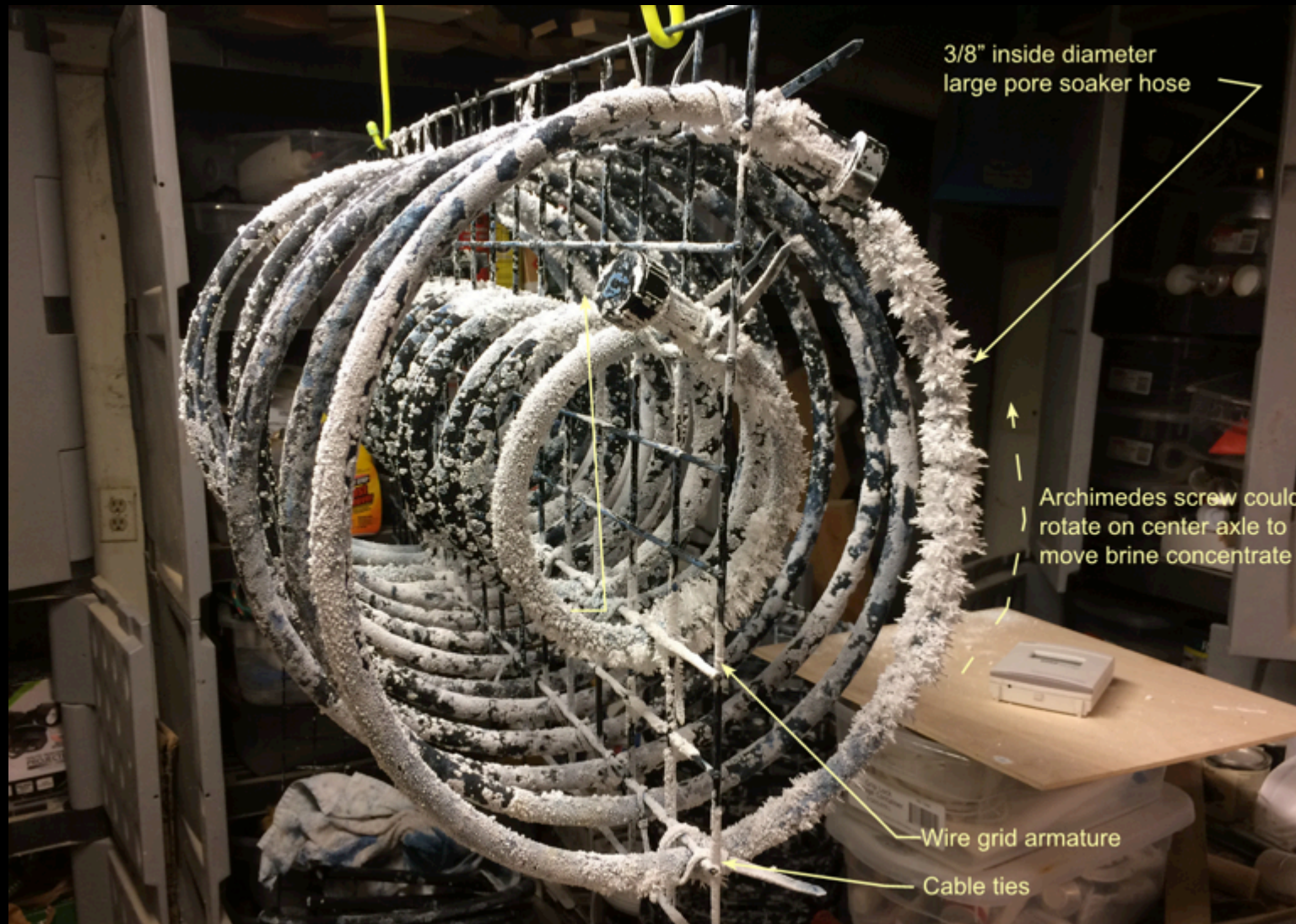


SunTunnel



Larry Kearns FAIA

Chicago, Illinois

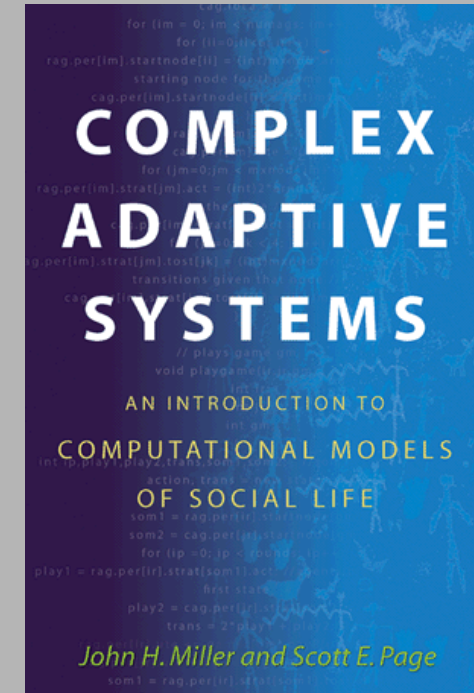
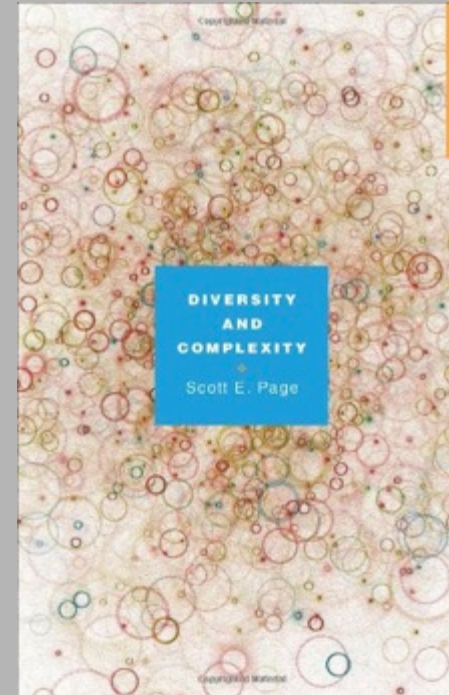
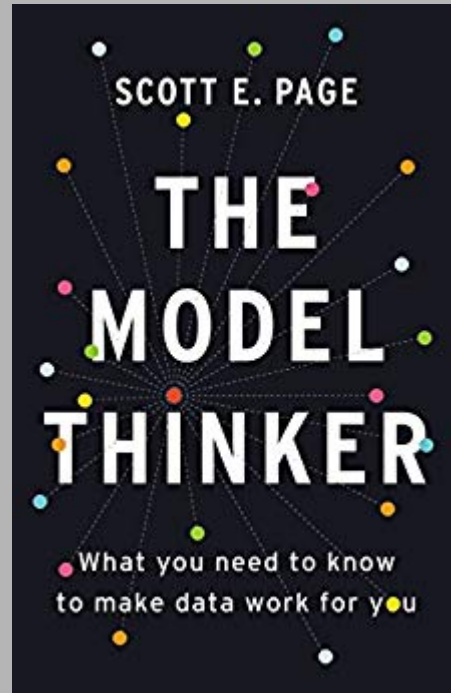
larry@wkarch.com



Day Job
Clockwise:

- The Momentary, Bentonville, AR
- University of Chicago Child Development Center, Chicago
- Intrinsic School, Chicago

