

## CHAPTER 10

### SITE SELECTION

#### INTRODUCTION

\*Selecting a “good” site for the location of a greenhouse is crucial.

\*But what constitutes a “good” site?

\*There are several things that should and must be considered in order to increase the chances of a successful operation and business.

#### 12 THINGS TO CONSIDER WHEN SELECTING A GREENHOUSE SITE:

**1. Solar Radiation** – Plants require sunlight in order to perform photosynthesis. When plants experience cloudy days their photosynthetic rates, and therefore their ability to grow and yield a product, such as tomatoes, cucumbers, peppers, etc., will be reduced.

\*Therefore, a region and location with high light intensity year-round is desired.

\*See “Solar radiation data for selected cities” at the end of this chapter.

Note that the southwestern United States has some of the highest light levels in the world. This is, therefore, an optimal region for crop production.

\*See “Microclimate” below for natural/manmade structures that reduce light.

**2. Water** – Water quantity and quality is crucial.

\*Water will be needed for irrigation (maximum of 1 gal/plant/day for tomatoes).

\*Water will be needed for the evaporative cooling system and can equal or exceed the irrigation water amounts (10,000 – 15,000 gal/acre/day).

\*In the past, excess irrigation and bleed-off water from the evaporative cooling system was allowed to “run off” onto the ground adjacent to the greenhouse (with a rec. minimum percolation rate into the soil of 1”/hr.)

\*HOWEVER, due to more strict regulations and a desire to avoid ground water contamination with high concentrations of salts, large greenhouses are now recirculating the nutrient solution.

\*THEREFORE, excess nutrient solution should be recycled and/or mixed with the cooler bleed-off water and redirected onto designated areas, such as grass, shrubs, trees/windbreaks, etc.

\*No matter what the source of the water, a water analysis should be done.

\*Note: Sea water = 32,000 ppm (mg/l) VS Tucson water = 200-400 ppm.

Note: 640 ppm TDS (total dissolved solids) = 1 mmhos/cm or 1 mS/cm.

See Chapter 8 for a discussion of EC or electrical conductivity.

\*Desired salt levels in the source water:

SO <sub>4</sub>	< 240 ppm	Cl	< 140 ppm	Non-Fertilizer Salts	
Ca	< 120 ppm	Fe	< 5 ppm	Na	<50 ppm
Mg	< 24 ppm	Zn	< 5 ppm	Al	< 5 ppm
K	< 10 ppm	Mn	< 2 ppm	F	< 1 ppm
P	< 5 ppm	B	< 0.8 ppm		
NO <sub>3</sub>	< 5 ppm	Cu	< 0.2 ppm		
		Mo	< 0.02 ppm		

**3. Elevation** – will effect the summer maximum and the winter minimum temperatures.

\*Choosing an appropriate elevation will minimize heating costs in the winter and cooling costs in the summer.

\*Example: In Arizona tomato production is most economical between 4000 and 5000 feet (1220m-1520m). Below 4000 feet cooling costs in summer will be more whereas above 5000 feet heating costs in the winter will be more. Lower elevations might be suitable for peppers or cucumbers.

**4. Microclimate** –

\*Latitude – Unless the global climate changes drastically, sea level at the poles will be colder than sea level in the tropics... latitude makes a difference!

\*Large bodies of water – will tend to moderate the temperature (e.g., coastal areas tend to have smaller day/night temperature differences than inland areas).

\*Trees, mountains or other obstructions – may cast shadows on the greenhouse, especially in the morning or afternoon hours. Mountains can also effect wind and/or storm patterns.

\*Clouds and fog – Note that certain areas (e.g., on the lee side of certain mountain ranges, or near coastal regions) may develop clouds or fog during certain times of the day or year that will reduce potential sunlight.

\*High Wind Areas – High winds can “suck” heat away from the greenhouse structure and therefore increase the heating energy demands.

\*Blowing dust/sand – High winds can “kick up dust or sand”, especially in desert regions, which can damage some greenhouse glazings.

