



City of Stevenson Planning Department

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TO: City Council
FROM: Ben Shumaker
DATE: June 16th, 2016
SUBJECT: Farm Animals

Introduction

The memo summarizes actions the City Council could take to make the Planning Commission's recommended farm animal Zoning Code amendments—which are unchanged since the May meeting—more restrictive.

Changes Considered Farm Animal

The Planning Commission continues to hear testimony from citizens and animal owners concerned about the City's potential removal of their right to keep farm animals in the SR District. At their June meeting, the Planning Commission considered changes to:

- The definition of allowable Farm Animals (including possible incorporation of Animal Unit Equivalencies),
- Increasing the minimum lot size where animals can be kept,
- Adding provisions for the range area an animal can enjoy,
- Making keeping farm animals an accessory use (dependent on the property having either an occupied onsite dwelling or another onsite principal use),
- Including setback provisions from wells and other sensitive areas,
- Including setback provisions for specific animals.

Of these considerations, the accessory use provision and setbacks from sensitive areas seemed the most popular. Animal Unit Equivalencies and range area provisions were thoroughly discussed, but ultimately found either overly complicated or overly simplistic. Changing the definition to exclude problem animals, was the least preferred approach.

City Council Options

Staff is available to help City Council work through the remaining issues without Planning Commission involvement. The draft changes below and attached may be considered by Council if it still desires to be more restrictive.

Modified Definitions

The Planning Commission's recommendation strives to create a simple program where livestock and farm animals are categorized into only 2 categories—Farm and Urban Farm. The simplicity of this program has acknowledged faults—small furbearing animals like mink are treated the same as chickens despite the difference in smells; cows are treated the same as alpacas despite the obvious weight difference, etc. Staff has promoted this simplicity as a positive aspect of the Planning Commission's recommendation and has recommended against including more complex systems like a third definition for "Large (or High Impact)

Farm Animal” or the even more complicated Animal Unit Equivalencies (See Attachment 3, *National Range and Pasture Handbook*). Both options, however, remain viable if the Council wishes to further explore them.

If the Council wishes to maintain the simplicity of the 2-category format, it could also exclude certain animals based on language such as the following:

Draft Farm Animal Definition: SMC 17.10.302 Farm Animal. “Farm Animal means any large animal commonly raised or bred on a farm. “Farm Animal” includes alpacas, cattle, donkeys, emus, goats, horses, llamas, mules, ostriches, ponies, roosters, sheep, and similar animals. “Farm Animals” does not include pets (SMC 17.10.632) or urban farm animals (SMC 17.10.303), and because of their negative community impacts, pigs are not included in the “Farm Animals” allowed by this title.

Principal or Accessory Use

The current regulations agriculture (excluding the raising of animals for commercial purposes) as a principal use in the SR District. These uses can occur on any property in the district without restriction. The proposed amendment would allow Farm Animals (whether commercial or for private enjoyment) on only (~35% of lots in the district) and limit the total number of animals based on lot size (~5 per acre). The Council could further limit the number of lots allowed to have Farm Animals by requiring some other use also be located on the property. This could be done as follows:

Accessory Use Language, General: SMC 17.16.030(H) “Animal Uses as follows:

1. The keeping of farm animals subject to the specific performance standards of SMC 17.40.095.
2. The keeping of pets.”

OR

Accessory Use Language, Restrictive: SMC 17.16.030(H) “Animal Uses as follows:

1. The keeping of farm animals subject to the specific performance standards of SMC 17.40.095, and where an onsite dwelling unit is occupied by a person responsible for the animals.
2. The keeping of pets.”

Structure Setback

The current and recommended regulations require a 60’ setback for the barns and stables housing farm animals. The recommendation also includes a grandfathering provision for nonconforming structures which currently house farm animals. The City Council could modify this grandfathering statement to require compliance within a certain time period. One example follows:

Setback Language: SMC 17.40.095(E) “Setbacks. Stables and barns housing farm animals shall be setback at least 60 feet from all property lines. An existing stable or barn having a setback of less than 60 feet shall not be considered a nonconforming use under SMC 17.44 and the keeping of animals in such structure shall be discontinued within 6 months of if the proponent can provide proof that the structure housed farm animals at the effective date of the ordinance codified in this section. Coops, hives, hutches and other structures housing urban farm animals shall be subject to the minimum density and dimensional standards required elsewhere in this code.”

Removing Animal “Grandfathering”

The setback of stables and barns is not the only method where the nonconforming use—or “grandfathering”—provisions could be altered. A broader, more restrictive approach could be to include a specific statement in the nonconforming use section of the Zoning Code such as the following:

Nonconforming Animal Uses: SMC 17.44.195 Nonconforming Animal Uses.”
Notwithstanding the other provisions of this chapter, the reasonable time for the
continuation of nonconforming animals uses shall not extend beyond 6 months after the
effective date of the ordinance codified in this section.

Other Options

Staff recommends against clouding the farm animal program with references to other City, state, or federal codes. Regulations for critical habitat, wetlands, etc. will apply to these uses regardless of whether they are referenced in the Zoning Code. Additional regulations for private wellhead protection would require a level of specialization beyond what should be necessary for Zoning Code enforcement (See Attachment 4, *Wellhead Protection Program Guidance Document*). As thoroughly discussed by the Planning Commission, minimum animal range area standards will differ based on the type of animal (steep slopes affect pigs differently than goats or alpacas).

The Council could also include options to be more permissive for certain types of animals. For example, the City of White Salmon has adopted a blanket prohibition of farm animals, but includes relief mechanisms for the permitting of 4-H lambs from March through August. Stevenson could follow a similar approach for any type of animal kept for 4-H reasons.

