**Section 570.APPENDIX J Sample Design Problem**

A livestock producer had 300 head of feeder cattle on a concrete feedlot (see Figure 1) and wanted to install a runoff field application system to control feedlot runoff which entered a nearby stream. The facility met the Conditions for System Utilization set forth in Section 570.202 and the runoff field application system was designed by following the procedure in Appendix A.

1. Site Specific Data

A. From Figure 1 and Appendix B:

|  |  |
| --- | --- |
| Concrete Feedlot Area | 20,038 sft. (0.46 acres) |
| Roof Area | 4,792 sft. (0.11 acres) |

All other drainage was diverted from the feedlot and field application area with gutters, curbs, and berms.

B. From the procedure in Appendix D, the slope of the field application area was 1.0%.

C. From the Soil Survey for the county the soil infiltration rate (SI) of the field application area was 2.0 inches/hour using the procedure in Appendix C (#3).

2. From Appendix B, runoff volume was calculated.

|  |  |  |  |
| --- | --- | --- | --- |
| Roof | 4,785 sft. x 0.1408 | = | 673.7 cft. |

|  |  |  |  |
| --- | --- | --- | --- |
| Feedlot | 20,037 sft. x 0.0991 | = | 1985.7 cft. |

|  |  |  |
| --- | --- | --- |
| Design Runoff Volume (VR) | = | 2660 cft. |

From Appendix B, the total drainage area was calculated.

|  |  |  |
| --- | --- | --- |
| 20,037 + 4,785 | = | 24,822 square feet |

3. Settling Basin Design

The total settling basin volume was calculated as provided in Section 570.204(a)(1).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 24,822 sft. | x | 4.5 cft. | = | 1117 cubic feet |
| 100 sft. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1117 cft. | x | .10 | = | 112 cubic feet |

|  |  |  |
| --- | --- | --- |
| Total Volume | = | 1229 cubic feet |

From Appendix I, the settling basin dimensions were calculated after choosing 3 feet settling basin height (h), 12 feet width (b), and 15:1 slope.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L1 | = | 3 x 15 | = | 45 feet |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| V1 | = | (½) (12 x 3 x 45) | = | 810 cft. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| V2 | = | 1229 - 810 | = | 419 cft. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L2 | = | 419 / (12 x 3) | = | 11 feet, 8 inches |
|  | Round-off L2 to 12 feet.  |

Foundation drainage tiles were not needed as the soil survey indicated the groundwater table did not rise above 5 ft. depth.

A 24-inch diameter riser pipe was provided pursuant to Section 570.204 (5) and concrete was chosen as the settling basin construction material.

4. Field Application Area Design

The field application area was calculated using Section 570.204(e)(4).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| FAA | = | 2660 x 12 | = | 31,920 | = | 13,818 sft. minimum area needed |
| (2 x 2.0) - 1.69 | 231 |

Appendix E was used to determine the dimensions of the field application area using the next larger sized area of 14,875 sft.

|  |  |
| --- | --- |
| Slope | 1.0% |
| Length | 425 feet |
| Width | 35 feet |
| FAA | 14,875 sft. (0.34 acres) |

5. Calculate Flow onto Field Application Area

The flow onto the field application area was determined using Appendix G as being approximately 40 gpm.

A more accurate calculation was made as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Qf | = | (0.0026) | x | FAA |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Qf | = | (0.0026) | x | 14,875 sft. | = | 38.7 gpm |

6. Effluent Transport System Design

A pipe was chosen to transport the settling basin effluent to the distribution manifold and was designed using Appendix F at the 179 gpm criteria (since this pipe design could handle 38.7 gpm).

Slope 0.5%

PVC non-perforated pipe

Diameter of pipe – 6 inches

7. Junction Box Design

A junction box was constructed to the specifications provided in Appendix H.

Adjustable slots were included in the drop boxes to compensate for frost heaving of the junction box in the future.

8. Distribution Manifold Design

The distribution manifolds were designed using the ½ Pipe criteria at 150 gpm as provided in Appendix H.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Length of each manifold | = | 35 feet - 2 feet | = | 16.5 ft. |
| 2 |

An 8-inch diameter PVC pipe (17 feet long) was purchased and cut in half down the pipe length to provide 2 manifolds each 4-inches deep. Each manifold had 6 inches removed to provide the required length of 16.5 feet.

Tin snips were used to cut V-notch weirs 12 inches apart on center on one side of each manifold with each notch cut 1.5 inches wide and 2.5 inches deep.

The two distribution manifolds were placed in the previously installed junction box (the junction box was located in the center of the field application area width). Caps were provided over the outside end of each distribution manifold and ⅛- inch wire staples were used to anchor each manifold at 5 foot spacings.

A 1-foot wide pea gravel splash apron was provided below the V-notch weirs over the length of each manifold.

Figure 1: Sample Design Problem

