



Actuarial certification: Dec. 31, 2019

Milliman has performed an actuarial valuation of the retirement plan as of Dec. 31, 2019. This valuation reflects the benefit provisions and contribution rates in effect as of Jan. 1, 2020. In preparing this valuation, we relied without audit on information (some oral and some written) supplied by the Texas County & District Retirement System staff. This information includes, but is not limited to, statutory provisions, employee data and financial information. We found this information to be reasonably consistent and comparable with information used for other purposes. The valuation results depend on the integrity of this information. If any of this information is inaccurate or incomplete, our calculations may need to be revised and our results may be different.

This report is a summary of the valuation results for your plan. Additional system-wide results are provided in the TCDRS Comprehensive Annual Financial Report (CAFR) and the actuarial valuation report for all of TCDRS.

All costs, liabilities, rates of interest and other factors for TCDRS have been determined on the basis of actuarial assumptions and methods that are reasonable (taking into account the experience of TCDRS and reasonable expectations); and which, in combination, offer a reasonable estimate of anticipated experience affecting TCDRS. While the valuation results are based on assumptions that are reasonable both individually and in the aggregate, there may be other reasonable assumption sets that will produce different results. The TCDRS Board of Trustees has the final decision regarding the appropriateness of the assumptions and adopted them as indicated in Section 4 of this report.

This report is an estimate of your plan's financial condition as of a single date and is not intended to predict your plan's future condition or guarantee future financial soundness. Actuarial valuations only affect the timing of contributions, not the ultimate cost of benefits.

Future actuarial measurements may differ significantly from the current measurements presented in this report. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of future measurements.

Actuarial computations presented in this report are for purposes of determining the recommended funding amounts for TCDRS. Government Accounting Standards Board (GASB) financial

accounting requirements are provided in a separate document and differ from those disclosed in this report. The calculations in the enclosed report have been made on a basis consistent with our understanding of TCDRS's funding policy. Determinations for other purposes may be significantly different from the results contained in this report. Accordingly, additional determinations may be needed for other purposes.

Milliman's work was prepared solely for TCDRS in TCDRS' capacity as plan administrator of the system. To the extent that Milliman's work is not subject to disclosure under applicable public records laws, Milliman's work may not be provided to third parties without Milliman's prior written consent; provided, however, we understand that in performing its duties as plan administrator, TCDRS intends to distribute the report to its participating employers and to the independent auditors of its participating employers. In addition, TCDRS may be required to release a copy of the report, if a valid request is filed pursuant to the Texas Public Information Act.

Milliman does not have a legal contract with parties other than TCDRS. The distribution of Milliman's report by TCDRS to participating employers and their auditors does not create or imply any legal duty between Milliman and the participating employers or their auditors. Milliman does not intend to benefit or create a legal duty to any recipient of its work product other than TCDRS. Milliman does not authorize the inclusion of Milliman's name or reports in any offering, memorandum, prospectus, securities filing, or solicitation of investment. Any third-party recipient should engage qualified professionals for advice appropriate to its own specific needs. The consultants who worked on this assignment are pension actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein. We respectfully submit the following report. If you have any questions, please contact TCDRS and they will either provide additional information or forward your request to us.

Mark C. Olleman, FSA, EA, MAAA
Consulting Actuary, Milliman Inc.

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Tarrant County, #319
Actuarial valuation results for your TCDRS plan
as of Dec. 31, 2019

INTRODUCTION

This report summarizes the major findings of the valuation for your retirement plan and reflects your benefit provisions in effect as of Jan. 1, 2020.

Much of the material contained in this report is intended to provide information to other actuaries to help comply with actuarial standards of practice. In particular, if an independent review is conducted by another actuary, the report provides information on the methods and calculations to aid the actuary in reviewing and verifying study results. More information can be found in TCDRS' Comprehensive Annual Financial Report for the year ended Dec. 31, 2019.

VALUATION RESULTS

The actuarial valuation recognizes investment gains and losses over five years to avoid single-year rate spikes to prevent overreaction in times of investment gains and give financial markets time to recover in times of investment losses. For 2019, there was an actuarial investment gain. Any deferred actuarial investment losses from previous years were first used to reduce that year's actuarial investment gain. A portion of the remaining gain or loss was recognized in this year's valuation, with the remainder deferred until future valuations.

All valuation calculations, including the required contribution rate, are based on the plan's funded status as of Dec. 31, 2019. Due to the coronavirus outbreak, investment markets have declined significantly in 2020. Unless a major market recovery happens this year, it is likely your plan will experience a substantial investment loss, which will cause required rates to increase. Because the valuation smooths investment gains and losses over five years to help keep rates stable, you can expect rates to increase over the next several years as the investment loss is recognized. A future market recovery could mitigate some of the rate increase.