Action Requested

The City Council is requested to discuss and evaluate these and other options prior to adoption of the new regulations.

Prepared by,

Ben Shumaker
Planning Director

Attachments

1. Recommended Draft Ordinance 2016-1093
2. Recommended Draft Ordinance 2016-1094
3. Excerpt from *National Range and Pasture Handbook*
4. Excerpt from Washington State Department of Health *Wellhead Protection Program Guidance Document*

CITY OF STEVENSON, WASHINGTON

ORDINANCE NO. 2016-1093

AN ORDINANCE AMENDING THE STEVENSON ZONING CODE PROVISIONS (SMC TITLE 17) RELATING TO ANIMAL USES; AND REPEALING PORTIONS OF ORDINANCES 894 AND SECTIONS 4.3.B AND 4.4.G OF ORDINANCE 1077.

RECITALS

WHEREAS, Goal 2 of the Stevenson Comprehensive Plan envisions a future where Development within the Stevenson Urban Area wisely considers the long-term interests of the community.”, and

WHEREAS, Objective 3.1 of the Comprehensive Plan seeks periodic review and revision of land use regulations based on residents changing social and economic needs, and

WHEREAS, Objective 3.4 of the Comprehensive Plan seeks to ensure appropriate maintenance of properties in the city, and

WHEREAS, the City Council deems the expanding the areas where urban farm animals may be kept and reducing the areas where farm animals may be kept are components of achieving these Comprehensive Plan policies, and

WHEREAS, the City has determined these regulations to be exempt from threshold determination under the State Environmental Policy Act under the Categorical Exemption in WAC 197-11-800(19)(b);

WHEREAS, the Planning Commission and City Council have given due public notice of hearings relating to this ordinance and have held such hearings;

AND WHEREAS, the Planning Commission has reviewed and recommended that the City Council approve these regulations.

NOW, THEREFORE, the City Council of the City of Stevenson do ordain as follows:

Section 1- THAT, the following shall be added to Stevenson Municipal Code Chapter 17.09: “SMC 17.09.095 – Farm Animals & Urban Farm Animals. The council finds that farm animals and urban farm animals are generally incompatible with close-density housing within the city limits due to noise, odor, public health, and security issues. However, even in an urban setting, citizens may keep certain farm animals with minimal impact to adjoining neighbors, while helping residents access inexpensive, healthy food and environmentally-friendly alternatives to fertilizer, pesticide and noxious weed control.”

Section 2- THAT, the following definitions shall be added to Stevenson Municipal Code Chapter 17.10:

2.A- “SMC 17.10.025 – Adult Animal. “Adult Animal” means an animal that has been weaned from reliance on its mother and/or has reached the productive age for which it is bred or raised. For bees, a bee colony as it is defined in RCW 15.60.005 is considered one (1) adult animal.”

2.B- “SMC 17.10.302 – Farm Animal. “Farm Animal” means any large animal commonly raised or bred on a farm. “Farm Animal” includes alpacas, cattle, donkeys, emus, goats, horses, llamas, mules, ostriches, pigs, ponies, roosters, sheep, and similar animals. “Farm Animal” does not include pets (SMC 17.10.632) or urban farm animals (SMC 17.10.303).”

2.C- “SMC 17.10.303 – Farm Animal, Urban. “Urban Farm Animal” means any small animal commonly raised or bred on a farm but which have minimal impact when kept in residential areas. “Urban Farm Animal” includes bees, chickens, ducks, geese, pigeons, pheasants, turkeys, rabbits and other fur bearing animals, and similar small

animals. “Urban Farm Animal” does not include roosters, pets (SMC 17.10.632) or farm animals (SMC 17.10.302).”

2.D- “SMC 17.10.632 – Pet. “Pet” means any animal commonly considered to be household pets, such as a cat, a dog as regulated under SMC 6.04, a fish kept in a tank or landscape pond, a gerbil, hamster, guinea pig, parakeet, parrot, or similar bird or rodent-like creature kept in a cage.”

Section 3- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.16:

3.A- Subsection SMC 17.16.010(C), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.16.010(C) Agricultural uses including:

1. Subsistence or hobby type gardening.
2. Indoor and outdoor horticulture.
3. Nursery.”

3.B- Subsection SMC 17.16.010(D), a portion of Ordinance 894, shall be repealed in its entirety.

3.C- Subsection SMC 17.16.010(E), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.16.010(E) Animal uses as follow, subject to the specific performance standards of SMC 17.40.095:

1. The keeping of farm animals.
2. The keeping of urban farm animals”.

3.D- Subsection, SMC 17.16.030(C), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.16.030(C) Home occupation, including retail and wholesale sales of agricultural and animal products raised or produced on the premises;”

3.E- Subsection SMC 17.16.030(H), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.16.030(H) Animal uses as follow: the keeping of pets.”

3.F- Subsection SMC 17.16.030(I), a portion of Ordinance 894, shall be repealed in its entirety.

Section 4- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.18:

4.A- Subsection SMC 17.18.020(K), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.18.020(K) Animal uses as follow:

1. The keeping of farm animals, provided that, at a minimum, the Planning Commission finds the proposal to be compliant with the performance standards in SMC 17.40.095.
2. Kennel.”

4.B- Subsection SMC 17.18.030(F), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.18.030(F) Animals uses as follow:

1. The keeping of pets.
2. The keeping of urban farm animals subject to the specific performance standards of SMC 17.40.095.”

4.C- Subsection SMC 17.18.030(G), a portion of Ordinance 894, shall be repealed in its entirety.

Section 5- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.20:

5.A- Subsection SMC 17.20.020(L), a portion of Ordinance 894, shall be repealed in its entirety.

