Well and Water Consumption Planning

Introduction

To maximize profits, three 100 acre fields will be grown on simultaneously with one 150 foot well and pump as the primary water source and Willcox, Arizona monsoon precipitation as the secondary source. In field one, 100 acres of figs will be grown with a drip irrigation system. In field two, 100 acres of pistachios will be grown with a drip irrigation system. In field three, 100 acres of grain sorghum will be grown with a center pivot irrigation system. A chemigation system, fertilization system, flow meter, variable frequency drive, and sand filter will be utilized on all three fields. Moisture probes, remote solenoids, and drones will be incorporated as well to reduce labor costs. Since the owner will be living, studying, and working in Tucson, Arizona, this automated system will allow him to control the farm with minimal man hours.

Soil Characteristics

The predominantly loamy clay soil in the high desert (4,000 feet) of Willcox, AZ and 0 to 0.5% slopes will work well with the three crops. The soil while it has poor infiltration rates of 0.2 inches/hour has an excellent ability to store water which will be vital when evapotranspiration rates reach their max. The three-square fields have the same soil characteristics (USDA). They are as follows:

- Water Holding Capacity (AWHC)= Field Capacity (FC) - Wilting Point (WP)
- = 3.8 inches/foot - 2.2 inches/foot
- AWHC=1.6 inches/foot

Field 1: Fig Orchard (Black Mission Variety)

Figs have been grown in the area for over 50 years and have done very well. They can produce up to two tons per acre annually at a maturity of ten years and an orchard can last up to 50 years. In addition, a fig orchard will begin to be profitable in about five years on average and soon as three years. It typically has six harvests a year which allows for ample contingency planning if the season is exceptionally hot and dry. The roots typically cover a 50 foot area and can descend 20 feet in ideal soil. A drip irrigation system will prevent water loss and the monsoon rains will be the primary leaching method which will ensure salinity does not become an issue with these salt sensitive trees (UC Davis; U of A). Assumptions are as follows:

1. Determine spacing of trees using historical data.
    - Spacing: 15 foot X 20 foot/tree
    - 155 tree/acre X 100 acres=15,500 trees/100 acres
    - Dimensions of Field=2,000 feet X 2,000 feet

2. Determine total area irrigated using area of roots at maturity.
    - Irrigated Area=15,500 trees X 10 feet X 10 feet
        - Irrigated Area=36 acres
            - (15 X 20 X 0.039 X 7.48 X15,500) - (10 X 10 X 0.039 X 7.48 X15,500)
                - (Reduces water use by 904,332 gallons/day at peak ET rates!)

3. Determine max evapotranspiration rates using historical data.

- Max Evapotranspiration (ET_{Max})= Max Reference Crop Evapotranspiration (ET_{OMax}) - Crop Coefficient (K_c)
- ET_{Max}=0.36 X 1.3
  - ET_{Max}=0.468 inches/day
  - ET_{Max}=0.039 feet/day
- $ET_{tree/day}$=10 foot X 10 foot X 0.039 feet/day
  - ET_{tree}=3.9 feet^3/day
- ET_{tree}=3.9 feet^3/day X 7.48
  - ET_{tree}=29.2 gallons/day

4. Determine total flow rate (Q) for 7 hour set per tree with 50% efficiency of system.
- $Q_{tree/hour}$=29.2 gallons/day ÷ 24 hours
  - $Q_{tree/hour}$=1.2 gph
- $Q_{tree/7\ hours}$=1.2 gph X (24/7)
  - $Q_{tree/8\ hours}$=4.1 gph
- $Q_{50\%\ efficiency}$=4.1 gph ÷ 0.50
  - $Q_{50\%\ efficiency}$=8 gph

5. Determine flow rate per emitter.
- $Q_{emitter/hour}$=8 gph ÷ 4 emitters
  - $Q_{emitter/hour}$=2 gph/emitter

6. Determine number of laterals and flow per lateral.
- Trees/Lateral=(2000 feet ÷ 15 feet)/2
  - Trees/Lateral=66 trees
- Emitters/Lateral=66 trees/lateral X 4 emitters
  - Emitters/Lateral=264 emitters
- Q=264 emitters X 2 gph
  - Q=528 gph
- Q=528 gph ÷ 60 minutes
  - Q=8.8 gpm

7. Determine number of tree and emitters per manifold and flow per manifold.
- Trees/Manifold=(2000 feet ÷ 20 feet) X 2 sets X 66 trees
  - Trees/Manifold=13,200 trees
- Emitters/Manifold=13,200 trees X 4 emitters
  - Emitters/Manifold=52,800 emitters
- Q= 52,800 emitters X 2 gph
  - Q=105,600 gph
- Q=105,600 gph ÷ 60 minutes
  - Q=1760 gpm

8. Determine number of tree and emitters per submain and main.
- Calculations will be for months of July and August when ET rates are highest and the farmer is forced to irrigate the entire 100 acres at once within 7 hours to keep up with ET rates of other crop in two other fields. Thus, calculations, will be the same as the manifold. However, the

farmer can divide the field into multiple sets with this system if he decides to have less irrigated acreage on one pump simply by putting manually operated shut-off valves or automated solenoid valves on the laterals to do so remotely.