\*Snow – The weight of heavy, wet snow on a greenhouse could crush it. However, high winds in snow areas can also blow snow up against the greenhouse structure (snow drifts) and cause damage to it. This danger can be reduced by using windbreaks (trees, snow fences, etc.).

**5. Pest Pressure** – Choose a site away from existing agriculture production areas which could harbor insect pests in the fields. Insect pests of concern include white flies, aphids, spider mites and thrips (see Chapter 4 for pests and control methods).

**6. Level and Stable Ground** – The ground upon which the greenhouse will sit must be

\*Graded for routing surface water to a drainage system or a holding pond.  
(Typical grade = ½ % or a 6 inch drop over a distance of 100 feet.)

\*Compacted such that there will be no settling of the site after the greenhouse has been constructed.

**7. Utilities** – Availability of utilities should include telephone service, three-phase electricity and fuel for heating and carbon dioxide generation.

\*Note that, when compared to propane, electricity or fuel oil, **natural gas** is the most economical heating energy source.

**8. Roads** – Need access to good roads to transport the “product”. Good roads close to a large population center, or to a brokerage center aids wholesale and retail marketing.

**9. North-South Orientation** – The greenhouse should be oriented north-south, AND the plant rows within the greenhouse should be oriented north-south.

\*If oriented north-south, the greenhouse structure itself will not cast consistent shadows on any one area of the plants throughout the day.

\*If oriented north-south, the plant rows will receive equal light throughout the day. If oriented east-west the south most rows (in the northern hemisphere) will shade the rows to the north.

**10. Capability of Expansion** – Purchase more land than you anticipate using in the beginning so that you have the ability to expand your operation. Locate the initial greenhouses such that future expansion will utilize the land area most efficiently.

**11. Availability of Labor** – The grower needs people who will want to work as laborers and who are “trainable” to become a retainable workforce.

\*Such skills included pruning/training the plants and harvesting/packing the fruit.

\*SPECIALTY LABOR will include people with additional training in such fields as plant production, plant nutrition, plant protection (insects and diseases) computers, labor management, marketing, etc. These may or may not be part of the regular workers, but could be call on as consultants as needed.

**12. Management residence** – The grower/manager residences should be close to the greenhouse so that they can get to the greenhouse quickly in case of emergencies.

#### **COMMUNITY PROFILE:**

\*Prior to selecting a site for greenhouse construction the grower should obtain a “Community Profile” for potential locations (see example of a community profile from Willcox, AZ at the end of this chapter).

\*These are available at the city or area Chamber of Commerce and contain information concerning weather, economics, labor, etc.

## REFERENCE MATERIAL:

1. **Energy Conservation for Commercial Greenhouses.** W.J. Roberts, J.W. Bartok Jr., E.E. Fabian, J. Simpkins. Northeast Regional Agricultural Engineering Service, Cornell University 152 Riley-Robb Hall, Ithaca, NY, 14853, Cooperative Extension, Greenhouse Series - NRAES-3.
2. **Hydroponic Food Production.** 2001. H.M. Resh. Woodbridge Press Publishing Company, P.O. Box 209, Santa Barbara, CA 93160. ISBN 0-88007-222-9
3. **Protected Agriculture: A Global Review. Part 7: Water supply, water quality and mineral nutrition.** 1995. M.H. Jensen and A.J. Malter. The World Bank (Technical Paper #253), 1818 H. Street, N.W., Washington D.C., 20433. ISBN 0-8213-2930-8
4. **Web Pages:**  
<http://ag.arizona.edu/ceac/>