5.B- Subsection SMC 17.20.030(F), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.20.030(F) Animal uses as follow, and excluding kennels and the keeping of farm animals:

1. The keeping of pets.
2. The keeping of urban farm animals subject to the specific performance standards of SMC 17.40.095.”

5.C- Subsection SMC 17.20.030(G), a portion of Ordinance 894, shall be repealed in its entirety.

Section 6- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.22:

6.A- Subsection SMC 17.22.030(F), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.22.030(F) Animal uses as follow, and excluding kennels and the keeping of farm animals:

1. The keeping of pets.
2. The keeping of urban farm animals subject to the specific performance standards of SMC 17.40.095.”

6.B- Subsection SMC 17.22.030(G), a portion of Ordinance 894, shall be repealed in its entirety.

Section 7- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.24:

7.A- Subsection SMC 17.24.030(F), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.24.030(F) Animal uses as follow, and excluding kennels and the keeping of farm animals:

1. The keeping of pets.
2. The keeping of urban farm animals subject to the specific performance standards of SMC 17.40.095.”

7.B- Subsection SMC 17.24.030(G), a portion of Ordinance 894, shall be repealed in its entirety.

Section 8- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.28:

8.A- Subsection SMC 17.28.010(C), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.28.010(C) Retail sales, personal and other services including kennel services, and rental operations;”

8.B- A new subsection, SMC 17.28.030(E), shall be added as follows:

“SMC 17.28.030(E) Animal uses as follow, and excluding the keeping of farm animals and urban farm animals: the keeping of pets.”

Section 9- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.30:

9.A- A new subsection, SMC 17.30.030(E), shall be added as follows:

“SMC 17.30.030(E) Animal uses as follow, and excluding kennels:

1. The keeping of pets.
2. The keeping of urban farm animals subject to the specific performance standards of SMC 17.40.095.”

9.B- Subsection SMC 17.30.050(E), a portion of Ordinance 894, shall be repealed and replaced as follows:

“SMC 17.30.050(E) Animal uses as follow: a limited allowance of farm animals when kept for the sole purpose of providing recreational horse, pony, mule and donkey rides, but excluding all other farm animals.”

Section 10- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.32:

10.A- A new subsection, SMC 17.32.010(H) shall be added as follows:

“SMC 17.32.010(H) Kennel.”

10.B- A new subsection, SMC 17.32.030(E), shall be added as follows:

“SMC 17.32.030(E) Animals uses as follow, and excluding the keeping of farm animals and urban farm animals: the keeping of pets.”

Section 11- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.33:

11.A- Subsection SMC 17.33.020(B), Section 4.3.b of Ordinance 1077, shall be repealed and replaced as follows:

“SMC 17.33.020(B) Animal uses as follow: the keeping of farm animals; provided, that at a minimum, the Planning Commission finds the proposal to be compliant with the performance standards in SMC 17.40.095.”

11.B- Subsection SMC 17.33.030(G), Section 4.4.g of Ordinance 1077, shall be repealed and replaced as follows:

“SMC 17.33.030(G) Animal uses as follow, and excluding kennels:

1. The keeping of pets,
2. The keeping of urban farm animals subject to the specific performance standards of SMC 17.40.095.”

Section 12- THAT, the following changes shall be made to Stevenson Municipal Code Chapter 17.34:

12.A- A new subsection, SMC 17.34.030(E) shall be added as follows:

“SMC 17.34.030(E) Animal uses as follow: the keeping of pets, farm animals and urban farm animals. The keeping of farm animals and urban farm animals in the PR District is not subject to the performance standards of SMC 17.40.095.”

12.B- A new subsection, SMC 17.34.040(J) shall be added as follows:

“SMC 17.34.040(J) Kennel.”

Section 13- THAT, the following shall be added to Stevenson Municipal Code Chapter 17.40: “SMC 17.40.095 – Farm Animals & Urban Farm Animals.

13.A- A. Where allowed by this code, the keeping of farm animals and urban farm animals is subject to the baseline standards in Table 17.40.095-1.

Table 17.40.095-1 Baseline Standards	
Animal Type	Maximum Density

	Lot smaller than 1 acre	Lot 1 acre or larger
Farm Animal ¹	0 farm animals	1 adult animal per 8,000 sf
Urban Farm Animals ¹	No maximum number	No maximum number
1-Both the animal owner and the property owner upon which the animal(s) are kept shall be jointly and severally responsible to comply with the provisions of this chapter.		

13.B- B. Animal Wastes. Any person who keeps animals under this title shall be responsible for the disposal of any excreta deposited by the animal(s) on public areas or private property. Such person shall further not permit such excreta or food supplies, on the property of such person or elsewhere, to be or become a breeding place for insects or flies, to be or become unsanitary, or to give offensive odor.

13.C- C. Animal Health & Well-Being. Any person who keeps animals under this title shall provide shelter for the animal(s) in the event of extreme weather conditions, take precautions to ensure that the allowed animal is protected from predators, and provide appropriate health care, food and water for the animal(s).

13.D- D. Running At Large. No person who keeps animals under this title shall allow the animal(s) to run at large within the city. Structural features or equipment shall be installed to maintain and control the animal(s) so as to reduce the nuisance impact on adjacent land uses.

13.E- E. Setbacks. Stables and barns housing farm animals shall be set back at least 60 feet from all property lines. An existing stable or barn having a setback of less than 60 feet shall be considered a nonconforming use if the proponent can provide proof that the structure housed farm animals at the effective date of the ordinance codified in this section. Coops, hives, hutches and other structures housing urban farm animals shall be subject to the minimum density and dimensional standards required elsewhere in this code.