9. Summary of flow rates for fig orchard.

Line	Trees	Emitters	Q (gph)	Q (gpm)
Lateral	66	264	396	8.8
Manifold	13,200	52,800	105,600	1760
Submain	13,200	52,800	105,600	1760
Main	13,200	52,800	105,600	1760

10. Select emitter.

- Netafim Button Drippers (2gph)
    - Max pressure is 30 psi
    - K constant=2.649
    - Exponent X=0.48

11. Determine pressure head for emitter.

- $q=Cp^X$
- $P=(1/2.649)^{(1/0.48)}$
    - P=0.13 psi

12. Determine pipe length and total number of pipes.

- $Length_{Lateral}$=2000 feet ÷ 2
    - $Length_{Lateral}$=1000 feet
- $Number_{Laterals/Manifold}$=(2000 feet ÷ 20) X 2
    - $Number_{Laterals/Manifold}$=200 Laterals/Manifold

13. Determine friction losses and pipe diameters.

- Used Hazen-Williams Equation in excel and actual pipe sizes that are available on the market. Ensured flow did not exceed 5 ft./sec. but above 2 ft./sec. for flushing. Also, ensured the smallest pipe was chosen to reduce cost and while minimizing head loss so that the pump is operating within in its efficient range.

14. Determine pipe diameter of lateral, manifold, submain, and main.

- Hazen-Williams Equation
    - $H_f=0.00090194(\frac{100}{C})^{1.852}(\frac{Q^{1.852}}{d^{4.866}})L$
        - Lateral
            - H_f=5.52 psi
                - Total Head Loss=55.18 ft.
            - C=150 (PVC)
            - L=1000 feet
            - Q=8.8 gpm
                - D=1 inches
        - Manifold/Main
            - H_f=0.27 psi

        - Total Head Loss=5.34 ft.
      - C=150 (PVC)
      - L=2000 feet
      - Q=1760 gpm
        - D=14 inches
    - Submain
      - H_f=0.27 psi
        - Total Head Loss=2.67 ft.
      - C=150 (PVC)
      - L=1000 feet
      - Q=1760 gpm
        - D=14 inches
    - Main
      - H_f=0.27 psi
        - Total Head Loss=5.34 ft.
      - C=150 (PVC)
      - L=2000 feet
      - Q=1760 gpm
        - D=14 inches

15. Summary of pipe length, diameter, and head loss.

Line	Length (ft)	Subtotal	Total	Diameter (in.)	Head Loss (ft.)
Lateral	1000	200 laterals	66 Trees/Lateral	1	55.18
Manifold	2,000	1 Manifold	200 Laterals/Manifold	14	5.34
Submain	1,000	1 Submain	200 Laterals/Submain	14	2.67
Main	2,000	1 Main	200 Laterals/Main	14	5.34

16. Determine total dynamic head (TDH).
- TDH=H_c + H_p + H_f + H_d
- H_c=150 ft (well) + 50 ft (above pump)
- H_p=0.13 psi (minimum operating pressure of emitter) X 2.31
- H_f=(4 psi (entrance loss) + 3 psi (water meter loss) + 5 psi) (sand filter loss) X 2.31
- H_d=(55.18 ft. + 5.34 ft. 2.67 ft. 5.34 ft.) (Lateral, manifold, submain, and main head loss)
- TDH=200 ft. + 0.2769 ft. + 68.53 ft.
  - TDH=269 ft.

17. Determine power required by pump (Nelson Pocket Guide).
- P=$\frac{Q_p * H}{3960 * E_p}$
- P=power (hp)
- Q_p=pivot flowrate (gpm)
- H=head the pump must produce (ft.)
- E_p=pump efficiency (75%)
  - P=160 hp

18. Select Pump.
   - Selected at the end of field three section.

<u>Field 2: Pistachio Orchard (*Pistacia vinera)*</u>

Pistacia vinera better known as pistachios are grown for profit internationally including very arid regions like Iran that is similar to Arizona's climate. They are dioecious so they cannot self-pollinate and require female and male tree. Female trees called Kerman and male trees called Peter will be planted using the entire 100 acres. They are very salt and drought tolerant which will be beneficial should monsoons rain be light and salt builds from the ground water usage via drip irrigation. They will bear a significant harvest in the fifth year with 2,200 to 2,500 pounds per acre and typically turn a profit in seven years. Pistachio trees are deep rooted but only pick up most nutrients from to a depth of two feet. Historical data from orchards well over 20 years old in the local Willcox, AZ area, gives added likelihood of a successful business venture (UC Davis; U of A).

1. Determine spacing of trees using historical data.
   - Spacing: 15 foot X 20 foot/tree
   - 155 tree/acre X 100 acres=15,500 trees/100 acres
   - Dimensions of Field=2,000 feet X 2,000 feet

2. Determine total area irrigated using area of roots at maturity.
   - Irrigated Area=15,500 trees X 10 feet X 10 feet
     - Irrigated Area=36 acres
       - (15 X 20 X 0.0357 X 7.48 X15,500) - (10 X 10 X 0.0357 X 7.48 X15,500)
         - (Reduces water use by 827,811 gallons/day at peak ET rates!)

