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## **Executive Summary**

Glen Burnie High School is a campus style high school located in Glen Burnie, MD. The campus is comprised of 6 buildings, but for the purposes of this report, only Building E was evaluated. Building E is the Physical Education Building and features a constant air volume system served by 9 air handling units with finned tube radiators, convectors and cabinet unit heaters acting as supplemental heat. There is also an individual unit ventilator serving the gymnastics area. As part of the current mechanical renovation, Building E is receiving a new chiller which will only serve Building E. Heating water is supplied to the building by steam boilers located in Building F.

The current system designed for this renovation was able to adequately meet the needs detailed by the client. However, there are other options that could potentially save the owner money while still performing at a level that meets or exceeds the current system. Based on the available ground area on the campus, a Ground Source Heat Pump system was selected to replace the air-cooled chiller. Ground loops were sized to meet 105 tons of the required 120 tons and installed under the baseball field next to Building E. This allowed for a major reduction in the size of the chiller from 155 tons to 20 tons. As a trade-off, new pumps were installed to circulate the ground water and a new heat exchanger was needed to cool the building's chilled water supply.

Building E has not had any recent window replacements. The windows that are currently in place are older single pane models which suffer from old age and poor thermal performance. As an architectural breadth the existing windows were replaced with newer Insulating Glass Units and windows were added to the previously windowless Southern façade. In addition, the gymnasium's window layout was reconfigured from multiple fixed windows to a single strip window layout. This matched other windows of the building and gave the façade a more modern look. The new windows performance had an effect on the HVAC design and the lighting of the spaces due to the increase in available ambient light. Overall, the renovation was able to significantly reduce the heating and cooling loads of the building by reducing summer season heat gain and winter season heat loss.

An evaluation of the changes to the schedule and cost estimate associated with the GSHP system and window renovation was performed as a construction management breadth. Neither the window renovation nor the Ground Source Heat Pump system had an effect on the construction schedule because neither is associated with the critical path of the renovation. When removed equipment savings are considered, the costs of both alterations are roughly the same at \$50,846 and \$51,273 for the window and GSHP systems, respectively. Based on the energy rates and associated savings, payback periods were calculated to be 17.1 years for the GSHP system and 9.7 years for the window renovation. If both alterations are considered together, then a total cost of \$102,119 and annual savings of \$8,273.71 averages the payback period to 12.3 years.