Section 14- THAT, this ordinance affects Title 17 of the Stevenson Municipal Code only insofar as set forth herein. All other provisions of Title 17 shall remain in full force and effect, and that where the provisions of this ordinance are the same as the provisions they replace, the provisions of this ordinance shall be interpreted as a continuation of those previous provisions and not as a new enactment.

Section 15- THAT, if any section, subsection, paragraph, sentence, clause, or phrase of this ordinance is declared unconstitutional or invalid for any reason, such decision shall not affect the validity of the remaining portions of this ordinance.

This Ordinance shall take effect and be in force five (5) days after its publication according to law.

PASSED by the City Council of the City of Stevenson and approved by the Mayor this _____ day of _____, 2016.

Mayor of the City of Stevenson

ATTEST:

Nick Hogan, Clerk of the City of Stevenson

APPROVED AS TO FORM:

KEN WOODRICH, Attorney for the
City of Stevenson

CITY OF STEVENSON, WASHINGTON

ORDINANCE NO. 2016-~~1093~~1094

AN ORDINANCE ALLOWING THE TEMPORARY KEEPING OF GOATS AND SHEEP ON ALL PROPERTIES IN THE CITY WHEN USED FOR FIRE AND WEED CONTROL.

RECITALS

WHEREAS, Objective 2.6 of the Stevenson Comprehensive Plan seeks to protect public and private property from fire hazards, and

WHEREAS, Objective 3.4 of the Comprehensive Plan seeks to ensure appropriate maintenance of properties in the city, and

WHEREAS, the City Council seeks to grant limited relief from the Stevenson Zoning Code's regulations regarding the keeping of goats in the City in order to further Comprehensive Plan Objectives 2.6 and 3.4, and

WHEREAS, the City Council deems the limited relief granted herein as an appropriate use of their police power to secure and promote the health, safety and general welfare of the people of the City; and

WHEREAS, the City has determined these regulations to be exempt from threshold determination under the State Environmental Policy Act under the Categorical Exemption in WAC 197-11-800(19)(a);

WHEREAS, the Planning Commission and City Council have given due public notice of hearings relating to this ordinance and have held such hearings;

AND WHEREAS, the Planning Commission has reviewed and recommended that the City Council approve these regulations.

NOW, THEREFORE, the City Council of the City of Stevenson do ordain as follows:

Section 1- THAT, a new chapter shall be added to the Stevenson Municipal Code as Chapter 6.10 Goats and Sheep Used for Fire and Weed Control.

Section 2- THAT, the following shall be added to Stevenson Municipal Code Chapter 6.10: "SMC 6.10.010 – Findings, Intent and Purpose. The council finds that the keeping of goats and sheep is generally incompatible with close-density housing within the city limits due to noise, odor, public health, and security issues. However, even in an urban setting, citizens may temporarily keep certain goats with minimal impact to adjoining neighbors, while helping residents access inexpensive and environmentally-friendly alternatives to fire risk reduction, pesticide, and noxious weed control."

Section 3- THAT, the following shall be added to Stevenson Municipal Code Chapter 6.10: "SMC 6.10.020 – Goats and Sheep, Allowed Temporarily. Notwithstanding the regulations in SMC Title 17, goats and sheep may be kept on any property in the City when used for the reduction of fire risk and/or control of weeds or noxious vegetation. This allowance is limited to no more than six (6) ~~goats-animals~~ for a period of time not to exceed 14 days in any 60-day period."

Section 4- THAT, the following shall be added to Stevenson Municipal Code Chapter 6.10: "SMC 6.10.030 – Running At Large Prohibited. No person who keeps a goats or goats-sheep under this chapter shall allow the animal(s) to run at large within the city. Structural features or equipment shall be installed to maintain and control the animal(s) so as to reduce the nuisance impact on adjacent land uses. Both the ~~goat~~ animal owner and the property owner upon which the ~~goat~~animal(s) are kept shall be jointly and severally responsible to comply with the provisions of this chapter."

Section 5- THAT, if any section, subsection, paragraph, sentence, clause, or phrase of this ordinance is declared unconstitutional or invalid for any reason, such decision shall not affect the validity of the remaining portions of this ordinance.

This Ordinance shall take effect and be in force five (5) days after its publication according to law.

PASSED by the City Council of the City of Stevenson and approved by the Mayor this _____ day of _____, 2016.

Mayor of the City of Stevenson

ATTEST:

Nick Hogan, Clerk of the City of Stevenson

APPROVED AS TO FORM:

