**Problem Statement**

- **Increased runoff**
  There is increased runoff at the Throckmorton-Purdue Agricultural Center due to newly constructed buildings (See Figures 1 and 2).

- **Inadequate drainage system**
  All of the runoff is currently being directed into a broken six-inch clay tile. The capacity of the tile is inadequate. The clay tile is breaking down and creating blowholes in the field (See Figure 4). Increased erosion and standing water is occurring as a result.

- **Potable water wells**
  Land around two potable water wells on the east side of the project site is currently cultivated with the rest of the field with standard farm practices taking place around the wells. There is a concern for potential water contamination by pesticides (See Figure 3).

A new drainage design is needed to redirect runoff to the open ditch east of the site while protecting existing, underground utilities.

**CONSTRANTS**

- **Design should:**
  - Protect underground utilities
    - 2 High pressure gas lines
    - 2 Potable water wells
    - Water lines
    - Electrical lines
    - Communication cable
  - Allow farm equipment to cross design on east side
  - Reduce erosion at ditch outlet on east side of field
  - Be easy for farm managers to maintain

**Alternative Solutions**

- Grass waterway
- Combination of grass waterway with tile replacement
- Replace tile with solid tile instead of slotted
- Additional breather pipes and/or concrete structure for surface drain

The farm managers would prefer subsurface drainage to maintain farmable acres and reduce costs. Since replacing the existing tile can provide the water capacity necessary at the lowest cost, it was the chosen solution.

**Cost Estimate**

Table 1. Construction and Materials Cost Estimate.

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Unit</th>
<th>Cost/unit</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>10&quot; slotted tile</td>
<td>900</td>
<td>feet</td>
<td>$3.10</td>
<td>$2,790.00</td>
</tr>
<tr>
<td>10&quot; Smooth core outlet pipe</td>
<td>20</td>
<td>feet</td>
<td>$4.40</td>
<td>$88.00</td>
</tr>
<tr>
<td>10&quot; tile installation *</td>
<td>40</td>
<td>hours</td>
<td>$86.00</td>
<td>$3,440.00</td>
</tr>
<tr>
<td>Laborer</td>
<td>40</td>
<td>hours</td>
<td>$31.00</td>
<td>$1,240.00</td>
</tr>
<tr>
<td>RipRap + installation</td>
<td>7</td>
<td>tons</td>
<td>$37.00</td>
<td>$259.00</td>
</tr>
<tr>
<td>8&quot; riser pipe</td>
<td>1</td>
<td>pipe</td>
<td>$35.00</td>
<td>$35.00</td>
</tr>
<tr>
<td>8&quot; tap tees</td>
<td>5</td>
<td>50</td>
<td>$3.50</td>
<td>$17.50</td>
</tr>
<tr>
<td>Seeding **</td>
<td>0.5</td>
<td>acres</td>
<td>$1,057.00</td>
<td>$528.50</td>
</tr>
</tbody>
</table>

Total: $8,398.00

* assumes 100 hp backhoe, 20-60 feet/hr installed + backfit
** Includes broadcasted seed, broadcasted fertilizer, mulched straw

**Final Design**

Given the increased runoff, and after considering alternate solutions, the best solution is to replace the existing clay tile with a 10" plastic, slotted tile in the same location as the existing tile. The location of the current and proposed tile is shown in Figure 1, the details for the design are shown in Table 2, and the elevation profile for the tile is illustrated in Figure 6. The estimated cost of this design is shown in Table 1.

**Design Process**

**Estimating Flow Rate**

\[
Q = \frac{Q_i}{n} \left( C_{ij} \right)^{2/3} \left( \frac{1}{2} \right)^{1/2} \]

\[
Q = \text{estimated flow rate}
\]

\[
A = \text{drainage area}
\]

\[
C = \text{runoff coefficient}
\]

\[
i = \text{rainfall intensity}
\]

**Calculating Maximum Allowable Discharge**

\[
V = \frac{n}{R}
\]

\[
V = \text{average flow velocity}
\]

\[
C_{ij} = \text{unit conversion}
\]

\[
R = \text{friction slope}
\]

\[
n = \text{Manning roughness coefficient}
\]

\[
q = \text{maximum allowable discharge}
\]

\[
V = \text{average flow velocity}
\]

\[
A = \text{cross sectional area of pipe}
\]

**Project Sponsor**

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