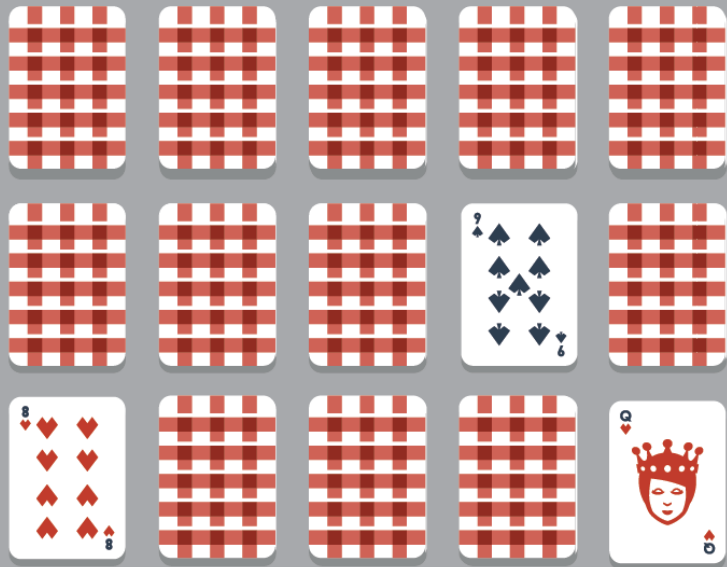




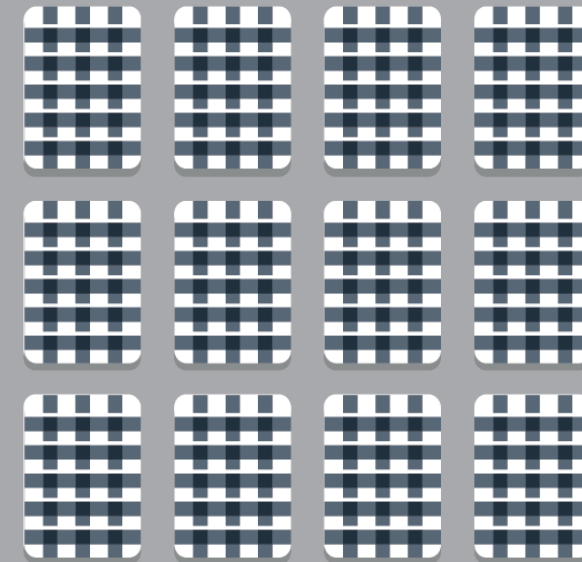
Scott E. Page



Recombination



15 Cards (Skills) out of 52
14.5 Trillion Possible Combinations



1:450,000,000 chance
that SHE has all HIS tools