## Solar radiation data for selected cities MJ/m<sup>2</sup>/day

Data ordered according to total light October - March

	oct-mar	total	jul	aug	sep	oct	nov	dec	jan	feb	mar	apr	may	jun
El Paso Tx.	96	259	28	26	23	19	14	12	13	17	22	27	30	30
Tucson Az.	93	255	27	25	23	18	14	11	13	16	21	27	30	31
Miami Fl.	89	213	21	20	18	15	14	12	13	16	19	22	22	21
Albuquerque NM	88	249	28	26	22	18	13	11	12	15	20	25	29	30
Prescott Az.	88	247	26	24	22	18	13	11	12	15	20	26	30	31
Las Vegas Nv.	87	254	29	27	23	18	12	10	11	15	21	26	30	32
Farmington NM	83	241	28	26	22	17	12	10	11	15	19	24	28	30
San Diego Ca.	82	218	25	23	20	16	12	10	11	14	19	22	23	23
Riverside Ca.	80	218	25	23	20	15	12	10	10	14	18	20	23	26
Santa Maria Ca.	78	217	26	23	20	16	12	9	10	13	18	21	24	26
Los Angeles WBAS	73	202	24	22	19	14	11	9	9	12	18	19	22	22
Grand Junction Co.	73	219	27	23	21	15	10	9	9	13	18	22	25	28
Denver Co.	73	214	26	23	20	15	10	8	10	13	17	21	24	27
Los Angeles WBO	71	197	25	22	19	14	11	9	9	12	16	18	21	22
La Jolla Ca.	66	172	19	17	15	12	10	8	9	11	15	17	19	18
Fresno Ca.	63	203	26	23	19	14	9	6	7	11	16	21	24	26
Davis Ca.	58	195	26	23	19	13	8	6	7	10	15	20	24	26
Madison (Wi.)	48	162	22	19	15	10	6	4	6	9	13	16	20	22
Pennsylvania	48	158	22	18	14	11	7	5	5	8	12	15	19	22
Columbus Oh.	44	152	21	16	13	10	5	4	5	8	12	16	20	23
Buffalo NY	37	141	20	17	13	9	5	3	4	6	10	15	18	21
Seattle Wa.	32	144	26	18	13	8	4	2	3	6	10	15	20	21
S. England	31	131	19	17	12	7	4	2	3	5	9	14	19	20
N. England	24	108	16	13	9	5	3	2	2	4	8	12	16	17

\*\*\*\*shaded data adapted from other sources reported in Langleys\*\*\*\*

conversion factor applied 1MJ/m<sup>2</sup>=0.03764 Langley

Includes data for northern and southern England.  
Data for Holland would be very similar to southern England



# Willcox Community Profile

## INTRODUCTION

Willcox, at an elevation of 4,167 feet, was established in 1880 and is located in the northern part of the Sulphur Springs Valley in Cochise County. The Sulphur Springs Valley cuts through Cochise County for nearly 100 miles, and averages over 15 miles in width. Willcox, located on I-10 halfway between Phoenix and El Paso, Texas, serves as the major trade and service center for agriculture and tourism within the County. The City of Willcox was incorporated in 1915.

## WEATHER

Month	Average Temperature (°F)		Average Total Precipitation (Inches)
	Daily Max	Daily Min	
January	58.3	24.8	0.78
February	63.1	26.5	0.57
March	68.2	30.7	0.59
April	77.6	36.5	0.27
May	86.4	43.1	0.13
June	95.0	52.3	0.43
July	95.4	62.7	2.60
August	92.2	60.4	2.66
September	89.5	53.3	1.18
October	80.1	40.9	0.59
November	67.8	29.7	0.39
December	59.3	24.8	1.00
Year	77.7	40.5	11.19

Average Total Snow, Sleet and Hail Annually: 4.0 inches  
(Based on a thirty year average)  
Willcox Weather Station

## PRINCIPAL WILLCOX ECONOMIC ACTIVITIES

Willcox was known as the Cattle Capitol of the nation due to the use of the railroad as a shipping point. Cattle are still an important aspect of the economy, and the largest livestock auction in the state is held in Willcox. Row crops such as cotton and small grains are an important part of the economy.

With diversification of agriculture in the last few years, nearly 4,500 acres of apple orchards, peaches, cherries and grapes are grown in Sulphur Springs Valley. Spin-offs of this diversification have resulted in two apple packing companies. Vegetables, pistachios and pecans are also important activities in the area.

Tourists, as well as traveling business people have an important impact on the City's economy. Development on the Interstate has resulted in increased traffic. With a mild year-round climate, relatively low cost land and housing, and a pleasant rural lifestyle, Willcox is also a desirable retirement community. The City, with its historical downtown, is part of the Arizona Main Street Program. Willcox has also developed a diversity of support industries such as finance, utilities, schools, government, communications and a full-scale health center. It serves as the corporate headquarters for several large corporations.

