map position of the cursor. You can hover over the spot where Google Earth sets the location pin if your One Pager will be used for the city as a whole or for multiple sites within the city, or zoom in and hover over your exact site if you want more specific data.

Elevation: Use Google Earth, as above for latitude. If you want to see results in metric, go to the Google Earth menu and choose Preferences to set the units. Or, use a topo map or another web-based tool if you prefer.

Fig. 3.1. Google Earth for Latitude and Elevation



Degrees North (in southern hemisphere) or **South** (in northern hemisphere) of **Due East** or **West** the **Sun Rises and Sets**: First, the easy part: On March 21 and June 21, the sun pretty much rises due east and sets due west almost everywhere, so you can enter 0° in all four of those fields. Slight deviations occur the closer to the north and south poles you get.

For June 21 and December 21:

Go to NOAA’s Solar Calculator at www.esrl.noaa.gov/gmd/grad/solcalc/ (Fig. 3.2).

Fig. 3.2. NOAA Solar Calculator

NOAA Solar Calculator

Find Sunrise, Sunset, Solar Noon and Solar Position for Any Place on Earth

Show: World Cities U.S. Cities GMD Observ.'s GMD Data Sites SurfRad

Click one of the small pins near (and in the same time zone as) your desired location. Use the control on the left side of the map to zoom in or out. Place the large pin in the exact desired location. You can use the Save button to have your computer remember the current location for next time. Check the DST check box if Daylight Saving Time is in effect for your site.

Location: Lat 32.2 Lng -110.9 Time Zone -7 DST? Save

Date: Day 21 Mon Jun Yr 2012 Local Time: 05 : 18 : 00 PM

Equation of Time (minutes):	Solar Declination (in °):	Apparent Sunrise:	Solar Noon:	Apparent Sunset:	Az/El (in °) at Local Time:	
-1.88	23.44	05:18	12:25:33	19:33	61.41	-0.33
Show on map:		Sunrise <input type="checkbox"/>		Sunset <input type="checkbox"/>	Local Time <input type="checkbox"/>	

Start by entering your site's **latitude** and **longitude** into the specified fields in the NOAA calculator. For the purposes of this tool, northern latitudes are positive, while southern are negative; eastern longitudes are positive and western ones are negative.

Enter your **standard time zone**. Time zones east of UMC/GMT are positive, and times zones west of UMC/GMT are negative. If you are not sure of your standard time zone, click the **Time Zone** label to access a basic chart. For more time-zone help, visit www.timeanddate.com/time/map/. If your site observes daylight savings time in the summertime, don't change the standard time zone, just check the "DST?" box when searching for

information for the *summer solstice only* (June 21 in the northern hemisphere, December 21 in the southern hemisphere). Otherwise leave the DST? box unchecked.

In the **Date** fields, start by selecting Day **21** and Month **June**. This will display the **Apparent Sunrise** and **Apparent Sunset** times for June 21 in their respective boxes. Manually enter the hour and minute of sunrise into the **Local Time** boxes.

Now look for the number in the **Az** (azimuth) box. Let’s call this one, for June 21 at sunrise, **Az(1)**. Round it to the nearest whole number (here, **61°**). Then plug that angle into the table below (Table. 3.1) to find the location of the sun at sunrise on June 21. (The reason for this conversion is that NOAA gives the azimuth as degrees clockwise from due north; for the purposes of solar design it is more helpful to have the sunrise and sunset azimuths focused around due east and west.)

Table. 3.1. Location of Sun at Sunrise and Sunset on Solstices

June 21		December 21	
<i>Sunrise</i>	<i>Sunset</i>	<i>Sunrise</i>	<i>Sunset</i>
90° – Az(1) N of E	Az(2) – 270° N of W	Az(3) – 90° S of E	270° – Az(4) S of W

Repeat for sunset on June 21 to find **Az(2)**, and sunrise and sunset on December 21 to find **Az(3)** and **Az(4)**, respectively. (If you enter the time using the 24-hour time format, leave the PM box unchecked regardless of the time of day.) Next, plug each of these Az values into Table 3.1 to determine where the sun rises and sets on each solstice.

