Pets Return Home
Site Design

Ruff Engineering

Abigail Hubler, Ryann DuBose, Allyson Fedor, & Crockett Saline

CENE 486 Final Presentation

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Purpose

CREATE:

- Site design for expansion of the kennel space
- Drainage plan for sanitary sewer runoff

Location

4555 N. Peyton Place
City: Clarkdale
County: Yavapai County
State: Arizona

Client

- Mark Happe: Co-founder of Pets Return Home Sanctuary

Figure 1: Aerial view of site location [1].

Zoning Due Diligence

Zoning ordinances considered applicable in relation to the project are as follows:

Yavapai County Designation

- RCU - Includes Rural, Single-family, residences
- Allow uses of R1L, RMM, and R1 Districts
    - R1L - single family residences limited to site built structures
    - RMM - single family, residential properties with site built, factory built and multi-sectional manufactured homes, no single-wide manufactured homes
    - R1 Districts - single family, residential properties with sit ebuilt, multi-sectional and manufactured structures

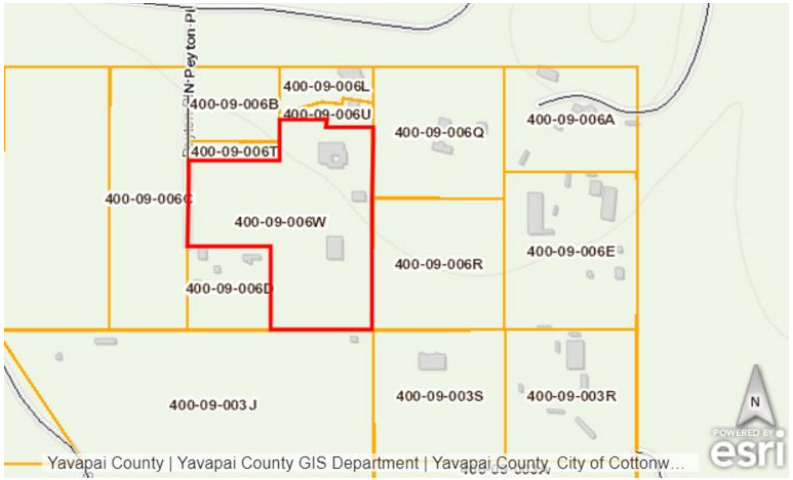


Figure 2: Parcel number and location map provided by the Yavapai County Interactive Map [2].

Geotech Field Investigation

Prior to site visit AZ 811 was contacted and a Safety and Sampling Plan were created.

In-situ data collection performed at all locations (Fig. 4)

- Test pit log of observed soil
- Grab samples of each observed soil type
- Ring samples

Figure 3 : Image of ring sample collected preserving the in-situ conditions of the soil.

Figure 4: Testing Locations.

Geotech Field Investigation - Infiltration Test

- Infiltration tests at location 2, 3, and 4 at approx. 4 ft deep
- Performed according to ADEQ - R18-9-A310 - subsection F
- Infiltration test results range from 16 to 68 minutes per inch of water infiltrated

Figure 5: Typical test pit after excavation (right) and a test pit with ongoing infiltration test (left).

Infiltration Rates			
Test Pit Location	2	3	4
Percolation (mins./inch)	68	56	16

Table 1: Results of infiltration tests for all site locations.

Geotechnical Lab Analysis

Tests performed:

- Soil classification - ASTM D2487
- Hydrometer - ASTM D7928-17
- Field moisture contents - ASTM D2216
- In-situ soil density - ASTM D2937
- Remolded expansion potential - ARIZ 249
- Compression - ASTM D2435
- Liquid limit and plasticity index - ASTM D4318-17el.
- Moisture density relationship/proctor - ASTM D698-12e2

Sample	1(0-2)	2(0-4)	2(PERK)	3(0-2)	3(PERK)	4(0-3)	4(3-4)	4(PERK)
	Soil Classification							
Replicate 1	SC-SM	SC	SC	SC	SC	CL	SC	SC-SM
Replicate 2	SC-SM	SC	SC	SC	SC	CL		SC-SM
Replicate 3	SC	SC	CL	SC	SC	CL		SC-SM
Final	**SC-SM**	**SC**	**SC**	**SC**	**SC**	**CL**	**SC**	**SC-SM**

Table 2: Soil classification results from samples taken at Locations 1, 2, 3, and 4.