Cognitive Diversity

Low Cost, Low Labor



+



Passive Solar Evaporation + Magnified Surface Area



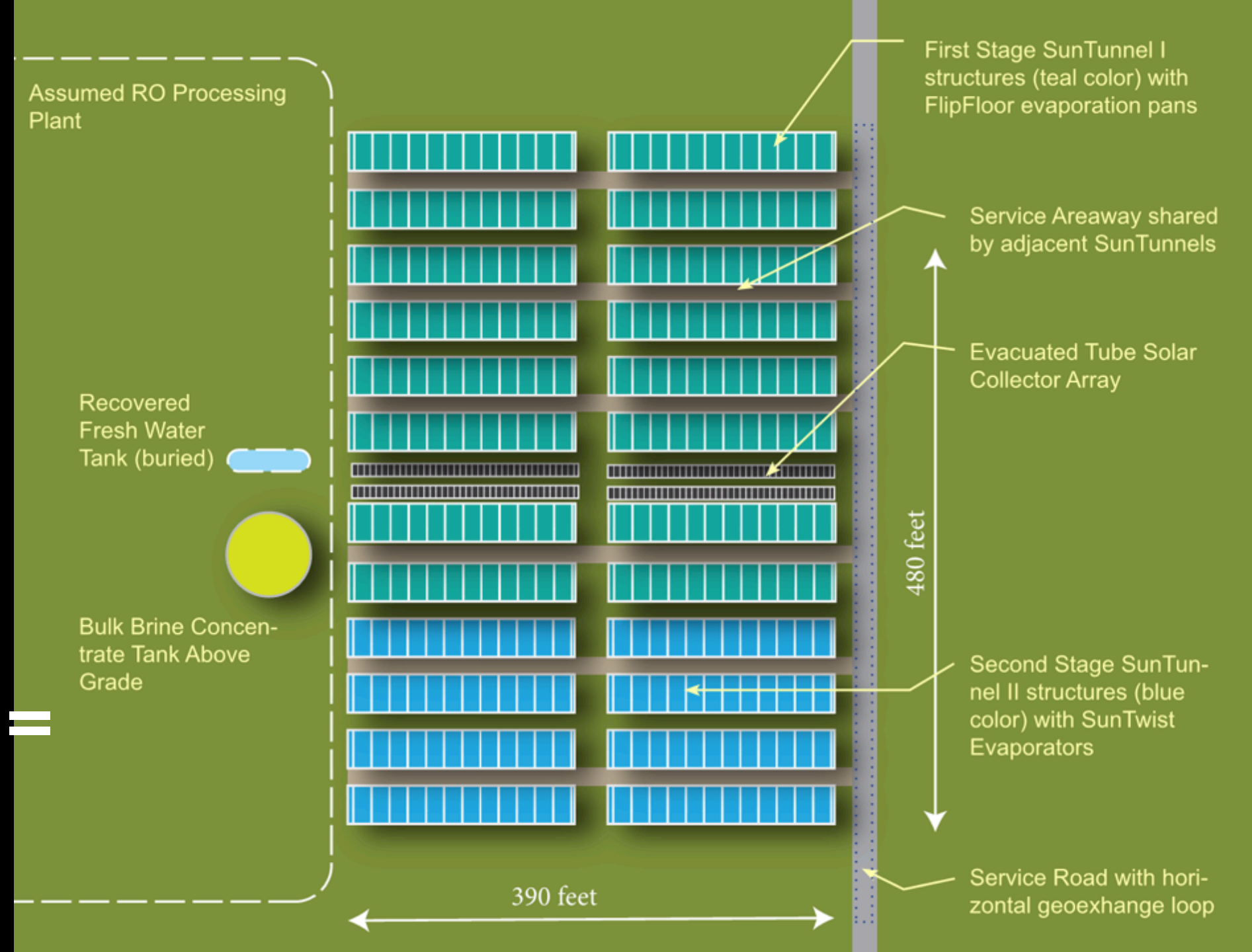
+

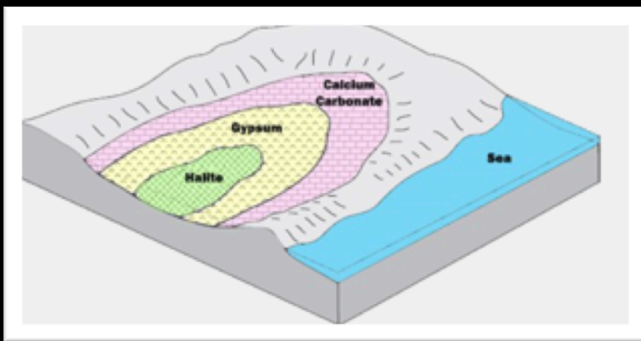




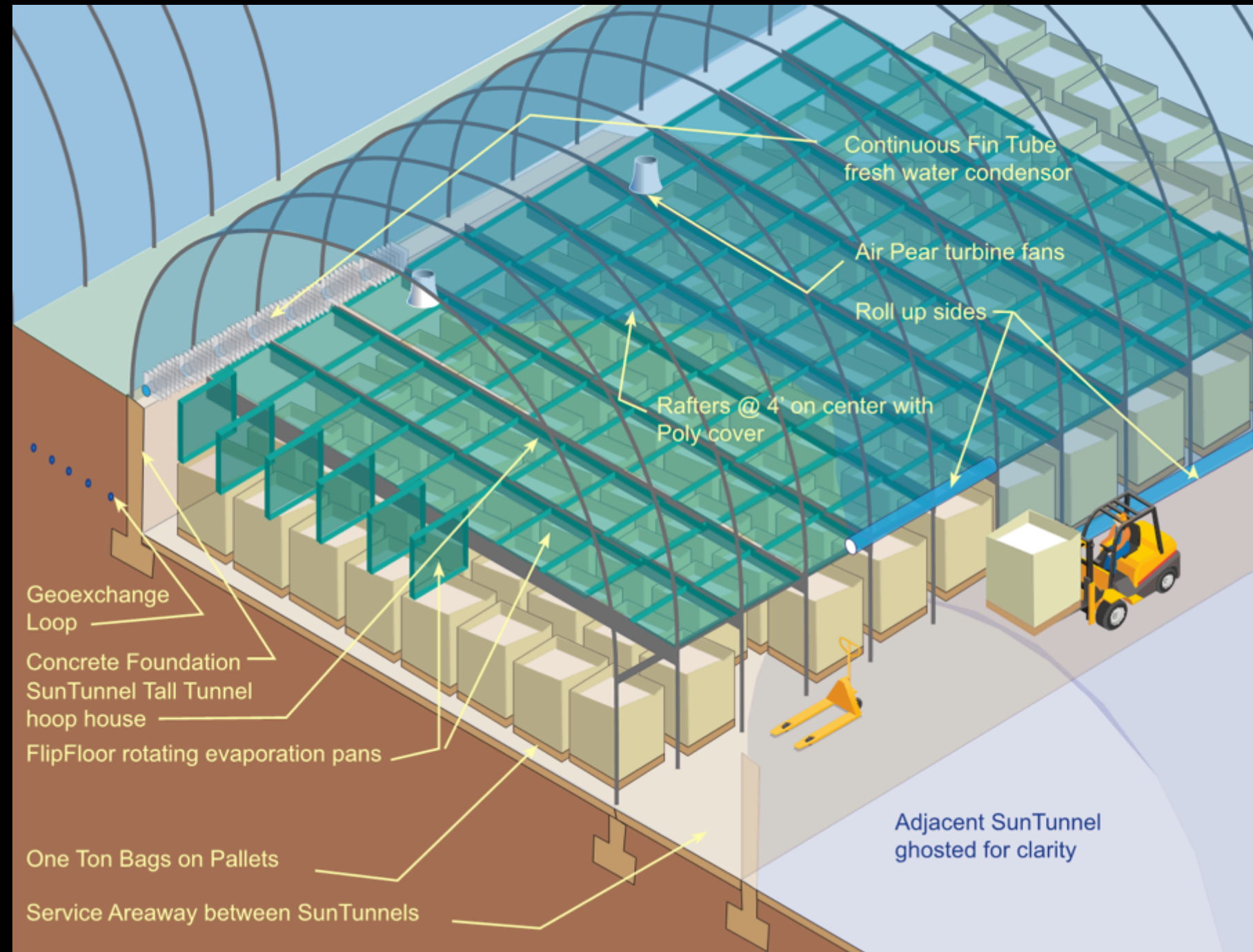
>100 Acres to 5 Acres