3. Determine max evapotranspiration rates using historical data.
   - Max Evapotranspiration ($ET_{Max)}$= Max Reference Crop Evapotranspiration (ET_{OMax}) - Crop Coefficient (K_c)
   - ET_{Max}=0.36 X 1.19
     - ET_{Max}=0.4284 inches/day
     - ET_{Max}=0.0357 feet/day
   - $ET_{tree/day}$=10 foot X 10 foot X 0.0357 feet/day
     - ET_{tree}=3.57 feet^3/day
   - ET_{tree}=3.57 feet^3/day X 7.48
     - ET_{tree}=26.7 gallons/day

4. Determine total flow rate (Q) for 7 hour set per tree with 50% efficiency of system.
   - $Q_{tree/hour}$=26.7 gallons/day ÷ 24 hours
     - $Q_{tree/hour}$=1.1 gph
   - $Q_{tree/7\ hours}$=1.1 gph X (24/7)
     - $Q_{tree/8\ hours}$=3.3 gph
   - $Q_{50\%\ efficiency}$=3.8 gph ÷ 0.5
     - $Q_{50\%\ efficiency}$=7.6 gph

5. Determine flow rate per emitter
   - $Q_{emitter/hour}$=7.6 gph ÷ 4 emitters
     - $Q_{emitter/hour}$=1.9 gph/emitter

6. Determine number of laterals and flow per lateral.

- Trees/Lateral=(2000 feet ÷ 15 feet)/2
  - Trees/Lateral=66 trees
- Emitters/Lateral=66 trees/lateral X 4 emitters
  - Emitters/Lateral=264 emitters
- Q=264 emitters X 2.0 gph (Used because Netafim does not make 1.9 gph emitters.)
  - Q=528 gph
- Q=528 gph ÷ 60 minutes
  - Q=8.8 gpm

7. Determine number of tree and emitters per manifold and flow per manifold.

- Trees/Manifold=(2000 feet ÷ 20 feet) X 2 sets X 66 trees
  - Trees/Manifold=13,200 trees
- Emitters/Manifold=13,200 trees X 4 emitters
  - Emitters/Manifold=52,800 emitters
- Q= 52,800 emitters X 2 gph
  - Q=105,600 gph
- Q=105,600 gph ÷ 60 minutes
  - Q=1760 gpm

8. Determine number of tree and emitters per submain and main.

- Calculations will be for months of July and August when ET rates are highest and the farmer is forced to irrigate the entire 100 acres at once within 7 hours to keep up with ET rates of other crop in two other fields. Thus, calculations, will be the same as the manifold. However, the farmer can divide the field into multiple sets with this system if he decides to have less irrigated acreage on one pump simply by putting manually operated shut-off valves or automated solenoid valves on the laterals to do so remotely.

9. Summary of flow rates for pistachio orchard.

Line	Trees	Emitters	Q (gph)	Q (gpm)
Lateral	66	264	528	8.8
Manifold	13,200	52,800	105,600	1760
Submain	13,200	52,800	105,600	1760
Main	13,200	52,800	105,600	1760

10. Select emitter.

- Netafim Button Drippers (2gph)
  - Max pressure is 30 psi
  - K constant=2.649
  - Exponent X=0.48

11. Determine pressure head for emitter.

- $q=Cp^X$
- $P=(1/2.649)^{(1/0.48)}$
  - P=0.13 psi

12. Determine Pipe Length and Total Number of Pipes.
- $Length_{Lateral}$=2000 feet ÷ 2
  - $Length_{Lateral}$=1000 feet
- $Number_{Laterals/Manifold}$=(2000 feet ÷ 20) X 2
  - $Number_{Laterals/Manifold}$=200 Laterals/Manifold

13. Determine friction losses and pipe diameters.
- Used Hazen-Williams Equation in excel and actual pipe sizes that are available on the market. Ensured flow did not exceed 5 ft./sec. but above 2 ft./sec. for flushing. Also, ensured the smallest pipe was chosen to reduce cost and while minimizing head loss so that the pump is operating within in its efficient range.

14. Determine pipe diameter of lateral, manifold, submain, and main.
- Hazen-Williams Equation
  - $H_f=0.00090194(\frac{100}{C})^{1.852}(\frac{Q^{1.852}}{d^{4.866}})L$
    - Lateral
      - H_f=5.52 psi
        - Total Head Loss=55.18 ft.
      - C=150 (PVC)
      - L=1000 feet
      - Q=8.8 gpm
        - D=1 inches
    - Manifold/Main
      - H_f=0.27 psi
        - Total Head Loss=5.34 ft.
      - C=150 (PVC)
      - L=2000 feet
      - Q=1760 gpm
        - D=14 inches
    - Submain
      - H_f=0.27 psi
        - Total Head Loss=2.67 ft.
      - C=150 (PVC)
      - L=1000 feet
      - Q=1760 gpm
        - D=14 inches
    - Main
      - H_f=0.27 psi
        - Total Head Loss=5.34 ft.
      - C=150 (PVC)
      - L=2000 feet
      - Q=1760 gpm
        - D=14 inches