Lab Analysis - Remolded Expansion Potential

The expansion percentages that are seen in Figure (left) are in the zero swell potential, 0% to 1.5%, and moderate swell potential, 1.5% to 3%.

REMOLDED SWELLS							
TEST PIT NO.	DEPTH (FEET)	SOIL CLASSIFICATION	SOIL PROPERTY		EXPANSION		REMARKS
			INITIAL DRY DENSITY (PCF)	INITIAL WATER CONTENT (%)	SURCHARGE (KSF)	EXPANSION (%)	
1	0-2	SC-SM	112.2	10	0.1	2.3	1,2
2	0-4	SC	113.3	12.7	0.1	0	1,2
2	4-5	SC	113.3	12.7	0.1	0.6	1,2
3	0-2	SC	113.3	12.7	0.1	0.2	1,2
3	4-5	SC	111.3	13.5	0.1	0.2	1,2
4	0-3	CL	113.3	12.7	0.1	1.8	1,2
4	3-4	SC	111.3	13.5	0.1	0.7	1,2
4	4-5	SC-SM	113.3	12.7	0.1	0.1	1,2

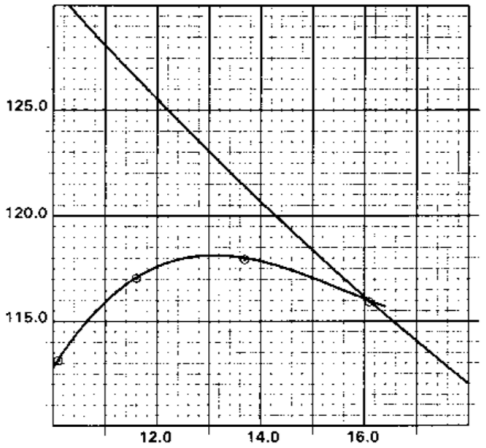
Remarks:
1. Compacted Density (approximately 95% of ASTM D698 maximum density and -3% below optimum moisture content
2. Submerged to approximate saturation

Table 3: Remolded Swells initial conditions and final swell potential results.

Lab Analysis - Compaction Proctor

Maximum density = 118.1 lbs/ft^3
Optimum moisture content = 13.0%

If no additional soil is used to produce grade under proposed kennel this data can be used to compare field density to determine rate of compaction and moisture content compliance.



Maximum Density	118.1	lbs/ft3	Optimum Moisture	13.0	%
Computed Max	118.1	lbs/ft3	Computed Opt	13.0	%
ASTM Corr Max	118.1	lbs/ft3	Corr Opt	13.0	%
AASHTO Corr Max	118	lbs/ft3	Corr Opt	13	%
ARIZ Corr Max	118.1	lbs/ft3	Corr Opt	13.0	%

Figure 6: Compaction proctor results (unit weight and optimum moisture).

Field Investigation - Existing Slab

Existing Slab Investigation Results:

- 4-5 inch thick slab-on-grade
- No Foundation
- Undermined Base
- Underlying soils in moist to wet conditions

Figure 7: Measurement of slab thickness

Slab on Grade Analysis

Meyrerhof's shallow foundation was observed to determine the bearing capacity of the existing surface (see Equations left).

Results show:
Net ultimate bearing capacity = 21,000 lb
Factor of Safety = 3
Net stress = 7,000 pounds.