SunTunnel I



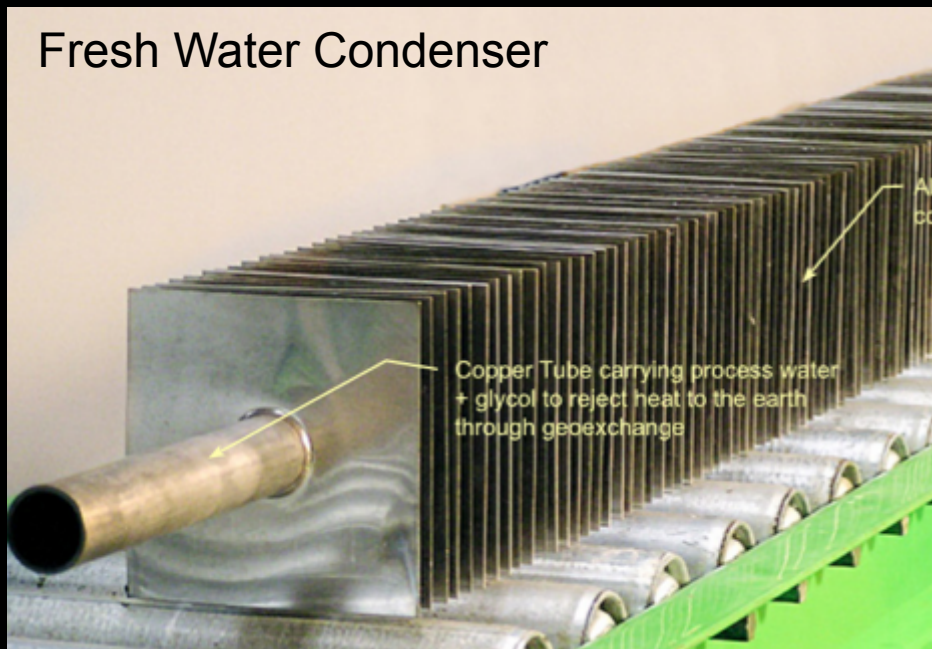


Outer Rings of Bull's Eye
Limestone, Gypsum



SunTunnel |

Fresh Water Condenser



Copper Tube carrying process water + glycol to reject heat to the earth through geexchange