15. Summary of pipe length, diameter, and head loss.

Line	Length (ft)	Subtotal	Total	Diameter (in.)	Head Loss (ft.)
Lateral	1000	200 laterals	66 Trees/Lateral	1	55.18
Manifold	2,000	1 Manifold	200 Laterals/Manifold	14	5.34
Submain	1,000	1 Submain	200 Laterals/Submain	14	2.67
Main	2,000	1 Main	200 Laterals/Main	14	5.34

16. Determine Total Dynamic Head (TDH).

- TDH=H_c + H_p + H_f + H_d
- H_c=150 ft (well) + 50 ft (above pump)
- H_p=0.13 psi (minimum operating pressure of emitter) X 2.31
- H_f=(4 psi (entrance loss) + 3 psi (water meter loss) + 5 psi) (sand filter loss) X 2.31
- H_d=(55.18 ft. + 5.34 ft. 2.67 ft. 5.34 ft.) (Lateral, manifold, submain, and main head loss)
- TDH=200 ft. + 0.2769 ft. + 68.53 ft.
    - TDH=269 ft.

17. Determine power required by pump (Nelson Pocket Guide).

- P=$\frac{Q_p * H}{3960 * E_p}$
- P=power (hp)
- Q_p=pivot flowrate (gpm)
- H=head the pump must produce (ft.)
- E_p=pump efficiency (75%)
    - P=160 hp

18. Select Pump.

- Selected at the end of field three section.

<u>Field 3: Grain Sorghum</u>

Sorghum is ancient crop that can be used and grown just like corn. However, it is superior to corn in arid regions because of its drought and salt tolerance. It has more protein and most varieties are highly palatable to livestock. In the Willcox, AZ area, numerous livestock operations exist and this crop can be sold directly to these medium to large farms or for other products like naturally gluten free cereal, flour, and grains. In addition, the stalks can be utilized for syrup or biofuel production. It is typically directly seeded in May with a harvest 90 to 120 days later and has a root depth of four feet. With the very early spring in Arizona planting will occur in March so that peak water consumption is reduced. The harvest time will coincide with the monsoons so that water can be further reduced and irrigation from the center pivot can be stopped two weeks prior to harvest in the June and July time frame or once the sorghum is fully matured. This plan will maximize profits and leave plenty of time and energy to address unique problems that can arise growing in a high desert that is susceptible to abrupt monsoons and long periods of drought (UC Davis; U of A).

1. Determine spacing of trees using historical data.

- Field Dimensions=2,000 feet X 2000 feet
- Field Dimensions=24,000 inches X 24,000 inches

- Spacing=20 inches X 20 Inches spacing
- Number of Plants=((20 inches X 20 Inches)/(1 seed) ÷ (24,000 inches X 24, 000 inches)
    - Number of Plants=1,440,000 Sorghum Plants

2. Determine total area irrigated.
- Irrigated Area=2,000 feet X 2,000 feet
- Irrigated Area=91.8 acres

3. Determine max evapotranspiration rates using historical data.
- Max Evapotranspiration ($ET_{Max)}$= Max Reference Crop Evapotranspiration (ET_{OMax}) - Crop Coefficient (K_c)
- ET_{Max}=0.28 X 1.2 (June ET average)
- ET_{Max}=0.336 inches/day
    - ET_{Max}=0.028 feet/day
- $ET_{tree/day}$=1.67 feet X 1.67 feet X 0.028 feet/day
    - ET_{tree}=0.0780892 feet^3/day
- ET_{tree}=0.0780892 feet^3/day X 7.48
    - ET_{tree}=0.584 gallons/day/plant

4. Select Center Pivot.
- Valley Irrigation 8000 series Center Pivot
- Pivot Point Options=10"
- Maximum Machine Length=2,800'
- Towable Pivot Point Options=2-Wheel E-Z Tow
- Pipe Diameter Options=10"
- 40 feet overhang
- Max pivot speed=10 ft./min

5. Area Irrigated with end gun and 87 sprinkler heads (Nelson Pocket Guide).
- A=$\frac{3.14*(L_p+R_g)^2}{43,560}$
- A=area (acres)
- L_p=pivot length (ft.)
- R_g=end gun radius (ft)
- A=$\frac{3.14*(1000+130)^2}{43,560}$
    - A=92 acres

6. Hours per pivot revolution at 100% timer (Nelson Pocket Guide).
- T_r=$\frac{0.105*L_t}{V_t}$
- T_r= hours per revolution (hr.)
- L_t=distance to last tower (ft.)
- V_t=last tower speed (ft/min) (Max 10ft./min)
- L_t=1000 - 40 (40 feet over-hang)=960 ft
- T_r=$\frac{0.105*960}{10}$
    - T_r=10 hrs/revolution

7. Determine flow to lateral per revolution required for June ET_{max} (Nelson Pocket Guide).

- D=$\frac{30.64 * Q_{p} * T_r}{(L_p+R_g)^2}$
- D=depth of water applied (in.)
- Q_p=pivot flowrate
- T_r=hours per revolution (hrs.)
- L_p=pivot length (ft.)
- R_g=end gun radius (ft.)
- 0.336"=$\frac{30.64 * Q_p * 10}{(1000+130)^2}$
  - D=0.336 in/10 hours @ 1400 gpm

8. Determine flow for a given pivot sprinkler with 11-foot spacing (Nelson Pocket Guide). (Only first, middle, and last done because 87 sprinkler heads are used).

