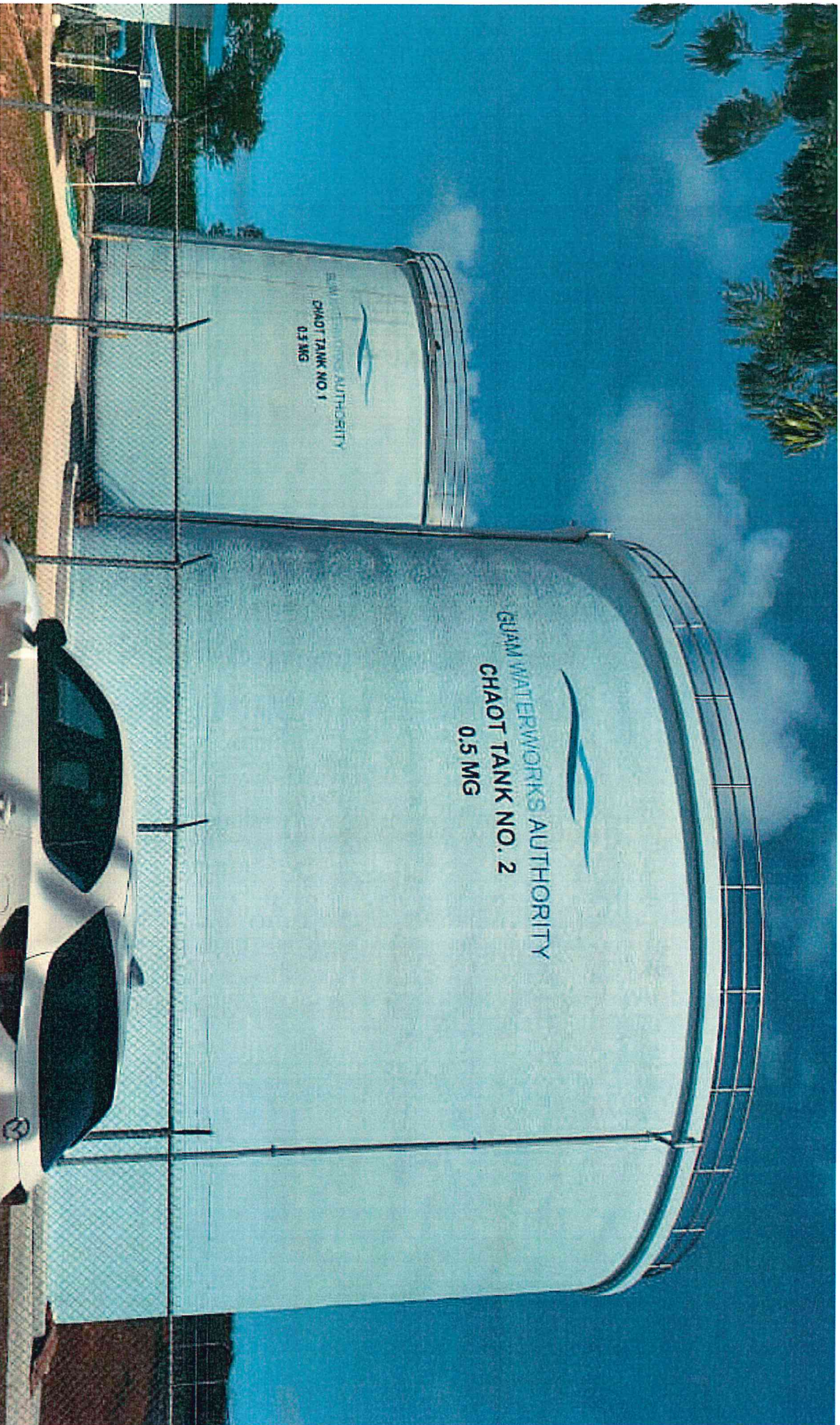


GUAM WATERWORKS AUTHORITY
YIGO TANK NO. 3
2.5 MG

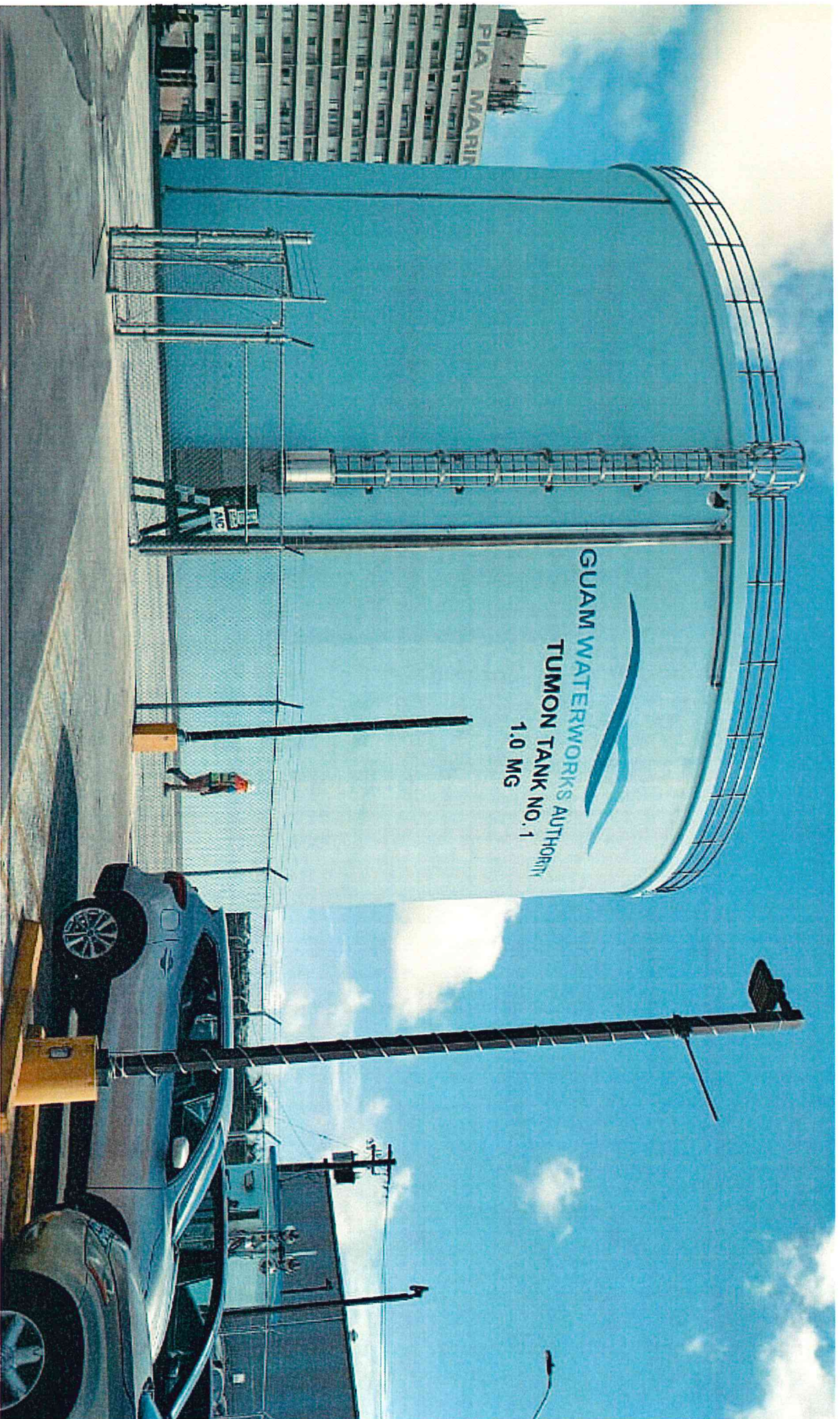
03/16/2022 08:55



GUAM WATERWORKS AUTHORITY
AGAT - UMATAC TANK
0.20 MG







JAM WATERWORKS AUTHORITY
YIGO TANK NO. 3
2.5 MG

GUAM WATERWORKS AUTHORITY
YIGOTANK NO. 2
2.0 MG



Analysis of pipeline renewal needs included the following two steps, which are described in more detail below:

1. Calculate total renewal needs per year.
2. Calculate which pipes need to be renewed per year using a risk-based approach.