One Ton Bags



Heat Pipe



Evacuated Tube Solar Water Heater

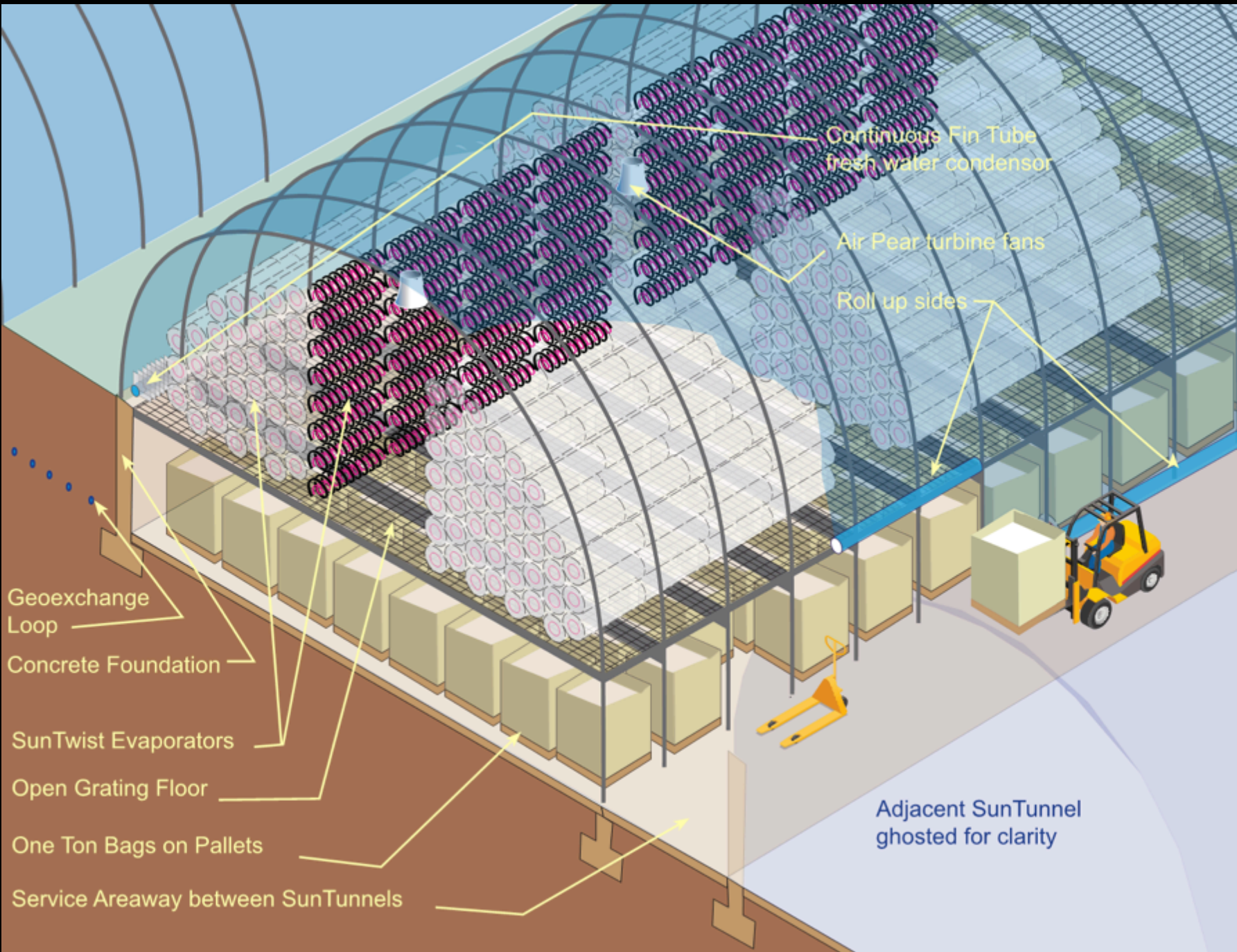


Air Pear Vortex





SunTwist Evaporator