- Q_e=$\frac{2 * L_s * Q_p * L_e}{(L_p + R_g)^2}$
- Q_e=sprinkler flowrate (gpm)
- L_s=distance to sprinkler (ft.)
- Q_p=pivot flowrate (gpm)
- L_e=sprinkler spacing (ft.)
- L_p=length of pivot (ft.)
- R_g=end gun radius (ft.)
- Q_e=$\frac{2 * L_s * Q_p * L_e}{(L_p + R_g)^2}$
  - Q_e=2.0 gpm @ 11 feet from tower at 1400 gpm
  - Q_e=12.1 gpm @ 500 feet from tower at 1400 gpm
  - Q_e=23.1 gpm @ 960 feet from tower at 1400 gpm
  - 87 total sprinklers needed

9. Select center pivot sprinkler heads.

- Senninger: Super Spray UP3
- Trajectory: straight o° angle
- Nozzle Size Range: 1.59 mm - 10.32 mm
- Flow Range: 0.27 gpm - 31 gpm
- Pressure Range: 10 -40 psi
- Max Spacing: 11 ft. at 6 ft. ground clearance

10. Determine pipe diameter of center pivot arm, submain, and main.

- Hazen-Williams Equation
  - H_f=0.00090194$(\frac{100}{C})^{1.852}(\frac{Q^{1.852}}{d^{4.866}})$L
    - Center Pivot Arm
      - H_f= 13.59 ft.
      - C=120
      - L=1000 feet
      - Q=1400 gpm
      - D=10 inches (max factory size but just at 5 ft./sec)

- Submain
  - H_f=1.75 ft.
  - C=150 (PVC)
  - L=1000 feet
  - Q=1400 gpm
  - D=14 inches
- Main
  - H_f=1.75
  - C=150 (PVC)
  - L=500 feet
  - Q=1400 gpm
  - D=14 inches

11. Summary of pipe length, diameter, flow rates and friction losses.

Line	Length (ft)	Diameter (inches)	Total Friction Loss (ft.)	Flow
Center Pivot Arm	1,000	10 (Max Factory Size)	13.59	1400
Submain	1,000	14	1.75	1400
Main	1000	14	1.75	1400

12. Determine Total Dynamic Head (TDH).

- TDH=H_c + H_p + H_f + H_d
- H_c=150 ft (well) + 50 ft (above pump)
- H_p=35.7 psi (minimum operating pressure of last sprinkler) X 2.31
- H_f=(4 psi + 3 psi + 5 psi) X 2.31(entrance loss, water meter loss, sand filter loss)
- H_d= (13.59 + 1.75 + 1.75) X 2.31 (Lateral, submain, and main head Loss)
- TDH=200 ft. + 82.4 ft. + 27.7 ft. + 39.5 ft.
  - TDH=350 ft.

13. Determine power required by pump (Nelson Pocket Guide).

- P=$\frac{Q_p * H}{3960 * E_p}$
- P=power (hp)
- Q_p=pivot flowrate (gpm)
- H=head the pump must produce (ft.)
- E_p=pump efficiency (75%)
  - P=165 hp

14. Select Pump (Derived from Cornell program).

- Cornell Pump
- Selected for max TDH and flow for three fields
  - Complete specifications are below

Pump Data Sheet - Cornell

Company: SW 111
Name: Sean Day
Date: 5/6/2017

CORNELL

Pump:

Size: 5HH

Type: Clear Liquids
Synch Speed: Adjustable

Speed: 1986 rpm
Dia: 16.38 in

Curve: 5HHVA

Impeller:

Specific Speeds:

Ns: 3200
Nss: ---

Dimensions:

Suction: 8 in
Discharge: 5 in

Pump Limits:

Temperature: 250 °F
Pressure: 175 psi g
Sphere Size: 0.75 in

Power: ---
Eye Area: ---

Search Criteria:

Flow: 1760 US gpm

Head: 350 ft

Fluid:

Water
Density: 62.37 lb/ft³
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor Pressure: 0.2563 psi a
Atm Pressure: 14.7 psi a

