**PROBLEM STATEMENT**

Yarbrough Elementary School was constructed in 1998 on land donated to the City of Auburn School Board. The property has a significant problem with erosion around the primary outdoor staircase south of the school building, and off the lower playground near the southeast corner of the school building. The property has steep slopes that exceed 10%, and contribute high velocities and volumes of runoff. Mr. Forester, the Principal of the school, has noted that he spends approximately $1,000 a year to replace pine-bark mulch that is washed away from the playground. He has expressed interest in remedying the erosion issues, and developing an education plan for the student body. IMGZ Design has been given a budget of $5,000 to complete the aforementioned goals, and plans to do so with the implementation of a grass channel, a new natural curb system off the lower playground near the southeast corner of the school building. The property has a significant problem with runoff volumes. Mr. Forester, the Principal of the school, has noted that he spends approximately $1,000 a year to replace pine-bark mulch that is washed away from the playground. The rip rap aprons will slow the velocity and flow rate of the runoff next to the staircase, and the new environmental engineering lesson plan meet the clients needs. The berm is large enough to direct runoff from a 10 year, 24 hour storm; resulting in a 25% Runoff Reduction Credit preventing downstream flooding.

**DESIGN OBJECTIVES**

1) Manage loss of mulch from lower playground
   - Divert runoff from 10-year, 24-hour storm around playground using earth berm
   - Gain a Runoff Reduction Credit of 25% from a 10-year, 24-hour storm using the grass channel and rip rap check dams
   - Improve aesthetic appeal, and upgrade safety of playground perimeter
   - Reduce $1,000 in annual spending on mulch replacement
2) Manage erosion around staircase.
   - Minimize loss of soil from the sides and at turning points of staircase and accessibility ramp with rip rap aprons
   - Slow velocity and flow rate of runoff flowing down the slope
3) Engineering education
   - Introduce simple environmental engineering concepts
   - Promote interest in environment conservation and STEM careers

**SITE LOCATION**

Yarbrough Elementary School
Auburn, Alabama

**PROPOSED SITE PLAN**

**ANALYSIS OF DESIGN COMPONENTS**

1) Grass Channel with Check Dams
   - 300 ft. long, 12 ft. wide, 3 ft. deep, and graded to match the existing elevation
   - Slow the velocity of water to 0.5 ft/s to detain and treat the runoff from a 10-year, 24 hour storm; resulting in a 25% Runoff Reduction Credit
   - Check dams: 2.5 ft. tall, 5 ft. wide, and made of rip rap ranging from 0.5 – 1 ft. in diameter
   - Slow the velocity of water to 0.5 ft/s to detain and treat the runoff from a 10-year, 24 hour storm; resulting in a 25% Runoff Reduction Credit

2) Berm with Gravel and rubber perimeter
   - Berm will have a brick core to increase strength; 4 ft. wide, 1 ft. tall, and 120 ft. long
   - Sized to divert the runoff velocity of 0.68 ft/s, and a peak flow of 0.38 cfs from 10-year, 24 hour storm
   - Hedges add aesthetic value, and act as safe, environmentally friendly barrier
   - Berm height: 2.5 ft. tall, 5 ft. wide, and made of rip rap ranging from 0.5 – 1 ft. in diameter

3) Rip Rap Aprons
   - Designed for peak flow of 0.76 cfs for the worst case for 10 year, 24 hour storm
   - Designed for peak flow of 0.76 cfs for the worst case for 10 year, 24 hour storm
   - Largest apron: 13 ft. long, 2.5 ft. wide, and 4 ft. deep

**STUDENT ENGAGEMENT**

- Education packet consisting of a presentation, 5E lesson plan (Engage, Explore, Explain, Elaborate, and Evaluate), and an assessment quiz for the elementary school students.
- The 5E document is broken down into stages for a simplified manor in which to digest the information.
- The presentation provides a third to fifth grade education level of environmental knowledge, STEM program, and I.D practices from IMGZ Design’s proposal.
- The quiz will evaluate the level of comprehension.
- The program is intended to last the duration of one class period.

**COST ANALYSIS**

<table>
<thead>
<tr>
<th>Items</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Design[1]</td>
<td>$4,478</td>
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<tr>
<td>Labor Cost[2]</td>
<td>$139</td>
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<td>5% Contingency</td>
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<tr>
<td>Total Cost</td>
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</tbody>
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[1]: Includes labor cost for grass channel. Design cost: $57 for check dams, $100 for rip rap, $17 for berm and gravel, $140 for playground border, $2160 for grass channel.

**SUMMARY**

The combination of the grass channel with its rip rap check dams, the earth berm with the brick core and the English Boxwood hedges, the rip rap aprons around the staircase, and the new environmental engineering lesson plan meet the clients needs. The berm is large enough to direct runoff from a 10-year, 24 hour storm around the playground into the grass channel, while improving the aesthetic of the area. In the channel, the runoff will be treated and give the property a 25% Runoff Reduction Credit preventing downstream pollution, and the clogging of storm drains. The rip rap check dams will trap whatever pine-bark mulch is washed away from the playground. The rip rap aprons will slow the velocity and flow rate of the runoff next to the staircase, while holding the remaining top soil in place. Finally, the new lesson plan will introduce basic environmental engineering concepts while teaching the students about environmental stewardship.

**ACKNOWLEDGEMENTS**

Special thank you to the following gentlemen for their contributions throughout the design process:
- Mr. Jon Davis, P.E. – Senior Design Instructor, Project Advisor, Biosystems Engineering
- Dr. Jeremiah Davis, P.E. - Senior Design Instructor, biomass Engineering
- Dr. Mark Dougherty, P.E. – Senior Design Instructor, Biosystems Engineering