





often last 40 years if well maintained, air handling equipment often lasts 20-30 years if well maintained, and central plant equipment such as boiler and chillers often last 30-40 years if well maintained. Building Automation Systems will be included for the analysis when the Study moves into Phase II.

## DEFINITIONS

**AIR CONDITIONING (AC)** – A system capable of delivering 55 degree air into a space in sufficient quantity to keep room temperatures at or below 75 degrees on an ASHRAE summer design day. For the purpose of this study, the ASHRAE 1% Cooling Design has been selected. 91° F dry bulb and 60° F wet bulb. 1% criteria indicates that 1% of the hours of the year exceed this criteria. Therefore 87.6 hours of the year, this design temperature will be exceeded. It should be noted that some of these 87.6 hours will occur in July and the beginning of August before school starts.

**TEMPERED AIR** – A system capable of reducing outside air or a mixture of return air/outside air temperatures before the air is introduced into the space.

**AC Spaces** – Space types to be air conditioned

- x Classrooms
- x Office areas
- x Corridors
- x Cafeterias

**Non-AC Spaces** – Space types not to be air conditioned

- x Gyms (unless they are also used as the cafeteria)
- x Locker Rooms
- x Kitchens

**MZ** – Multizone air handling unit.

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## BUILDING ANALYSIS AND RECOMMENDATIONS

### NO TEMPERING OR AC

School	Replace Duct Due to Age	Replace Pipe Due to Age	Replace AC spaces equipment due to age	Replace Non-AC spaces equipment due to age	Equipment required to Add AC	Alternative to AC	Remarks
Barton	Yes, abandon UG duct	New pipe required to implement VUVs	Yes	Yes	Chiller. Pipe. VUV per classroom. RTUs for gym and admin	T	

School	Replace Duct Due to Age	Replace Pipe Due to Age	Replace AC spaces equipment due to age	Replace Non-AC spaces equipment due to age	Equipment required to Add AC	Alternative to AC	Remarks
Livermore	No	No	No	Yes	New AHUs with DX coils	Economizers only	VRV system should also be considered if AC is desired
O'Dea	Yes	Yes	Yes	Yes	Chiller. VUV for 1962/1966 areas. VAV box zoning, RTUs for 1994 areas	Tower. VUV for 1962/1966 areas. VAV box zoning, RTUs for 1994 areas	1962 UVs, AHU and 1966 MZs to be removed
Putnam	Yes, UG duct and 1966 area	No	Yes	No	Chiller. VUV for classrooms Add cooling coils to 1994 equip	Tower. VUV for classrooms Add cooling coils to 1994 equip	1955 bsmt MZ and 1966 MZs to be removed. Some 1994 DX units to be removed
Red Feather	No	No	No	No	Add DX coils to existing furnaces	Economizers only	VRV system should also be considered if AC is desired
Stove Prairie	No	No	No	No	Add DX coils to existing furnaces	Economizers only	VRV system should also be considered if AC is desired
Timnath	No	No	No	No	Chiller. VUVs. Improve building relief air	Tower. VUVs. Improve building relief air	1988 and 1992 UVs are approaching the end of their service life



School	Replace Duct Due to Age	Replace Pipe Due to Age	Replace AC spaces AHU equipment due to age	Replace Non-AC spaces
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## AIR CONDITIONED

School	Replace Duct Due to Age	Replace Pipe Due to Age	Replace AC spaces AHU equipment due to age	Replace Non-AC spaces AHU equipment due to age	New Equipment required	Remarks
Bethke	No	No	No	No	None	School was only visited for an example of non-traditional AC that is working well.
Fullana	Yes	NA	Yes	NA	New Furnaces in Early Ed area. New AHUs in Gym and Annex	Scheduled for 2017 work related to 2010 Bond
Rice	No	No	No	No	None	School was only visited for an example of non-traditional AC that is working well.
Wellington Middle School	No	No	No	Yes	Chiller, RTUS, VAV zoning	Building will be up for a major replacement in 7-10 years
Rocky	Yes, 1971 areas	Yes, 1971 areas	Yes	Yes	Chiller, RTUs, Duct, VAVs, Pipe	The whole bldg is due for a mechanical replacement

## SYSTEM AND ENERGY CONSIDERATIONS

## Air cooled chiller

- x For the current school calendar (no summer operation) this is an economical option that provides energy efficiency and a reasonable first cost. These systems will be carried into Phase II of the study.
- x Ice storage systems will not be considered as this study moves into Phase II. Only \$2,000 of savings is realized by adding ice storage. The

cost to add ice storage in a typical elementary or middle school would exceed a 20 year payback based on the current school calendar. Due to not operating in June and July, there is only one month where high peak demands costs due to cooling would be experienced (August).

#### Packaged VAV RTUs

- x For the current school calendar (no summer operation) this is an economical option that provides redundancy and a reasonable first cost. These systems will be carried into Phase II of the study for schools that lend themselves to a centralized RTU solution in lieu of a VUV solution.

#### Water cooled chiller

- x Water cooled chiller systems will not be considered as this study moves into Phase II, except for Rocky Mountain High School due to its size. Minimal savings is realized by utilizing a water cooled chiller. Due to not operating in June and July, there is only one month where high peak demands costs due to cooling would be experienced (August). Also, school is released before the hottest times of the day, and therefore largest chiller loads; most chillers see the maximum load between 3 and 6pm. Most schools are let out before or shortly after 3pm.

#### Ground Source Heat Pumps

- x

the school calendar – then a water to water heat pump system could be installed and replace the boiler and proposed chiller plants.

Cooling Tower Tempering

- x Due to the success of these systems at Irish, Riffenburgh, Kruse and McGraw, and because they are a less expensive and more energy