Equation 1: Meyerhof Shallow Foundation Bearing Capacity

$$q_u = c'N_cF_{cs}F_{cd}F_{ci} + qN_qF_{qs}F_{qd}F_{qi} + \frac{1}{2}\gamma BN_\gamma F_{\gamma s}F_{\gamma d}F_{\gamma i}$$

q_u = Net ultimate bearing capacity
C' = Cohesion
q = effective stress at the level of the bottom of the foundation
γ = unit weight of soil
B = width of foundation
F_{cs}, F_{qd}, $F_{\gamma s}$ = shape factors
F_{cd}, F_{qd}, $F_{\gamma d}$ = depth factors
F_{ci}, F_{qi}, $F_{\gamma i}$ = load inclination factors
N_c, N_q, N_γ = bearing capacity factors

Equation 2: The Gross Allowable Load

$$q_{all} = q_u/FS$$

q_{all} = Net stress increase on soil
q_u = Net ultimate bearing capacity
FS = Factor of safety

Surveying

Equipment used:

- Nikon Total Station
- Rod and Prism
- Nomad Data Collector
- Tripod

Figure 8: Topographic Map of site.

Figure 9: Septic tank and concrete pad location on site.

Hydrology

- Flow Routing
  - Contours suggest flow seen in Figure 10
- Weighted Curve Number
- Time of Concentration
- Storm Event Runoff
  - Yavapai County Drainage Design Manual

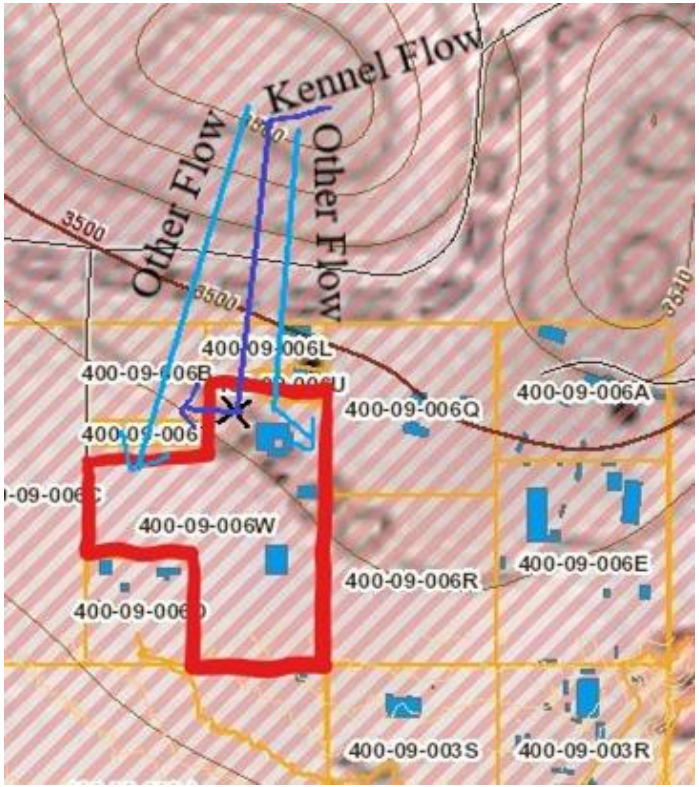


Figure 10: Flow Routing

Hydrology

Table 4: Weighted Curve Number

Percentage of Surface Type within Sub-Basin (%)				Weighted C
Natural Desert Rangeland	Hillslopes	Gravel Road	Roof	
66%	16%	16%	2%	0.58
0.48	0.67	0.84	0.95	
Runoff Coefficient				

Table 5: Time of Concentration

Time of Concentration	***30 min***

Table 6: Storm Event Runoff

Flow Through Kennels	
Storm (yr)	**Q (cfs)**
1	0.57
2	0.74
5	1.00
10	1.21
25	1.53
50	1.79
100	**2.07**

Decision Matrix

Criteria weight based on ability to affect the client's suggested importance.
Design's ranked; "one" being the design that best met the criteria and "three" being the design that least met the criteria.
Criteria weight and design rank were multiplied and summed together to give a weighted score for each design.

Table 7: Decision Matrix

	Decision Criteria				
	Sanitation	Area Required	Construction Cost	Maintenance Cost	
Weight	**23.00%**	**23.00%**	**31.00%**	**23.00%**	**Score**
Septic Tank and Leach Field	1	1	2	2	**1.54**
Lagoon	3	2	1	1	**1.69**
LID Retention Pond	2	2	3	1	**2.08**

*Lowest score means highest expectation.

