Executive Summary

One alternative was considered in this analysis because all the changes made were linked to one another and depended upon the previous change of work. In this analysis, the existing mechanical system in Hunter's Point South School was compared against the institution of a dedicated outdoor air system with fan-powered inductions units for the terminals. With the changes made to this DOAS/FPIU design, a secondary chilled water loop was created to distribute a higher temperature chilled water to the FPIU's cooling coils. Total energy recovery wheels were used in both DOAS's to recover energy from the room exhaust air. Lastly, with the clearing of roof space a 68.99 kW photovoltaic solar system was installed on the roof. It was found that minor structural upgrades would have to be made to strengthen the roof deck/slab and girders under the solar array.

In comparing the costs, it was found that the new alternative would save $1,273,311 in upfront mechanical cost. This is more than enough to front the costs for the photovoltaic solar array and structural upgrades. When throwing these two items in, the new alternative saved $958,143 in initial costs. The new alternative also managed to save on electricity and natural gas usage. Electricity usage was reduced by 7% and natural gas by 41%. This led to a decrease in total energy costs of 13%. The natural gas had a huge decrease in use due to the addition of the total energy recovery wheels in the DOAS's being used to preheat the OA during the winter months. The wheels were able heat the OA so much that preheat coils were not needed in the DOAS's except as a backup for safety. With the energy and upfront savings, a 25 year life cycle-cost analysis was performed. Bringing both the costs back to a net present value found that the new proposed designs would save $2,018,185 over the existing design.

With the changing of the terminal units and air distribution to the rooms, a computational fluid dynamics (CFD) study was performed on a common classroom. This was done to determine if the new system's air distribution to the space would create a thermally comfortable and draft free environment for the students during the winter design peak. The current variable air volume box design was also tested for full flow and 30% turndown. The analysis focused on the area of the room occupied by the students because this was felt to be the most critical zone. In the new FPIU layout, it was found that the room had a uniform temperature gradient right at the setpoint temperature of 72°F with no drafts being caused in the student section. The two VAV layouts produced problematic results. It was found that the space was being overheated in both scenarios and a huge draft problem occurred in the 30% turndown case. From the results of the CFD analysis, it was determined that the new FPIU layout would create a thermally comfortably, draft-free environment for the occupants.

A big objective of the redesign of the mechanical system was to create a more sustainable, green building with increased comfort control. Temperature control of rooms will be greatly increased because the FPIU's allow for extra heating and cooling to be accomplished at each space. The new FPIU system will provide each room with the correct amount of ventilation air, something that is problematic when VAV boxes are turned down. The emissions of the new design reduced greatly. There was a 16% reduction in CO_2 equivalent. The photovoltaic solar array will produce emission free electricity for years. It can also serve as an educational function for students in teaching green technologies. Through all the changes proposed to Hunter's Point South School, a new cheaper, healthier schoolhouse will be created.