KEN WOODRICH, Attorney for the
City of Stevenson

Montana Table 6-5

Animal Unit Equivalent Guide

ANIMAL KIND / CLASS	ANIMAL UNIT EQUIVALENT (AUE)	NO. OF ANIMALS EQUAL TO 1 AU	AIR-DRY WEIGHT OF FORAGE CONSUMED (lbs.)		
			DAY	MONTH	YEAR
Cow, dry (1000 lbs.)*	.85	1.2	25.5	765	9180
Cow (1000 lbs.), with calf to 6 months	1.0	1.0	30	915	10,980
Cow (1100 lbs.), with calf to 4 months	1.1	.91	33	990	11,880
Cow (1200 lbs.), with calf to 4 months	1.2	.83	36	1080	12,960
Cow (1300 lbs.), with calf to 4 months	1.3	.77	39	1170	14,040
Calf, 4 months to weaning	0.3	3.3	9	270	3240
Yearling cattle, 7-12 months	0.56–0.65	1.5–1.8	17-19.5	510-585	6120-7020
Yearling cattle, 12-17 months	.75	1.3	22.5	675	8100
Heifers, 18-24 months	.86	1.2	26	780	9360
Bulls, 12-24 months	1.2	.83	36	1080	12,960
Bulls, mature (1850 lb. average)	1.5	.67	45	1350	16,200
Horse, yearling	0.75	1.3	22.5	675	8100
Horse, 2 year old	1.0	1.0	30	915	10,980
Horse, mature (1100 lbs.)	1.1	.91	33	990	11,880
Sheep, mature lactating ewe (150 lbs.), with lamb, less than 2 months	0.17	5.9	5.1	153	1836
Sheep, mature non-lactating ewe	0.15	7.1	4.5	135	1620
Lamb, 2 months to weaning	0.06	16.7	1.8	54	648
Lamb, weaned to yearling	0.12	8.3	3.6	108	1296
Lamb, yearling	0.15	6.7	4.5	135	1620
Ram (200 lbs.)	0.17	5.9	5.1	153	1836
Goat, mature	0.15	6.7	4.5	135	1620
Kid, yearling	0.10	10.0	3.0	90	1080
Llama, mature female	.23	4.3	6.9	207	2484
Bison, lactating cow, yearlong average	1.1	.91	33	990	11,880
Bison, lactating cow, spring	1.0	1.0	30	915	
Bison, lactating cow, summer	1.22	.82	36.6	1098	
Bison, lactating cow, fall	1.65	.61	49.5	1485	
Bison, lactating cow, winter	0.65	1.54	19.5	585	
Bison, bull	1.5	0.67	45	1350	16,200
White-tailed deer	.19	5.3	5.7	171	2052
Mule deer	.19	5.3	5.7	171	2052
Elk, mature	.70	1.4	21	630	7560
Moose	.81	1.2	24.3	729	8748
Bighorn sheep	.16	6.25	4.8	144	1728
Antelope	.13	7.7	3.9	117	1404

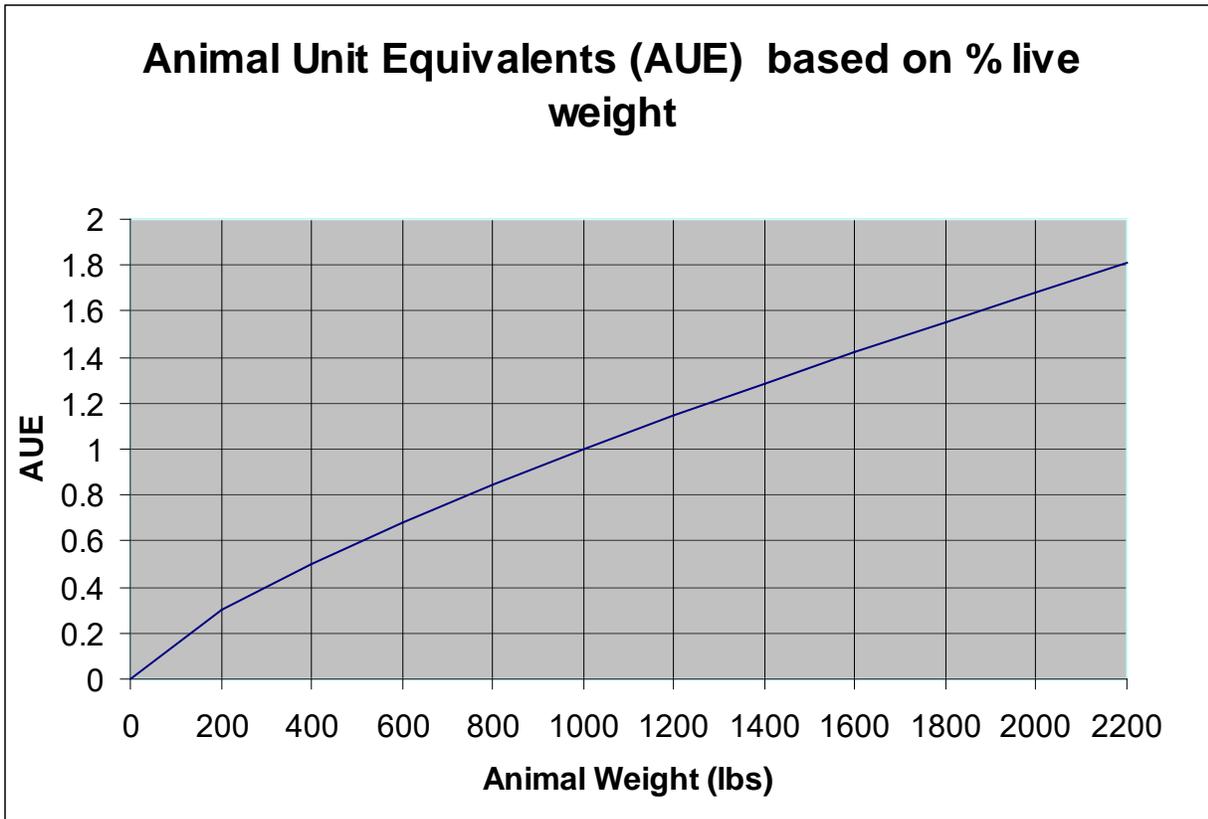
* Add 0.1 per additional 100 pounds of body weight for dry cows.

Figures are based on a daily air-dry matter intake of 2.2 to 3.0% of body weight, depending on the nutritional demands for the type and class of livestock and wildlife.

Wildlife values are based on the nutritional needs of average-sized breeding females.

Montana Figure 6-4.5

Animal Unit Equivalent Guide



Buffer Zone

The buffer zone is an area sloping up from Zone 3. It can include the entire zone of contribution or may focus on selected areas of concern such as recharge areas or locations where the aquifer may be exposed at the surface. The buffer zone is an area of added protection for the wellhead protection area. This zone helps compensate for errors when calculating the wellhead protection area boundaries, and provides information for long-term planning.