COCHISE COUNTY EMPLOYMENT STRUCTURE	Percent of Total
Agriculture & Mining	3.5%
Construction	3.4
Manufacturing	6.4
Transportation, Communication & Public Utilities	6.4
Wholesale & Retail Trade	22.1
Finance, Insurance & Real Estate	2.6
Services	19.7
Public Administration	35.9

Source: Arizona Department of Economic Security

LABOR FORCE DATA	1980	1989	1990
Civilian Labor Force	1,206	1,545	1,560
Employed	1,128	1,477	1,487
Unemployed	78	68	73
Unemployment Rate	6.5%	4.4%	4.7%

Source: Arizona Department of Economic Security

GROWTH INDICATORS	1988	1989	1990
Taxable Sales (\$)	28,941,900	30,375,400	33,025,650
Postal Receipts (\$)	430,993	454,533	469,617
New Building Permits Issued*	57	80	84
Public School Enrollment	1,381	1,300	1,385
Net Assessed Valuation (\$)	9,622,826	9,535,495	10,983,052

\* Arizona Business, Arizona State University

PROPERTY TAX RATE PER \$100 ASSESSED VALUE	1988	1989	1990
Arizona State Tax	\$0.47	\$0.47	\$0.47
Community College	1.52	1.52	1.62
Flood Control (Cnty)	0.18	0.33	0.26
Library	0.15	0.16	0.14
County Fire District	0.10	0.10	0.10
County	3.65	3.68	3.67
County Total	6.07	6.26	6.26
School District #13	5.17	5.25	5.07
City of Willcox	1.33	1.32	2.16
Total	\$12.57	\$12.83	\$13.49

Source: Arizona Tax Research Foundation

POPULATION	1980	1990	1980-1990 Percentage Change
Willcox*	3,243	3,122	-3.7%
Cochise County	85,686	97,624	+13.9
Arizona	2,716,546	3,665,228	+34.9

Local sources estimate the trade area population at 20,000.

Sources: Arizona Department of Economic Security  
U.S. Census Bureau



Arizona  
Department of Commerce

## FINANCE

Inter West Bank: 1 office  
Desert Finance Co.: 1 office  
Valley National Bank: 1 office  
Farmers Home Administration: 1 office

Willcox businesses are eligible for assistance in financing fixed assets through the Development Finance Division, Arizona Department of Commerce. Information on availability of industrial development bonds within the City may be obtained from the same source or from the Industrial Development Authority of Willcox, 151 W. Maley, Willcox, Arizona 85643.

## TRANSPORTATION

Highways: I-10, U.S. 666, AZ 86 and 186  
Railroads: Southern Pacific (freight only)  
Bus: Continental Trailways, Greyhound  
Truck: Pacific Motor Transport, Bestway, Antelope, United Parcel Service (interstate); Whitefield (intrastate), Jenney Freight Lines, Consolidated Freight Way (Intra & Interstate)  
Airport: Cochise County Airport; one lighted, paved 6,100-ft runway; UNICOM radio, fuel and maintenance

## COMMUNICATIONS

Newspapers: Daily: Arizona Republic (Phoenix); Arizona Daily Star, Tucson Citizen (Tucson)  
Weekly: Arizona Range News  
Radio: KHIL (5,000 watts), KWOC-FM  
Television: 4 Tucson channels via antenna, 24 stations available via cable

## UTILITIES

Electricity: Sulphur Springs Valley Electric Cooperative  
Natural Gas: Municipal, South West Gas  
Butane: Cal-Gas  
Telephone: Valley Telephone Coop., Inc., U.S. West  
Water & Sewer: Municipal

## MEDICAL FACILITIES

Hospital: 1 [24 beds]  
Nursing Homes: 2 [1, 24 bed extended care 1 private home with 23 beds]  
Physicians: 6 Dentists: 3  
Chiropractors: 1 Optometrist: 1  
Veterinarians: 2