NPSHa: ---

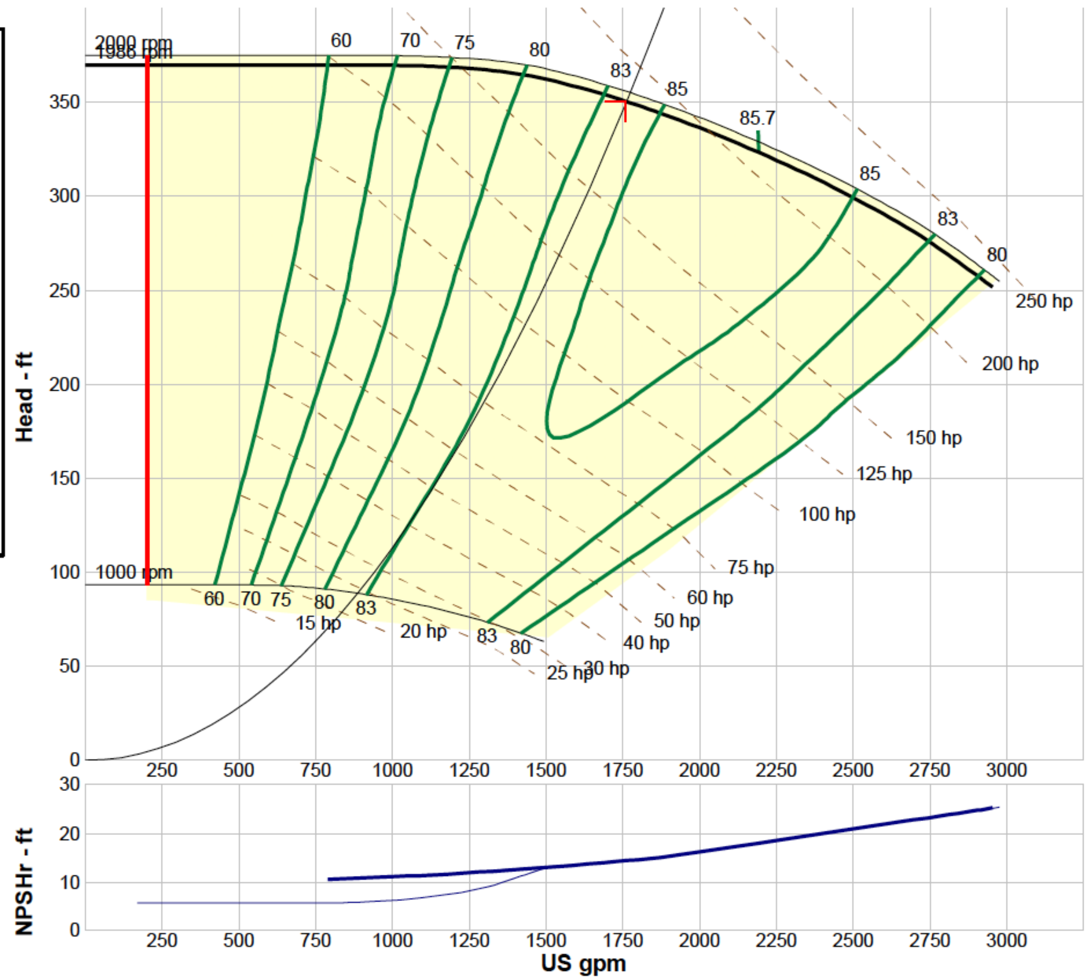
Motor:

Standard: ---
Enclosure: ---

Speed: ---
Frame: ---

Sizing Criteria: Max Power on Design Curve

---- Duty Point ----	
Flow:	1761 US gpm
Head:	350 ft
Eff:	84%
Power:	186 hp
NPSHr:	14.4 ft
---- Design Curve ----	
Shutoff Head:	370 ft
Shutoff dP:	160 psi
Min Flow:	200 US gpm
BEP:	85.7% @ 2190 US gpm
NOL Power:	238 hp @ 2953 US gpm
-- Max Curve --	
Max Power:	243 hp @ 2975 US gpm