SunTunnel

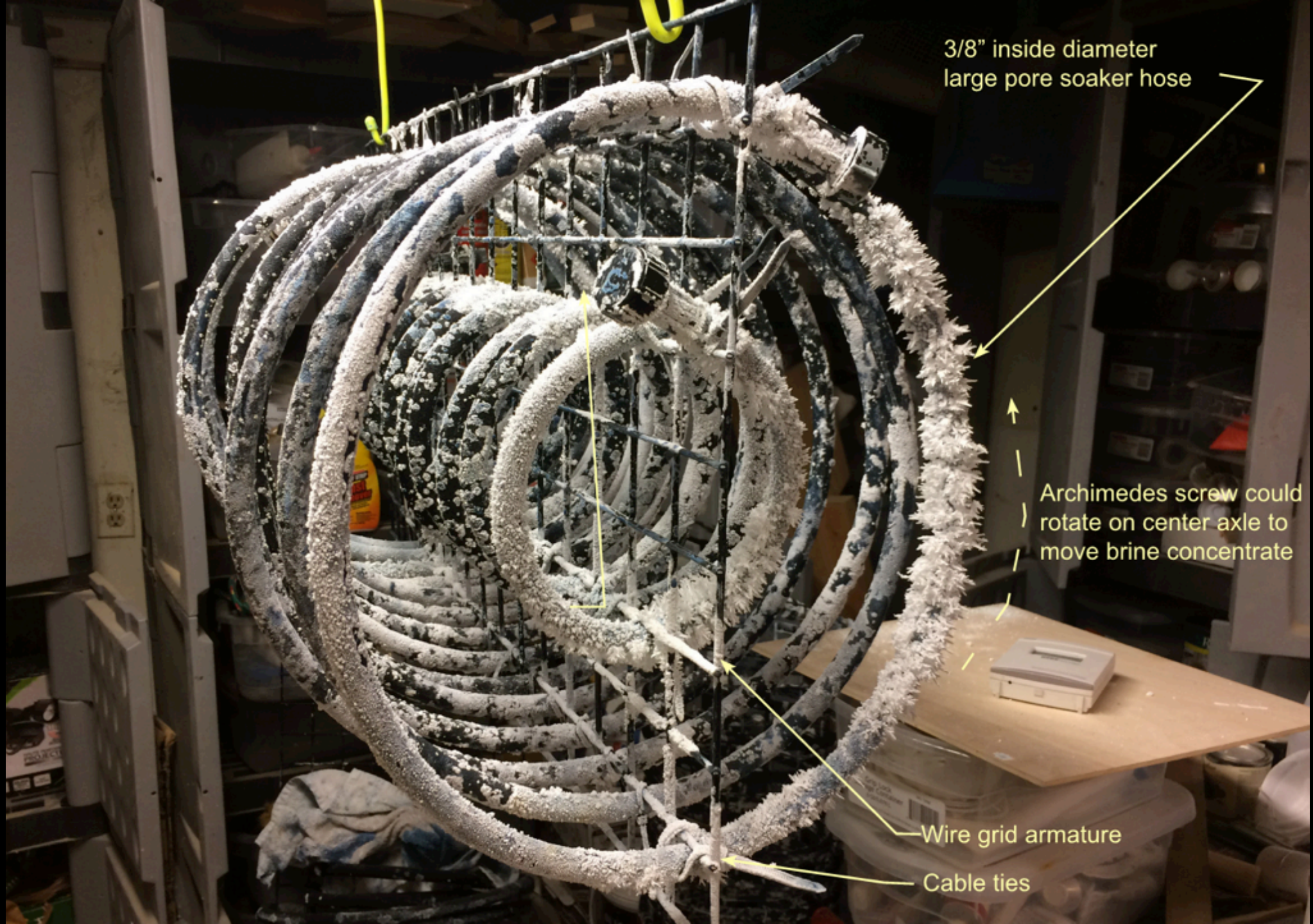


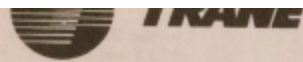
3/8" inside diameter
large pore soaker hose