## GOVERNMENT SERVICES

Local Government: Mayor, 6 Council Members, City Manager  
Police Department: 1 Director, 10 officers, 5 dispatchers, 3 civilians  
Sheriff's Department: 12 deputies, 1 civilian  
Dept. of Public Safety: 4 officers  
I.N.S.: 7 patrolmen  
Fire Department: 20 volunteers, 6 EMT  
Underwriters Rating: Grade 6

## EDUCATIONAL FACILITIES

	No.	Faculty	Enrollment
Public Elementary [K-4]	1	31	549
Middle School [5-8]	1	29	412
Public High School [9-12]	1	28	424
Private School [1-12]	2	10	56

Cochise College, Willcox campus serves as an extension campus (350 students), where an Associate Arts degree can be earned.

## CHURCHES

1	Catholic	15	Protestant
1	Church of Jesus Christ LDS		

## COMMUNITY FACILITIES

Bowling Alley: 1 Library: 1  
Art Center: 1 Pool: 1 [olympic size]  
Golf Courses: 1 [9-hole] Tennis Courts: 8 [3 lighted]  
Parks: 5 [ramada, playground equipment]  
Athletic Facilities: 6 [lighted baseball/softball fields, 1 soccer field]  
Historic Railroad Avenue  
Community Center with meeting facilities

Museum of the Southwest (adjacent to I-10): Willcox Cowboy Hall of Fame and a Heritage Park. Rex Allen memorabilia is located in the Rex Allen Arizona Cowboy Museum, located in downtown Willcox.

## ANNUAL EVENTS

Willcox, home of the famous TV, movie and radio personality Rex Allen, annually celebrates "Rex Allen Days." The event, held the first weekend of October, includes a parade, country fair, air show, PRCA rodeo, a Rex Allen concert, golf tournament and cowboy dances.

The Willcox History Fest, held in May during National Historic Preservation Week, celebrates more than 100 years of Cowboys, Indians and Railroads. Willcox also hosts the Magic Circle Bike Challenge (Labor Day weekend), the Christmas Apple Festival (first weekend in December), the Cowboy Hall of Fame induction and Dinner; and AG Day (including demonstrations, seminars, etc. for farmers and ranchers).

## SCENIC ATTRACTIONS

Cochise County, located in the southeastern corner of Arizona, is unparalleled in its historical, cultural, scenic and recreational features. From the rugged Dos Cabezas Peaks and the Chiricahua Mountains to Cochise Stronghold in Dragoon Mountains, part of the Coronado National Forest, the dramatic changes in scenery and wildlife will both delight and amaze visitors. These awe-inspiring mountains and mystifying deserts were once the homeland of the Chiricahua Apache Indians, and it is from the great Apache Indian Chief, Cochise, that the County gets its name.

Visitors to the area are encouraged to "Travel the Magic Circle of Cochise", a journey through the area that will bring its rich history and unique and dramatic geology to life. The Magic Circle tour begins at the Museum of the Southwest and Tourist Information Center which is operated by the Willcox Chamber of Commerce and Agriculture. From there, visitors travel down modern highways through this high desert region, exploring the vast beauty of the land where the Apache Indians roamed, where settlers scratched a living from the soil, where prospectors searched for mineral wealth and where wildlife roams freely. The sights and stories of Cochise, the great Apache Chief, Dos Cabezas, the Town of Pearce, the Cochise Stronghold, the Chiricahua National Monument, the Amerind Foundation and Fort Bowie, as well as the exciting history of the City of Willcox itself make for a delightful and memorable experience.

## INDUSTRIAL PROPERTIES AVAILABLE

Industrial Park: 1, with utilities, served by rail and truck routes is available. Contact the City Manager's Office, City of Willcox.

## LODGING AND MEETING FACILITIES

Motels: 15 with 523 rooms  
Meeting Facilities: Numerous facilities with the largest seating 300 persons  
Mobile Home & Trailer Park: 10 with 250 spaces  
R.V. Parks: 3 with 170 spaces

This profile was prepared in cooperation with the Willcox Chamber of Commerce.

For further information, contact:  
Willcox Chamber of Commerce City of Willcox  
and Economic Development Group 151 West Maley  
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