A primary goal of the buffer zone is to **provide information to planners on activities or facilities outside Zone 3 that could release contaminants into the wellhead protection area.** Analysis may show the need for contingency plans to respond to uncontrolled surface discharges that may travel overland to enter a stream located in or adjacent to the wellhead protection area. It may also identify other non-contiguous critical aquifer recharge areas requiring protection.

Selected Wellhead Protection Area Delineation Methods

After the boundaries of the Wellhead Protection Area are calculated, they must be displayed on a map of suitable scale.

Not all delineation methods are suitable for all settings. Therefore, it is critical to conduct a susceptibility assessment of the site before selecting a delineation method. Of the delineation methods evaluated, the Wellhead Protection Technical Advisory Committee selected four, listed below in order of complexity, cost and reliability:

1. Calculated Fixed Radius
2. Analytical Models
3. Hydrogeologic Mapping
4. Numerical Flow/Transport Models

EPA compared delineations using the calculated fixed radius method, an analytical model, and a numerical model (See Figure 3). Because hydrogeological settings vary widely, no set of examples should be considered typical

Calculated Fixed Radius

The calculated fixed radius method draws a circular protection area for a specified time-of-travel threshold. A simple volumetric flow equation is used to calculate the radius (Figure 1). (Note that Figure 1 depicts Zone 1 as a single circle. Zone 1 includes an internal 6-month time-of-travel delineation.)

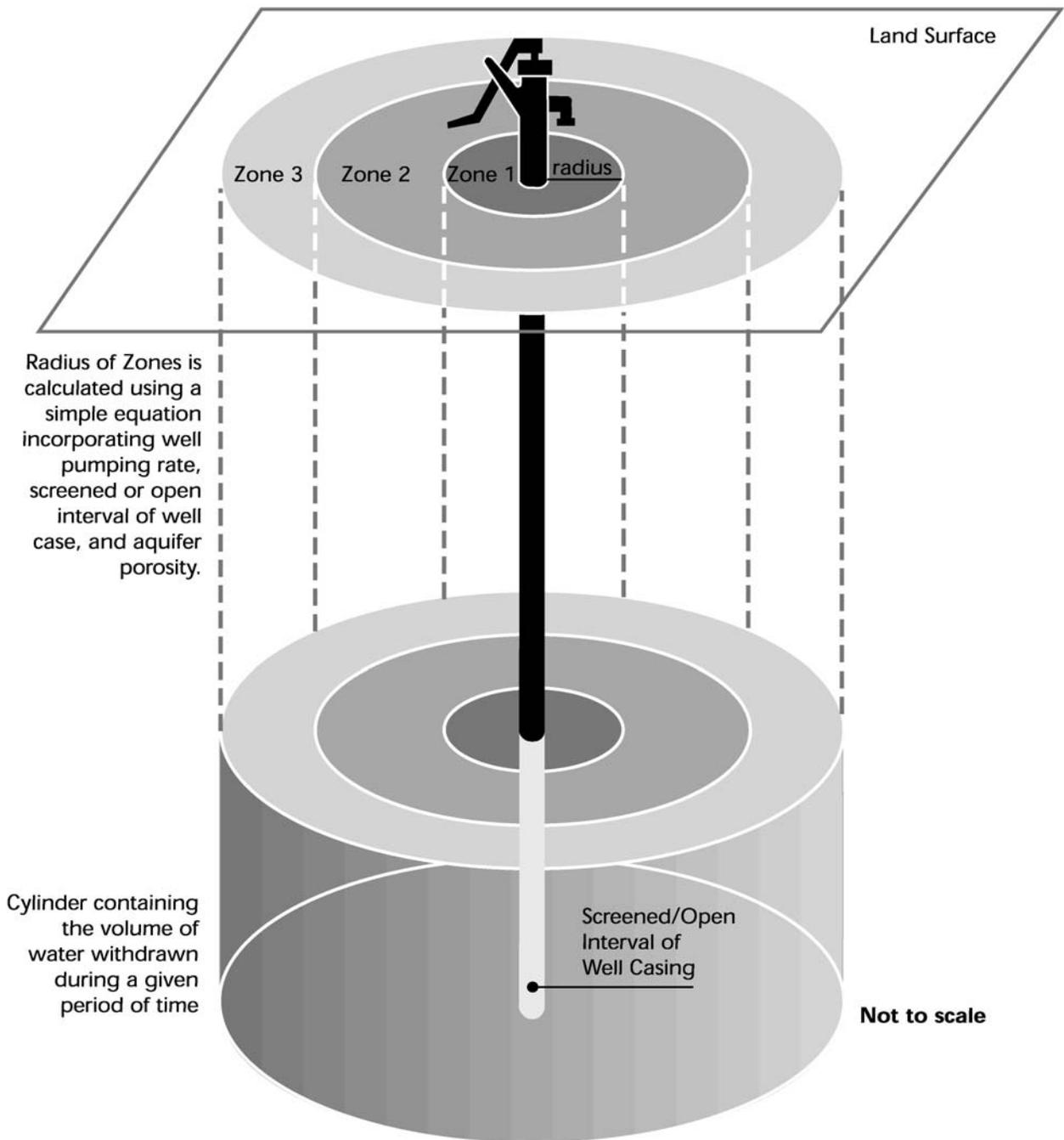
The calculated fixed radius method is part of the basic Washington State susceptibility assessment.

To use this method, you must have the:

1. Well pumping rate.
2. Porosity of the aquifer. Lacking a site-specific estimate of aquifer porosity, you may substitute a value of 0.22.
3. Open or screened interval of the well. If the actual screened interval is unknown, or the well is constructed with an open interval at its base, use a value of 10 feet.