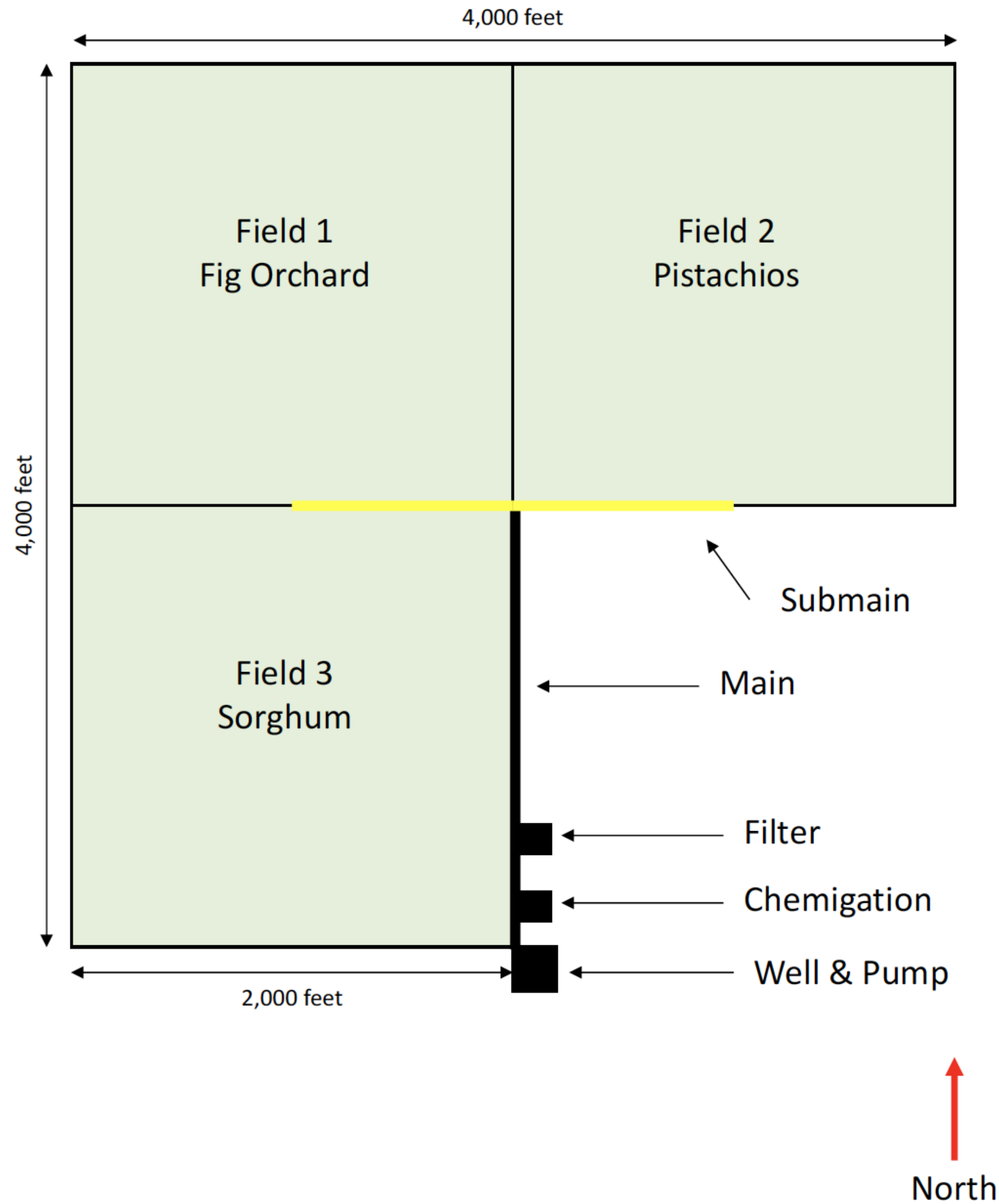


Performance Evaluation:

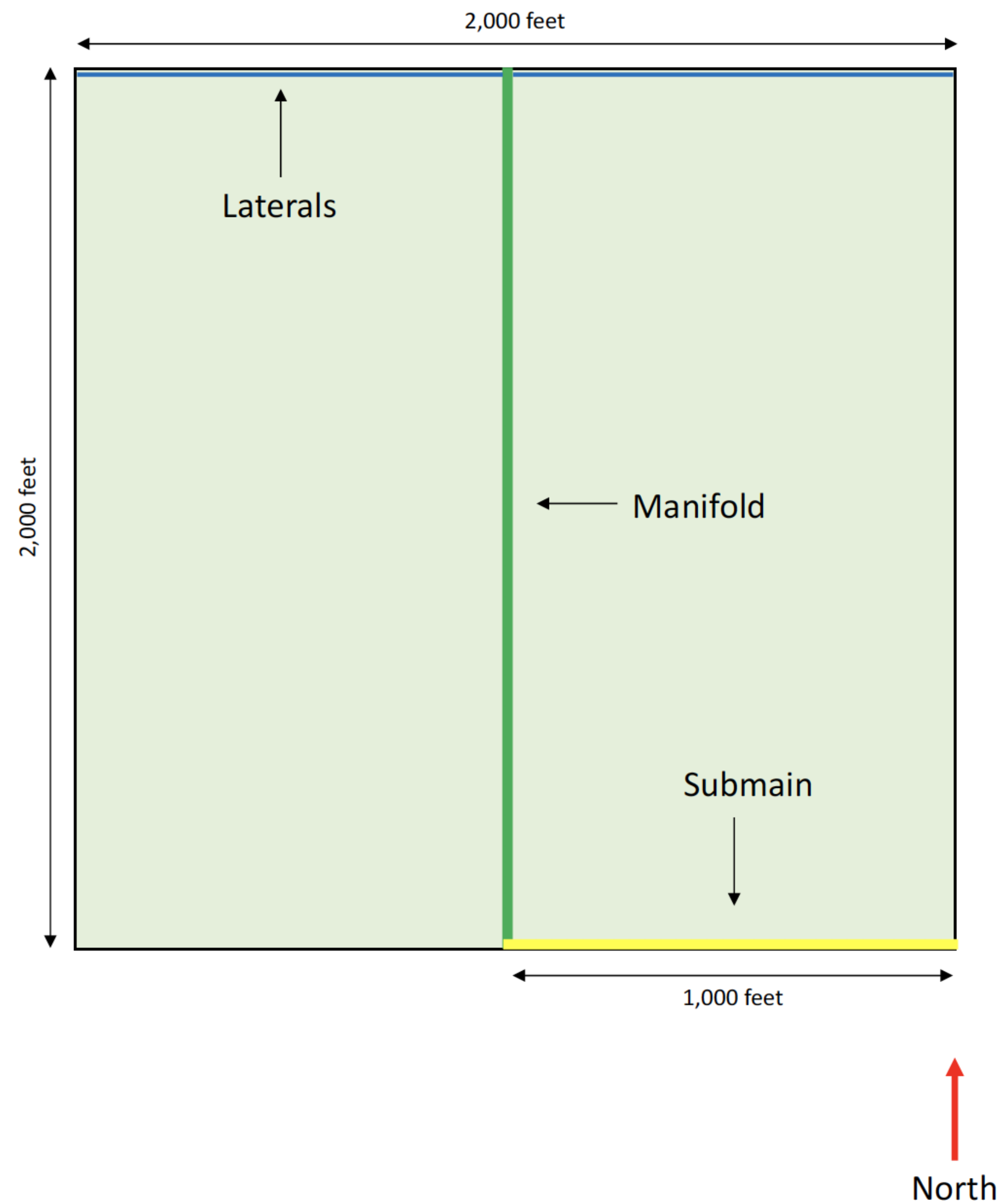
Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
2112	1986	329	86	205	17.3
1760	1986	350	84	186	14.4
1408	1986	365	80	163	12.6
1056	1986	370	71	138	11.3
704	1986	370	56	118	10.5