Septic Tank Storage Determination

Utilized Bernoulli's Energy Equation

Assumptions made:

- Assumed 200 ft PVC pipe from well to facet at hose
- Hose length is 100 ft
- Elevation change from pump to pad is little to none - assumed zero

Flow rate of 3.4 gpm found

Client washes pad for 1 hour daily; utilizing 200 gallons per day

ADEQ R18-9-A314 suggests minimum design capacity be 1000 gallons

Equation 3: Bernoulli's Equation

$$\frac{P_1}{\gamma} + \frac{V_1}{2g} + Z_1 + h_p = \frac{P_2}{\gamma} + \frac{V_2}{2g} + Z_2 + h_f$$

With:

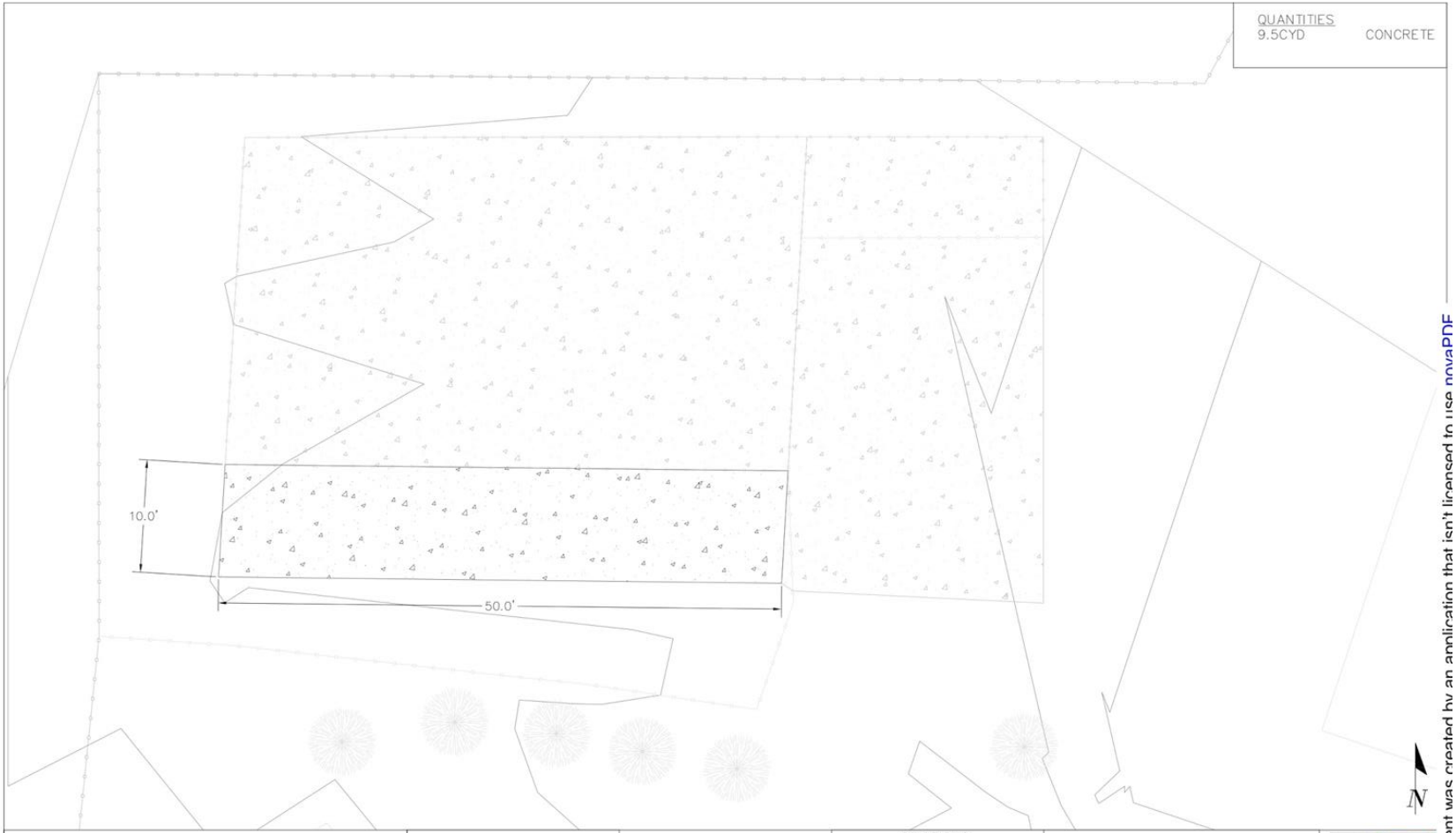
P_n= Pressure

V_n= Velocity