Archimedes screw could
rotate on center axle to
move brine concentrate

Wire grid armature

Cable ties

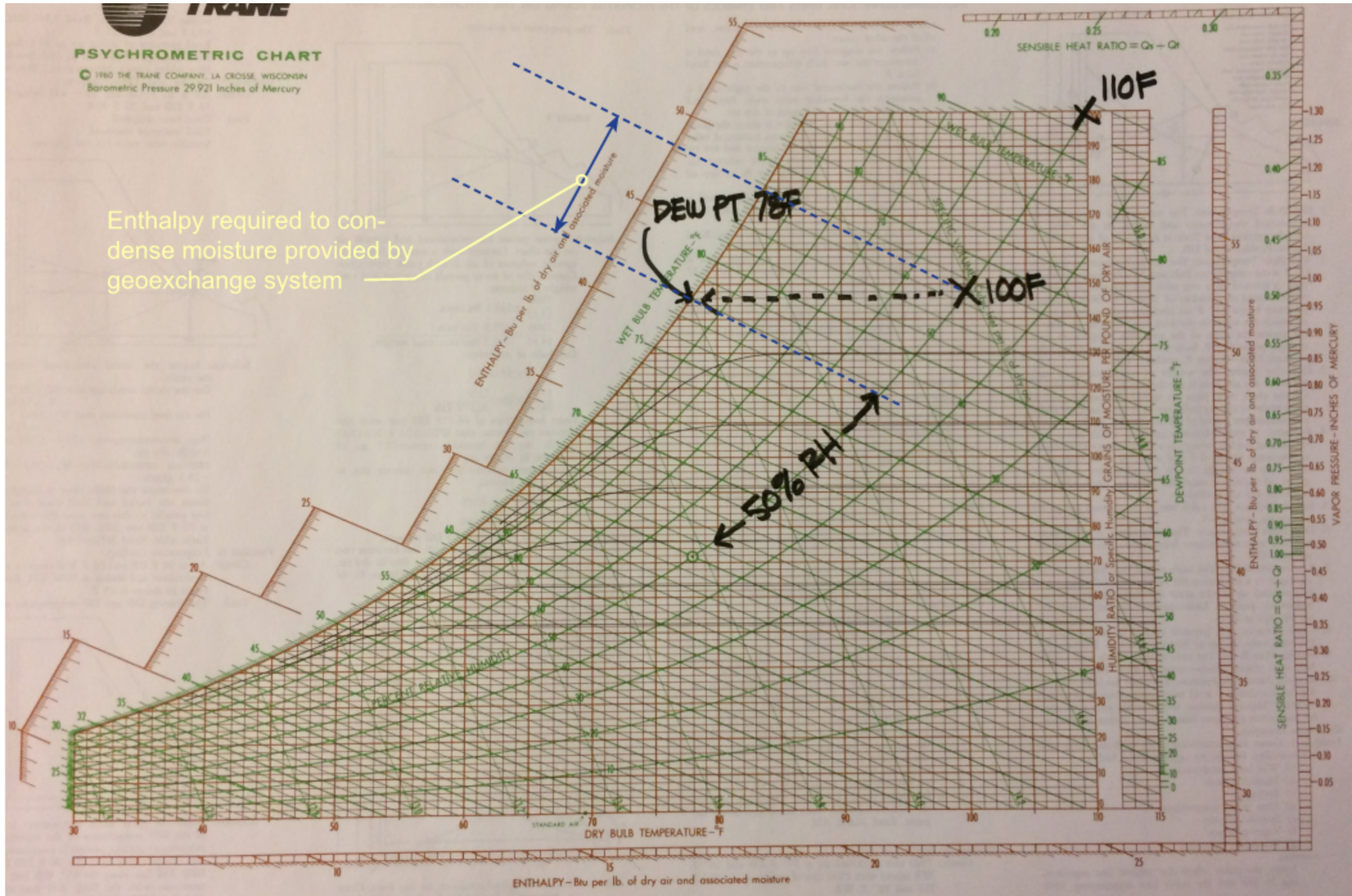




PSYCHROMETRIC CHART

© 1980 THE TRANE COMPANY, LA CROSSE, WISCONSIN
Barometric Pressure 29.921 Inches of Mercury

Enthalpy required to condense moisture provided by geoechange system



SunTwist Surface Area Calculations		
Length of Archimedes Screw	175 ft	input
Outside Diameter	0.82 inches	input
Outside Diameter (ft)	0.068 ft	calc
Length of Screw Footprint	3 ft	input
Width of Screw Footprint	1.5 ft	input
Surface Area of Each Nested Archimedes Screw	37.56 sq ft	calc

SunTunnel Footprint Tributary Area		
15' high Round High Tunnel		
Screws in Half Round Section	96 screws	input
Evaporative Surface Area per Section	3,605 sq ft	calc
Density Ratio	40	calc

SunTwist Emperical Test Results 72F 50RH		
96% Saturated NaCl Solution	4.5 cups	input
Cups Solution Remaining	2 cups	input
Cups Evaporated in 12 hours	2.5 cups	input
Gallons Evaporated Per 3/8 inch 50ft Screw	0.15625 gallons/50 ft	calc
Evaporation Rate 3/8 inch Screw Surface	0.000238 lb/hr/sf	calc
Effective Evaporation Rate at SunTunnel Density	0.010 lb/hr/sf	calc

Calculated Evaporation Rates at High Water Temperaturs by the Shah Correlations (2012a) Larger of Equations 1 and 2, IP Units (lbs/sf*hr)									
Water Temp °F	Air Temperature F and Relative Humidity % RH								
	90F			100F			110F		
	30%RH	AVG	70%RH	30%RH	AVG	70%RH	30%RH	AVG	70%RH
100	0.111	0.087	0.063	0.087	0.058	0.029	0.058	0.031	0.004
110	0.182	0.155	0.128	0.157	0.1225	0.088	0.27	0.1565	0.043
120	0.278	0.249	0.220	0.251	0.213	0.175	0.22	0.171	0.122
130	0.408	0.377	0.346	0.379	0.338	0.297	0.345	0.2915	0.238
140	0.58	0.548	0.516	0.549	0.506	0.463	0.513	0.456	0.399
150	0.805	0.7725	0.740	0.772	0.728	0.684	0.735	0.676	0.617
160	1.097	1.0645	1.032	1.063	1.019	0.975	1.023	0.964	0.905
170	1.471	1.4395	1.408	1.435	1.3925	1.35	1.395	1.3375	1.28
180	1.946	1.9165	1.887	1.91	1.8695	1.829	1.869	1.8145	1.760