This delineation method is inexpensive and requires minimal technical expertise. Because of its simplicity, it can be used to delineate moderate and small systems. Many systems should use it as a first-cut way to identify immediate threats to the water quality. A major drawback of this model is that groundwater rarely behaves as simply as this model predicts. See Element 4 of Appendix F for a table to use when calculating times of travel using the calculated fixed radius method.

Figure 1. Illustration of a Calculated Fixed Radius Model



$$r = \sqrt{\frac{Qt}{\pi n H}}$$

Where:

- Q = Pumping Rate of Well (cubic feet per year)
- n = Aquifer Porosity = 0.22
- H = Open Interval or Length of Well Screen
- t = Travel Time to Well (1, 5, 10 years)

Analytical Methods

Analytical methods use simple calculations, graphical methods, or simple analytical solution-based computerized groundwater-flow models to delineate wellhead protection zones (Figure 2). While analytical models require more skill and data than the calculated fixed radius method, they use equations a hydrogeologist or civil engineer can easily understand. Required data includes hydraulic gradient, hydraulic conductivity, saturated thickness, and hydrogeological divides.

A simple analytical model (such as EPA's WHPA Code¹⁰) can often provide a good approximation of the time-of-travel boundaries. However, settings with significant aquifer boundaries and non-uniform hydrogeological characteristics may require more sophisticated methods, such as detailed hydrogeological mapping or numerical modeling.

Hydrogeological Mapping Methods

EPA loosely defines hydrogeological mapping methods used to define zones of contribution as geologic, geophysical and dye tracing. To use this method you must have geologic maps, aquifer water level mapping, aquifer pumping test data, hydrogeological reports and well reports.

In Washington, hydrogeological and geologic information is often regional or does not exist. Therefore, hydrogeological mapping is often required to characterize aquifer properties, groundwater-flow directions, and aquifer boundaries as a prelude to analytical numeric modeling.

Hydrogeological mapping methods can be useful where hydrogeological conditions preclude application of simple analytical models. Settings where geologic features exert strong control over groundwater flow direction and rates include fractured rock (such as basalt), karst, small valley fill deposits, and irregular river or other barrier boundaries.

These methods require specialized expertise in geologic and geomorphic mapping, and significant judgment on what constitutes likely flow boundaries.

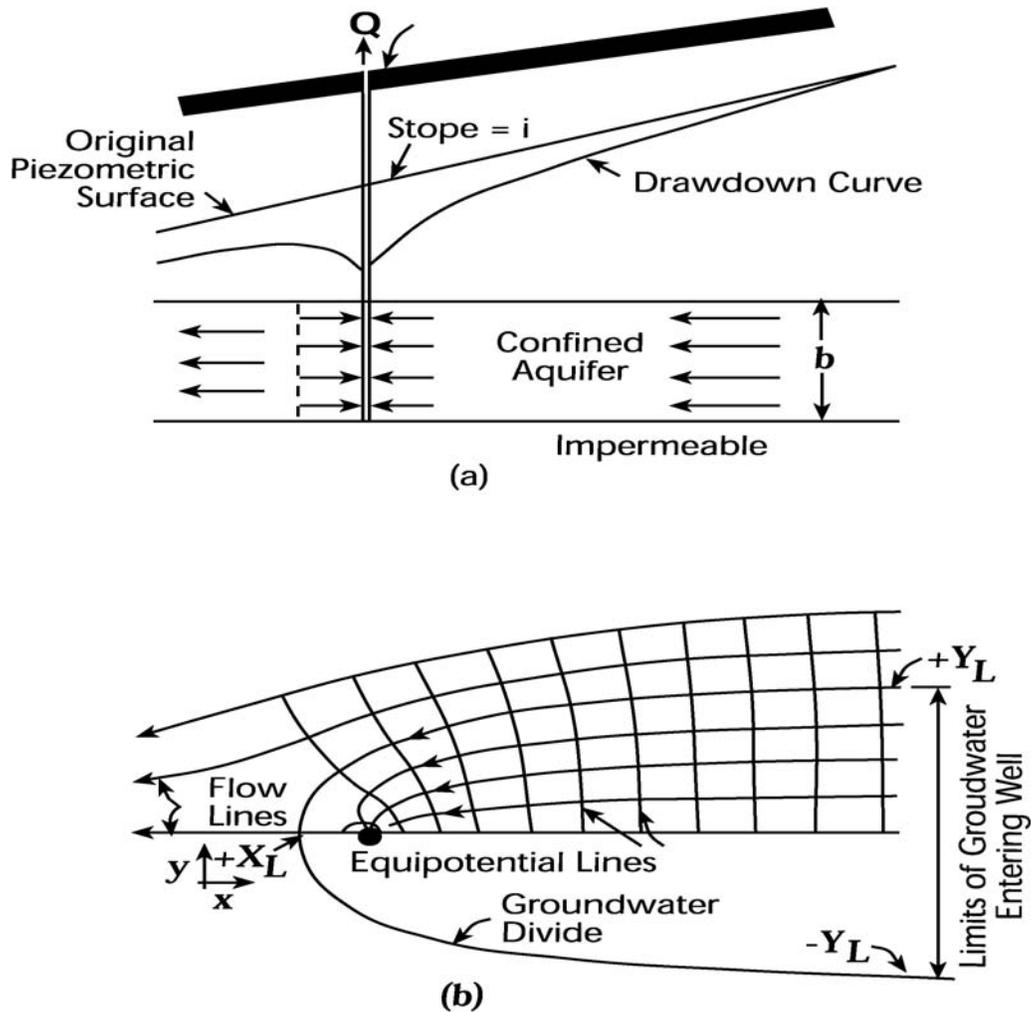
Numerical Flow and Transport Models

Computer models that numerically approximate groundwater flow and solute transport equations can be used to delineate wellhead protection areas. Generally grouped as two- and three-dimensional, computer models require data similar to the hydrogeological mapping and analytical method. However, computer models can incorporate much more of this information. With sufficient data, numerical models are recognized as a technically superior delineation method.