Z_n= Elevation

h_p= Head at Pump

h_f= Head loss due to Friction



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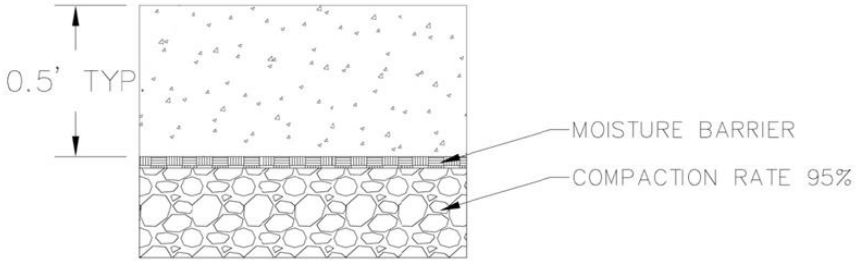
PLAN VIEW	DRAWN BY:A. FEDOR		90%	4/14	AF
	PAGE:2 OF:3		FIN	4/21	AF
	CHECKED BY:A. FEDOR	SCALE:SCALE			

RUFF ENGINEERING



CONCRETE SLAB CROSS-SECTION TYP.
N.T.S

JOB:P.R.H. EXPANSION YAVAPAI COUNTY

DETAILS

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DATE:04/03/2020
DRAWN BY:A.FEDOR
PAGE 3 OF:3
CHECKED BY:A FEDOR

0 N/A N/A N/A

SCALE:N/A

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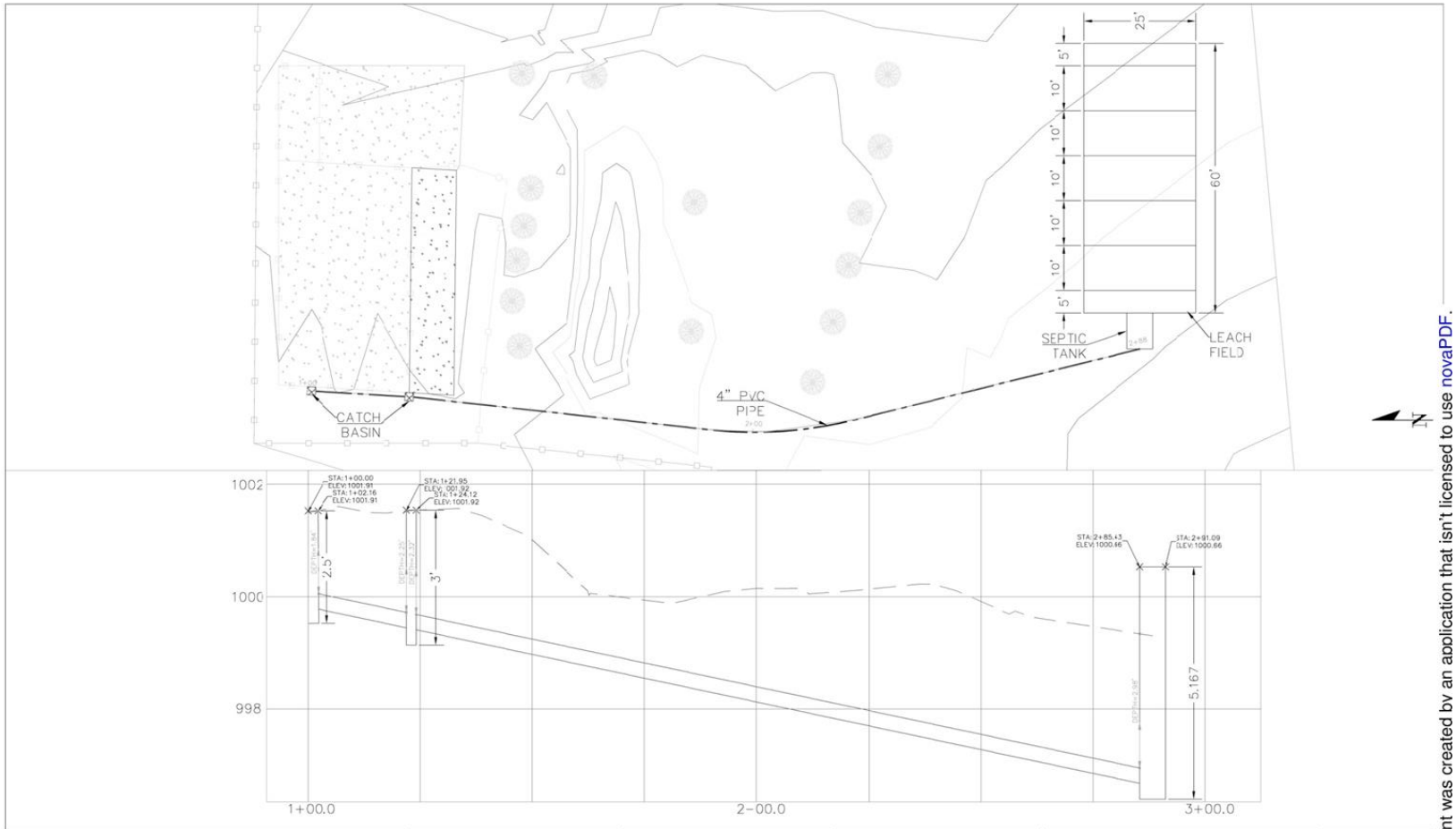