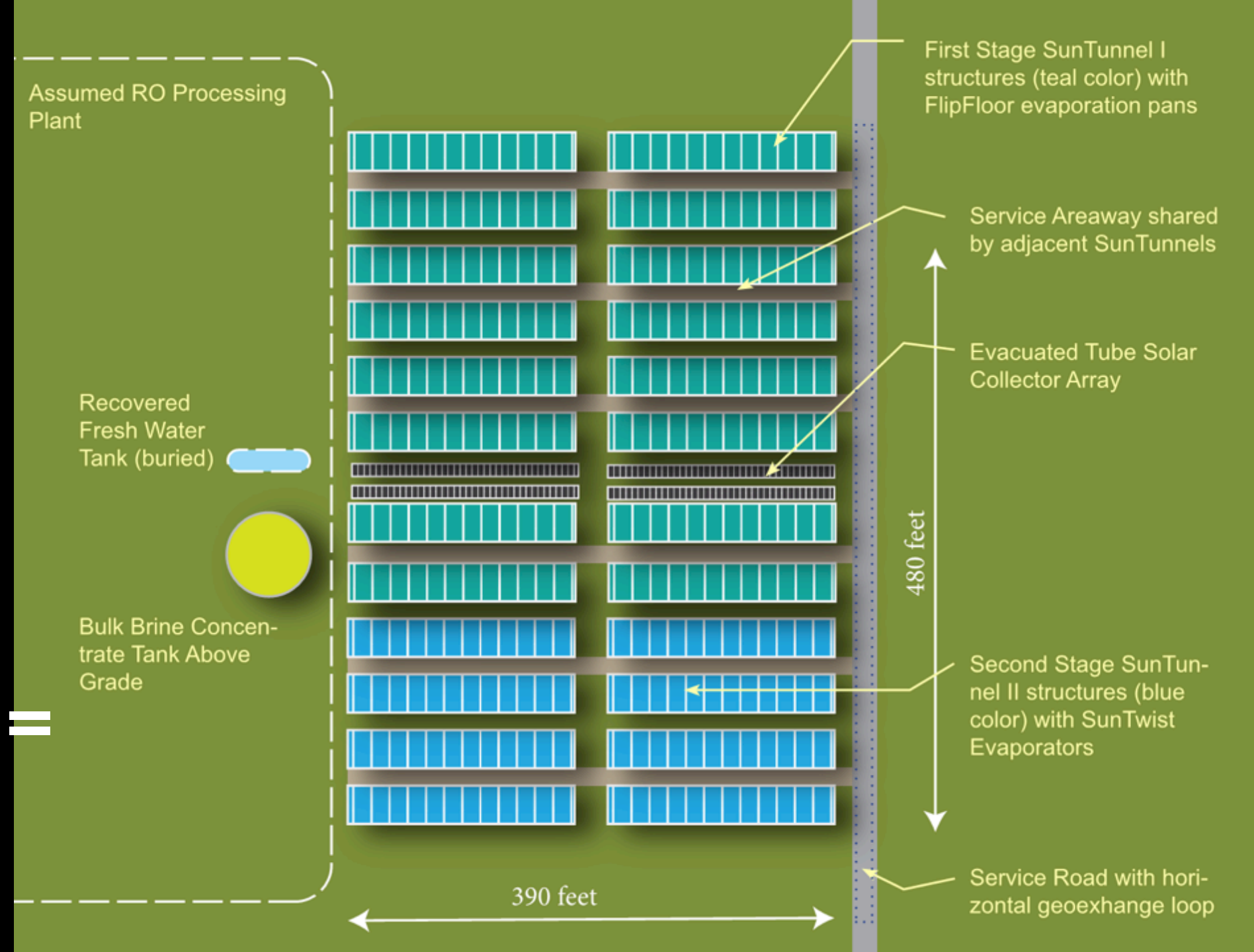
Feed Water Volume	1,000,000	gallons per day
Percent Waste	25%	
Resulting Brine Volume	250,000	gallons per day
Solar Operational Hours Per Day	12	hours per day
Resulting Brine Volume Per Hour	20,833	gallons per hour

At Atmospheric Pressure Heat Requirements to Boil		
Sensible Heat to 212F per gallon 70F water	1,179	BTU
Latent to evaporate per gallon water *1.06 for brine	8,534	BTU/ gallon
Enthalpy to heat + evaporate gallon of brine	9,713	BTU/gallon
Total heat required per hour	202,347,083	BTU/hr
Percent heat assumed recovered in closed system	99%	
Input Heat Required per hour	2,023,471	Btu/Hr

Evacuated Tube Collector Contribution		
Peak Radiation per sf sun	317	BTU/hr/sf
Heat per SF of Evac Tube Collector	227	BTU/hr/sf
Solar Energy Efficiency of Evac Tube Collector	50%	
Area of Evac Tube Collector (ETC) required	4,457	sf
Length of 6 foot tall ETC array	742.83	ft

SunTunnel Passive Solar Contribution		
Peak Radiation per sf sun	317	BTU/hr/sf
Solar Efficiency of Tall Tunnel	45%	
Resulting Heat per SF of Tall Tunnel	143	BTU/hr/sf
Percent Heat recovered in Tall Tunnel	80%	
Percent Heat Provided by Evac Tubes	50%	
Input Heat Required	20,234,708	BTU/hr/sf
Area of Tall Tunnel Required	141,855	sf
Acres of Tall Tunnel Required	3	acres
Width of Tall Tunnel	30	feet
Length of Tall Tunnel Required	4,729	feet
Number of 96' Tall Tunnels Required	49	tunnels
Total Cubic Feet of Brine (from above)	2,785	cu ft / hour
Total lbs of brine per hour required	173,958	lbs/hour
Total Evaporation Rate Required	1.22631	lb/hr/sf

SunTunnel I



SunTunnel