Solar-Noon Altitude Angle (Above Horizon); and **Solar-Noon, 9am & 3pm Winter-Solstice Shadow Ratios and Azimuths** (SUN): These can be determined using the NOAA Solar Calculator &/or our Excel-based Sun-Angle Calculator (email us with questions).

4. Prevailing Wind Direction, Average Speed, Max Speed (WIND)

Prevailing Wind Direction is the direction *from* which the wind blows. We’ve found that the reported prevailing-wind directions vary a lot from source to source, so we advise you don’t simply accept the first set of data you find—instead, compare it against your own local observations (or those of a seasoned local source). For example, although we found that the WRCC (which we gladly cite above for temperature and rainfall) has compiled a list of prevailing-wind directions by month at www.wrcc.dri.edu/htmlfiles/westwinddir.html, the wind data given for Tucson did not match up with what we’ve experienced. Therefore we ran a web search and accessed data from the USDA’s website at ftp://ftp-fc.sc.egov.usda.gov/AZ/NRI/prevailing_winds.pdf. When conducting your own search, consider the general reliability of the source as well as what your real-world experience tells you about the actual data. Your One-Pager will be only as useful as your data is valid.

For **Wind Speed**, we checked the WRCC’s Average Wind Speed data (at www.wrcc.dri.edu/wind-information/), but opted instead to use data from www.myforecast.com/bin/climate.m?city=10954, since, unlike the WRCC, this website also provided **Max Wind Speed** data. Ideally, we would like to find one solid resource that provides reliable data for all elements. Absent that, we weighed the pros and cons of taking this data from a *previously referenced* source versus getting as much related data as possible from *one* source. In this case, we opted for the latter.

5. Average Pan Evaporation (WATER)

We returned to the WRCC resource for **Average Pan Evaporation** data, and used the information on their site at www.wrcc.dri.edu/htmlfiles/westevap.final.html. Note that between the two Tucson stations reporting pan evaporation, we chose the station with the much-longer period of record.

6. Rainfall Income, Area, Population (WATER)

The calculation for **Rainfall Income** (given in gallons (liters) per capita per day) is built into the Excel version of the One-Pager, drawing on Average Rainfall (see above), and **Area** and **Population** of Tucson, both found at Census.gov (Figs. 6.1a–d). Both are for the city proper (not the greater metro region). This last bit is key—be sure to give the population and area of the same geographic region—which if at all possible should also be the same region for which you report Utility-Water Use (see item 7, below).

Figs. 6.1a–d. Population and Area on Census.gov

The screenshot shows the U.S. Census Bureau's State & County QuickFacts website. The page is titled "State & County QuickFacts" and features navigation tabs for "Select a State", "USA QuickFacts", "What's New", and "FAQ". The main content area is for "Arizona" and includes search filters for "Arizona counties- selection map" and "Arizona cities- place search". The "Arizona cities- place search" filter is set to "Tucson (city)". The page displays data for "Tucson (city), Arizona" under the "People QuickFacts" section, showing a population of 525,796 (2011 estimate). Under the "Geography QuickFacts" section, it shows a land area of 226.71 square miles (2010). The page also includes a "QuickFacts" sidebar on the left and a "Share this page" button.

7. Utility-Water Use (WATER)

Most water delivered in Tucson comes from Tucson Water, a division of the City of Tucson. Whether your water is supplied by the municipality or by a privately owned water company, it should be relatively easy to find the average number of **Gallons (Liters) Per Capita per Day**—or GPCD (lpcd)—consumed in your city or town. Some water companies state this clearly on their website; others bury the data in reports which can be downloaded from their website. Look for the most-recent statistic, typically for residential usage (not including water used by industry or agriculture). If you cannot find this information online, call your water company and ask them to provide it. We advise citing the residential GPCD when possible, but if all that is available is an all-inclusive number for residential, commercial, industrial, and agricultural, go ahead and use that, noting this fact in your notes section.

8. Historic and Current Depths to Groundwater, Current Groundwater Extraction vs. Natural Recharge (WATER)

Depth to Groundwater: When comparing historic and current groundwater levels, it is important to find measurements that were taken as physically close to one another as possible, if not from the same well. Also, since groundwater levels fluctuate seasonally, look for measurements taken during the same month if possible. You might want to start by finding the oldest-possible reliable measurement first, as it will likely be easier to match a more-recent statistic to the location and month of an historical reading than the other way around. The statistics we use in the Tucson One-Pager came from the Arizona Department of Water Resources.