JOB:P.R.H. EXTENTION YAVAPAI COUNTY

PLAN AND PROFILE

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DATE:04/03/2020
DRAWN BY: A. FEDOR
PAGE 2 OF:3
CHECKED BY: A. FEDOR

0 2.5 5 10
SCALE:1"=10'

REVISIONS			
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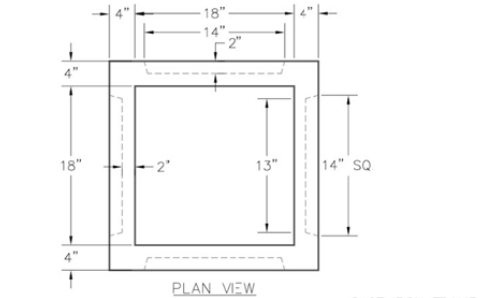
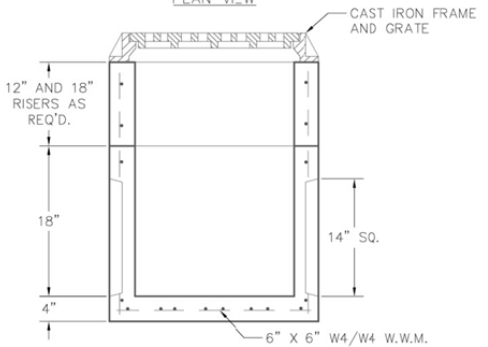


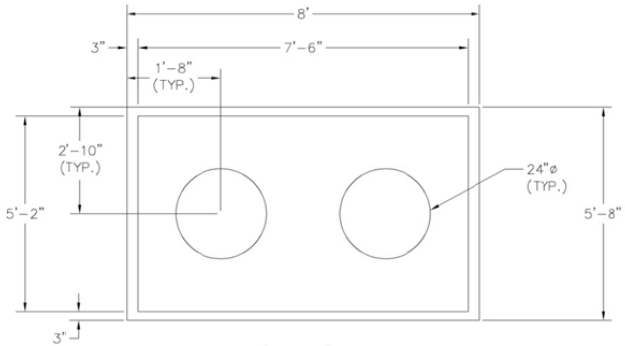
PLAN VIEW



SECTION

NOTE:
CONCRETE: 4,000 PSI @ 28 DAYS
REINFORCING: AS PER ASTM A-185 6"X6" W4/W4 W.W.M.
WEIGHTS: CATCH BASIN - 645 LBS.CONCRETE
FLAT TOP ALSO AVAILABLE 180 LBS. (3" THICK)
RISER WEIGHTS: 363 LBS/FT.

