design of pump lines for any given pipe size (providing the pipe would withstand pressure created) any given quantity of water may be pumped through the line by increasing or decreasing the power applied to the pump. Therefore, it may be readily seen (Fig. 5) that the maximum pressure on a pump line normally occurs at the pump or at a lower point in elevation along the pipe relatively near the pump.

For an example, using Fig. 5, assume the need to deliver 10 gpm to 50 ft through a 1.5-inch line. The elevation difference between 0 and 50 ft is 175.0 ft. The friction loss in the 1.5-inch pipe flowing 10 gpm would be 8.6 ft/1,000 or 43.0 ft total for the 5,000 ft of pipe. Neglecting minor losses, the total head would equal the elevation difference plus friction loss, or 218.0 ft at O-00.

On gravity and pump lines, the maximum pressure on any segment of the line should be checked. The maximum pressure occurs where the hydraulic gradient or the static head is a maximum distance above the center line of the pipe. This head in feet is easily converted to pressure in lb/in² (P).

\[ P = 62.4 \times \text{Head in ft} \]

VII. Pumping Plant.—Pumping water for livestock considerable distance against a high head normally requires only small pumping plants. Horsepower is an expression of the time rate of doing work. Work is defined as a force (lb) moving through a distance (ft). One horsepower is defined as 550 ft-lb/second or 33,000 ft-lb/minute. The first step in determining power requirements is to determine the waterhorsepower required.

When \( Q \) = Quantity of flow in gpm.

\[ \text{Water HP} = \frac{8.33Qh}{3,960} = \frac{Qh}{3,960} \]

With a gasoline engine it may be safely assumed that an overall pumping plant efficiency of 50% could be obtained. This includes pump efficiency, transmission efficiency, and efficiency of the engine itself. In the sample problem an engine of 1.1 rated horsepower should be sufficient. Selection of a power unit for this system would probably be a 1.5 horsepower engine. Care must be taken in selecting pump and engine and matching them in respect to performance data. Performance data is available from the manufacturers.

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TECHNICAL NOTES

Mortality of Rock Goldenrod in Sagebrush Stands Sprayed With 2,4-D

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Highlight

Rock goldenrod, an undesirable range plant, was sprayed with 2,4-D incidental to a sagebrush-control project on the Ashley National Forest. One-half to two-thirds of the rock goldenrod plants sprayed at the rate of 2 pounds per acre were killed. This application killed all mature sagebrush.

Sagebrush-control projects on the Ashley National Forest north of Vernal, Utah, provided an opportunity to determine if 2,4-D will kill rock goldenrod (Petrororia pumila (Nutt.) Green). Rock goldenrod is an undersirable range plant that grows in a wide altitudinal range (3,500-11,000 ft) extending from Wyoming and southeast Idaho, south into northern Arizona and New Mexico, and west to the mountains of California's Mohave Desert (Anderson, 1963). Rock goldenrod is not eaten by livestock or big game (U.S. Forest Service, 1964), nor is it a good soil binder because it has a taproot with few laterals near the surface.

Some cattlemen believe that rock goldenrod has increased in amount and distribution on the south slopes of the Uinta Mountains during the last decade. However, quantitative records are not available to confirm this belief. The form of rock goldenrod in this area is P. pumila ssp. pumila (Anderson, 1963). It grows with other forbs and with grasses in the understory of big sagebrush (Artemisia tridentata Nutt.) communities, and is most abundant on rocky ridges and other areas with shallow soils. It is also abundant in some areas on deep soils that have been cultivated and seeded to introduced grasses.

This paper does not report a “study” of the usual sort—merely some observations incidental to the sagebrush control projects mentioned above. Since rock goldenrod
An Adaptation of the Grazed Plant Method for Estimating Utilization of Thurber Fescue

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Highlight

The grazed plant method of estimating utilization is sometimes inadequate because a large percentage of the plants may be grazed lightly. Utilization by weight may be no more than 40% when 100% of the plants are grazed. An adaptation of the grazed plant method aimed at overcoming this weakness has yielded very gratifying results for Thurber fescue in the Central Rocky Mountain area.

A vital factor in good range management is proper stocking.

Proper stocking, in turn, is based on proper utilization of the key forage species. To maintain proper stocking then, a manager must have an efficient method for estimating utilization.

Several methods for estimating utilization of range plants have been described. The use of these methods has met with varying degrees of success and satisfaction to the user. For use on National Forest allotments, a

### Table 1. Density of rock goldenrod one year after spraying with 2,4-D.

<table>
<thead>
<tr>
<th>Spray date</th>
<th>Site description</th>
<th>No. of 9.6-sq.-ft. plots</th>
<th>Av. no. plants per plot</th>
<th>Percent kill</th>
</tr>
</thead>
<tbody>
<tr>
<td>June, 1962</td>
<td>Scattered sagebrush shallow soil</td>
<td>20</td>
<td>2.6</td>
<td>4.4</td>
</tr>
<tr>
<td>June, 1963</td>
<td>Scattered sagebrush shallow soil</td>
<td>40</td>
<td>3.6</td>
<td>5.4</td>
</tr>
<tr>
<td>June, 1963</td>
<td>Moderate sagebrush deep soil</td>
<td>100</td>
<td>4.2</td>
<td>4.4</td>
</tr>
</tbody>
</table>

1 Counts 2 years after spraying showed 66% kill.