Current Groundwater Extraction vs. Natural Recharge: We found sources of this information both on the website of the Arizona Department of Water Resources as well as in a local daily newspaper.

9. WATERGY

There are various angles from which the energy costs of water can be illustrated. The goal here is to bring this hidden cost to light in a way that is easy for people to grasp. We were able to get from a City employee the percentage of Tucson’s energy that is used to pump and treat water. Another option is to research how many kilowatt-hours (kWh) of energy were used by your water supplier in a year to pump and treat water—you should be able to get this from your water supplier’s website or by calling them—and divide this by the number of kWh used in a year by an average local household. For this kWh statistic we use an online U.S. EIA resource (Fig. 9.1) that gives monthly statistics by state, found at www.eia.gov/cneaf/electricity/esr/table5.html. Be sure you are on the Residential tab, not Commercial or Industrial, and **remember** to multiply the monthly statistic by 12 to get annual usage. To recap: (water supplier’s annual kWh to pump and treat water) ÷ (average monthly household kWh usage × 12) = how many local households could be powered with the energy used to pump and treat local water. Use this, the overall percentage of energy, or another illustrative statistic of your own choosing to increase awareness of the true costs of your water.

Fig. 9.1. U.S. EIA’s Residential Average Monthly Bill by Census Division, and State

Residential Average Monthly Bill by Census Division, and State				
Date of Latest Data: 2009 Report Released: November 2010 Next Release Date: November 2011				
		Residential	Commercial	Industrial
Residential				
Census Division	State	Number of Consumers	Average Monthly Consumption (kWh)	Average Rate per Kilowatt
New England		6,125,483	630	17.70
Connecticut		1,452,080	731	19.55
Maine		695,368	521	16.20
Massachusetts		2,647,529	618	17.68

[continued...]

10. Totem Species

Possible sources for totem-species candidates include agents of your local U.S. Fish & Wildlife office, state Game & Fish department, and/or local conservation- or permaculture-oriented nonprofit organizations. Based on our experience, we advise you to get clear in advance on the Totem-Species selection criteria and purpose of gathering this information before making any phone calls; while some folks we’ve contacted have pretty quickly grasped the concept, others have struggled with it. It might help to understand that Totem Species are examples of starting points from which to explore how water and wildlife are connected, rather than a definitive, limiting endpoint of inquiry.

Taking Your One-Page Place Assessment Further

What other key indicators (past, present, and future) of the health, challenges, and potential of your location might you capture in *your* One (or Two?)-Page Place Assessment? Consider adding the following to your assessment:

- Geology and soils, including your area's geologic history and how it yielded the current landforms and soils at your site. Also address changes in soil fertility, organic matter, depth of topsoil, and how soil affects your area's food-web diversity and density.
- Light pollution. Using the info at www.globeatnight.org, I found that downtown Tucson's 2012 light pollution rating is a "limiting magnitude" of 4 (LM4). Applying that rating to the interactive night sky map at www.globeatnight.org/learn_orionsky.html, I discovered that this light pollution has erased *thousands* of stars previously visible to the naked eye from our night sky. If seen, these stars could help us find direction (see appendix 7); tell time; and more directly connect us to the stories, histories, and knowledge of cultures that have used those stars in the past.
- Culture indicators, including diversity and density of different cultural groups in the past and present, the languages spoken, how long these cultures have been present, what knowledge and strategies supported them then and support them now, and how these have changed. There is evidence of Paleo-Indians living in my area of the Santa Cruz River valley over 10,000 years ago and of irrigated agriculture as early as 1000 B.C. This area is one of the longest continuously inhabited locations in what is now the U.S., due in large part to formerly abundant river water, springs, artesian wells, and shallow groundwater. These water sources have largely disappeared in the last 100 years, due primarily to our overconsumption of water and mismanagement of waterways and watersheds. (REFERENCE: Logan, Michael F., *The Lessening Stream: An Environmental History of the Santa Cruz River* (University of Arizona Press. 2002).

Check out www.StoryofPlace.org (especially its resources) for examples of more comprehensive, regenerative assessments presented through compelling stories.