CATCH BASIN
N.T.S



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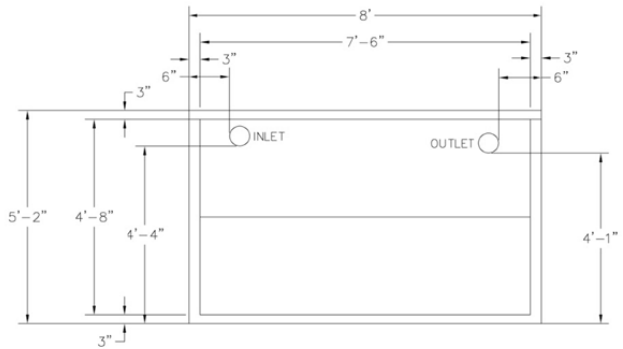

SECTION

SEPTIC TANK
N.T.S

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	PAGE 3 OF:3		FIN 4/21 AF
	CHECKED BY: A. FEDOR	SCALE:N/A	RUFF ENGINEERING

Final Recommendations

- Construction
  - Expand 10 feet south
  - Tie into existing surface
  - 95% compaction of ASTM D698, and +/- 3% of optimum moisture
  - Add a moisture barrier
  - Pad thickness 5 inches
- Drainage
  - Add two catch basins at the low points
  - 4 inch PVC pipe
  - Septic tank:
    - Width: 8 feet
    - Depth: 5 feet 8 inches
    - Height: 5 feet 2 inches
    - Volume: 1,000 gallons
  - Leach field:
    - Rows: 7
    - Width: 2 rows 5 foot, 5 rows 10 foot
    - Length: 25 feet
    - Total Area: 1,500 feet ^2

Impacts of Design

- Social
  - More room resulting in increased exercise and mental welfare of dogs
  - Little to no impact on work load for client and volunteers
  - Increased health and safety of dogs and people
- Environmental
  - No more sesis pools at the end of the kennel
  - Lower the amount of water flow into the vrede river
  - Micro dust particles into the air
  - Lower water flow affecting plant growth
- Economical
  - Dogs adopt-ability increases
  - Increase revenue
  - Decreasing infection/illness expenses
  - Additional revenue needed to cover cost of construction/maintenance

Figure 11: Sleepy puppies after a hard day of work. Photo Credit: Abigail Autieri

Cost of Design

Table 8: Quantity and Cost

Materials	Unit price	Units	Total
Vapor Barrier ($/per unit)	$60.00	1	$60.00
Cement ($/per bag)	$4.55	312.5	$1,421.88
1,000 gal Septic Tank ($/per tank)	$1,000.00	1	$1,000.00
4 inch PVC pipe ($/per 10 feet length)	$20.00	18.5	$370.00
Steel frame for catch basin ($/per unit)	$240.00	2	$480.00
Septic Tank Installation ($/per tank)	$5,000.00	1	$5,000.00
Total Cost			**$8,331.88**

References

[1] Google. “4555 N. Peyton Place in Clarkdale, Arizona” [Online]. Available: https://goo.gl/maps/oGF4dUhMb2ud5J6s8. [Accessed: October 6, 2019].

[2] Y. C. GIS, “Interactive Map,” *Yavapai County Interactive Map*. [Online]. Available: http://gis.yavapai.us/V4/map.aspx?zoom=3&x=-112.41532745361118&y=34.780708973222005&layers=Parcels,ParcelLabels,MajorRds,MajorRdLabels,Roadctrline,RdLabels,CityBnds,Cities,CityLbl,CountyBdy,CountyLbl,ChiZon,ChiZonLbls. [Accessed: 13-Jan-2020].

[3] *Planning and Zoning Ordinance For The Unincorporated Areas of Yavapai County, Arizona*. Yavapai County Board of Supervisors, 2003.

Questions?

Figure 12: Dr Bero with Angel.
Photo Credit: Ryann DuBose

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