A 20-year planning horizon was used to calculate pipeline renewal needs. As part of the analysis, a renewal needs model was run for 65 years. A renewal needs model is typically run for a long period to observe how the model reacts in later years. The renewal needs model results were then put into the context of the 20-year planning horizon.

8.4.1 Calculation of Total Renewal Needs per Year

The first step in prioritizing the renewal of distribution piping was to calculate total renewal needs per year using a long-term outlook. This step is described below.

8.4.1.1 Installed Pipeline Inventory

Existing pipeline data from GWA's GIS was used as an input to the renewal analysis because age and material of existing piping significantly impacts future replacement needs. Table 8-2 lists the length of piping by material and decade installed. As a comparison, Table 2-1 lists the length of piping by material and diameter.

Table 8-2. Length of Piping Installed by Decade

Years	Length of Piping (miles)								Percent of Length
	Asbestos Cement	Cast Iron	Ductile Iron	Galvanized	PVC	Steel	Unknown	Total	
1960-1969	1.1	16.4	1.3	-	6.1	-	0.3	25.2	4%
1970-1979	11.0	13.8	3.1	-	25.3	-	1.8	55.0	9%
1980-1989	1.7	9.9	19.3	-	52.7	-	9.6	93.3	16%
1990-1999	0.8	0.4	20.7	-	106.5	-	4.1	132.6	23%
2000-2009	0.4	0.0	4.1	-	15.2	-	0.1	19.8	3%
2010-2011	-	-	-	-	0.5	-	-	0.5	0%
Unknown	15.7	4.9	15.2	0.3	154.2	0.1	69.5	259.8	44%
Total	30.7	45.3	63.8	0.3	360.6	0.1	85.4	586.2	100%
Percent of Length	5%	8%	11%	0%	62%	0%	15%	100%	

Most piping in the GIS that did not have an installation date is expected to be PVC. Because the average installation date for most PVC in the system (for piping with known installation dates) is approximately 1990, and because a large amount of piping was installed in 1990 due to the island's high growth period, piping missing an installation date was assumed to be installed in 1990.

8.4.1.2 Service Life Curve Development

The renewal modeling calculations used estimated pipe service life values to develop service life curves, indicating how pipe assets will “survive” over time. The curves are similar to a human life expectancy curve with the majority of people surviving to middle age, some infant mortality, and the rest living to an old age. The curves were developed using a three-point method with the following three points:

1. The first point is the year at which 100 percent of the pipes within that group are expected to remain in service before they completely fail.
2. The second point is the year at which 50 percent of the pipes in that pipe category are expected to remain in service and the other 50 percent fail.
3. The third point is the year at which only 10 percent of the pipes remain in service.

A Hertz distribution function was used to randomly select pipe segments of each material type to model the failure of the complete set of pipes of each material type based on the length of time they have been in the ground. Through this process, the real-world random distribution of water line failure was estimated.

To develop the service life values for GWA, information was used from other utilities and the latest AWWA guidance regarding water pipe service life (AWWA, 2012a). Table 8-3 lists the pipe service life values used in the analysis.

Table 8-3. Pipe Service Life Values

Material Description	Pipe Age at % of Service Life Remaining			AWWA Service Life (years)	Notes
	90%	50%	10%		
Asbestos Cement	40	60	80	80	
Cast Iron	40	75	120	120	
Ductile Iron	40	70	110	110	
PVC	40	65	90	100	PVC water line manufacturers have stated that PVC pipe generally has a 100-year life span, but many systems are experiencing issues with PVC piping earlier than 100 years.
Unknown/Other	40	60	80		