Selected from catalog: Cornell.60 Vers: 3.10.1

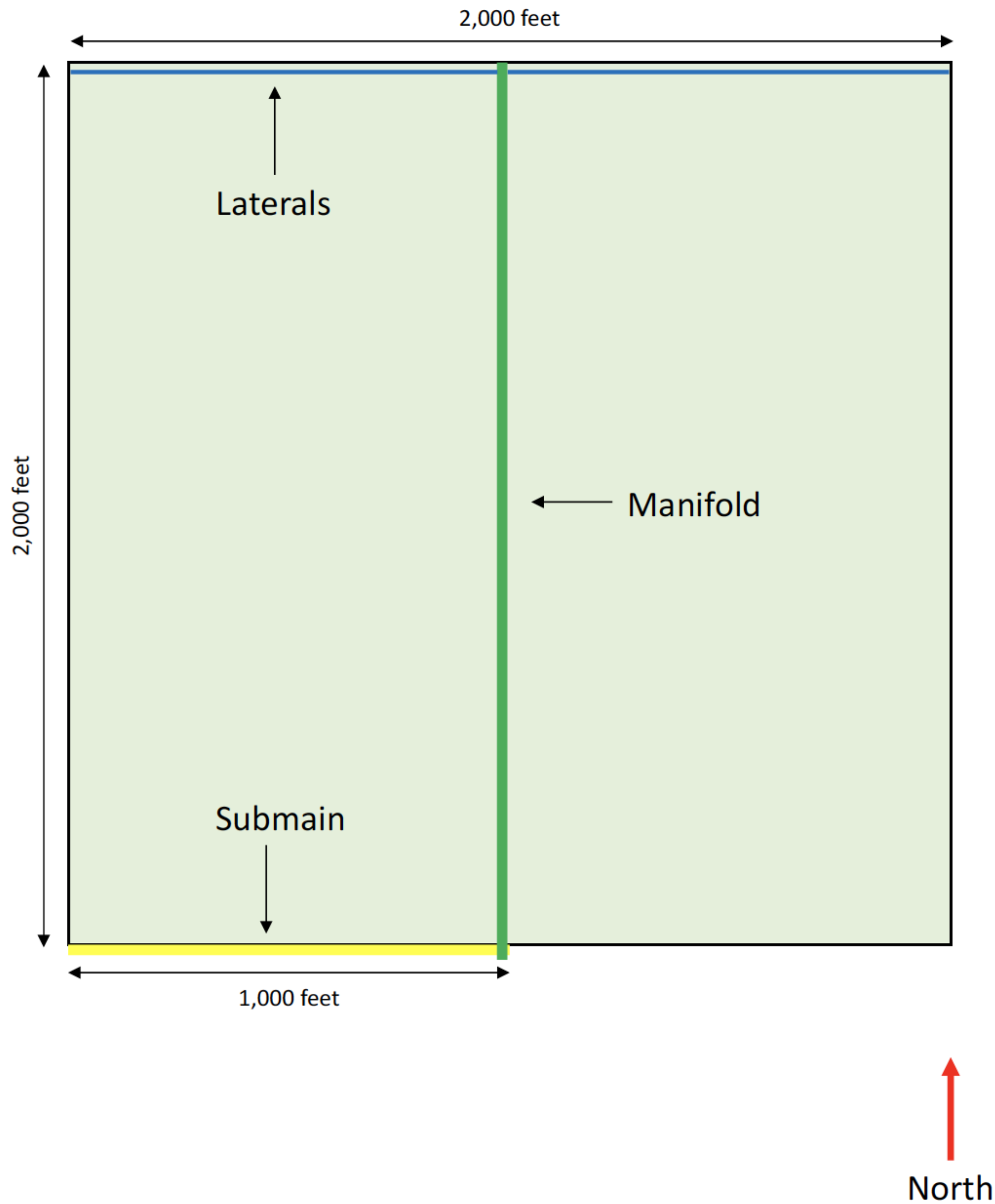
Overview


4,000 feet
4,000 feet
Field 1
Fig Orchard
Field 2
Pistachios
Field 3
Sorghum
Submain
Main
Filter
Chemigation
Well & Pump
2,000 feet
North

Field 1: Fig Orchard



Field 2: Pistachio Orchard



Field 3: Sorghum