Numerical models provide a very high degree of accuracy. They can be used in nearly all hydrogeological settings. They may be very desirable in areas with other ongoing groundwater management programs in place. This method costs more than other methods and requires considerable technical expertise in hydrogeology and modeling. However, the cost may be warranted in areas where a high degree of reliability is necessary.

¹⁰ EPA developed software to help delineate wellhead protection areas. You can obtain it from the International Groundwater Modeling Center online at <<http://typhoon.mines.edu/software/igwmcsoft/>> There is a fee to cover reproduction, shipping and handling.

Figure 2. An Analytically Derived Model



$$\frac{-Y}{X} = \tan\left(\frac{2\pi Kbi}{Q} Y\right)$$

Uniform-Flow Equation

$$X_L = -\frac{Q}{2\pi Kbi}$$

Distance to Down-Gradient Null Point

$$X_L = \pm \frac{Q}{2\pi Kbi}$$

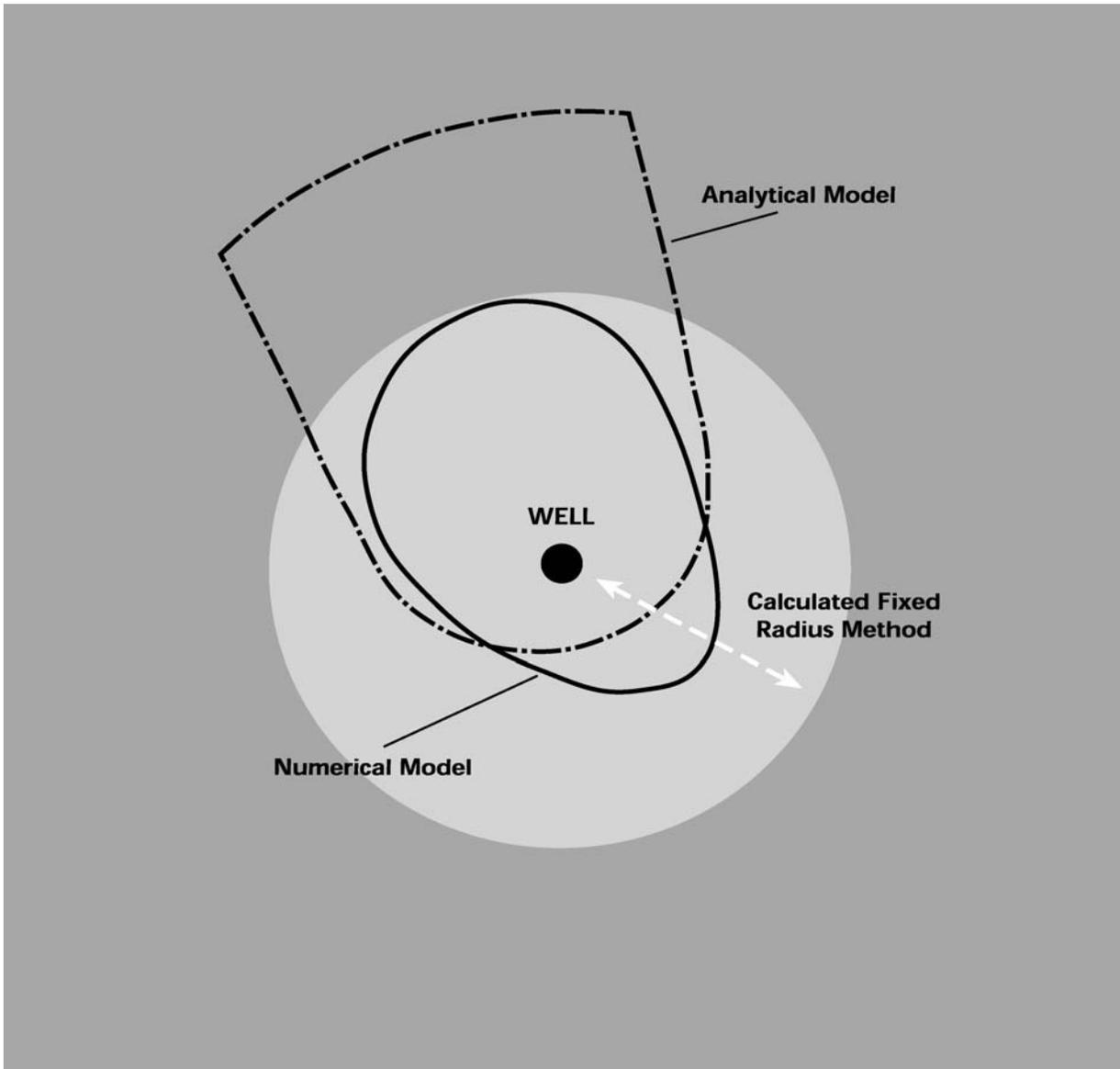
Boundary Limit

Legend:
 • Pumping Well

Where:
 Q = Well Pumping Rate
 K = Hydraulic Conductivity
 b = Saturated Thickness
 i = Hydraulic Gradient
 $\pi = 3.1416$

Source: U.S. Environmental Protection Agency, 1987.
Guidelines for Delineation of Wellhead Protection Areas.

**Figure 3. Wellhead Delineation Method Comparison*
10-Year Time-of-Travel Boundaries**



***Note:** This is a sample showing a comparison for 1 water system. Delineation at all wells may not follow this same pattern or exhibit similar differences.