As you review your benefit plans, please keep in mind that any benefit increases, such as a higher matching rate or a retiree cost-of-living adjustment, will further increase rates.

You may also want to consider making an additional contribution or adopting an elected rate to help buffer against future adverse plan experience. If your plan saw a decrease in the 2021 required contribution rate and does not already have an elected rate, you should consider adopting an elected rate that is at least equal to your 2020 required contribution rate.

SCOPE OF THE REPORT

This report presents the results of the actuarial valuation for your TCDRS retirement plan. The report consists of five sections:

- Section 1 is a summary of the actuarial valuation results as of the valuation date — Dec. 31, 2019 — for your plan.
- Section 2 includes a summary of your member and benefit recipient data, and a summary of your plan assets.
- Section 3 is a summary of the plan provisions.
- Section 4 is a summary of the actuarial methods and assumptions.
- Section 5 includes a brief glossary of terms used in this report.

SECTION I
Actuarial valuation results for your TCDRS plan
as of Dec. 31, 2019

RATES EFFECTIVE 2021

The following shows some key results of the actuarial valuation as of Dec. 31, 2019. For comparison purposes, the results of the prior valuation, after reflecting any plan changes effective Jan. 1, 2020, are also shown. Please refer to the bottom of the section titled “Reasons for Rate Change” in the Retirement Plan Assessment for an analysis of what caused the changes in your contribution rate.

Employer Name: Tarrant County

Employer Number: 319

Plan Assets & Liabilities	Dec. 31, 2019	Dec. 31, 2018
1. Present value of future benefits:		
Benefit recipients	\$828,244,954	\$762,134,948
Members	\$1,334,121,867	\$1,299,126,087
Total	\$2,162,366,821	\$2,061,261,035
2. Present value of future normal cost contributions	\$342,330,567	\$329,255,281
3. Actuarial accrued liability (line 1 – line 2)	\$1,820,036,254	\$1,732,005,754
4. Actuarial value of assets	\$1,624,822,764	\$1,513,298,525
5. Unfunded/(Overfunded) actuarial accrued liability [UAAL/(OAAL)] (line 3 – line 4)	\$195,213,490	\$218,707,229
6. Funded ratio (line 4 / line 3)*	89.3%	87.4%
7. Effective amortization period (in years)**	5.2	6.4
 Retirement Plan Funding	 2021***	 2020****
Total normal cost rate	14.15%	14.15%
Member deposit rate	7.00%	7.00%
Employer-paid normal cost rate	7.15%	7.15%
UAAL/(OAAL) rate	6.35%	7.22%
Required rate	13.50%	14.37%
 Elected rate	 19.50%	 19.50%
 Retirement plan rate (greater of required or elected rate)	 19.50%	 19.50%

Please refer to the Glossary for additional information on the terms used above.

* The funded ratio assumes on-going TCDRS plan participation. The funded ratio does not represent the financial status for a terminating plan.

** This is the period it would take for the UAAL to be fully paid down assuming the required rate shown is paid each year in the future and all future experience emerges exactly as assumed.

*** 2021 rates assume you do not make any plan changes and that you continue your elected rate, if any, currently in effect for 2020.

**** These rates reflect plan changes effective Jan. 1, 2020 (if any).

Unfunded Actuarial Accrued Liability (UAAL)

If a plan has a UAAL (i.e., the Actuarial Accrued Liability exceeds the Actuarial Value of Assets), this does not indicate that the plan is insufficiently funded or is behind in making required contributions. All TCDRS employers pay 100% of their required rate. Just by paying the required rate, the employer is funding the existing UAAL over a closed period of 20 years or less.

The UAAL represents the estimated amount needed to fully fund benefits attributable to service already rendered by employees. Most new plans begin with a UAAL. The UAAL will increase when a plan adopts benefit increases attributable to past service, like a cost-of-living adjustment (COLA) for retirees. Actuarial gains and losses (for example, investment returns either greater than or less than the assumed rate of return) and changes in actuarial assumptions will also affect the UAAL.

UAAL Contribution Rate and Explanatory Notes

Amortization payments are based on a fixed schedule that increases by the payroll growth assumption each year. Amortization payments are adjusted from Dec. 31 amounts to reflect that actual contributions are made on a monthly basis.

Date Established	Description	Remaining Period as of Dec. 31, 2020	2021 Amortization Payment / (Credit)
Dec. 31, 2008	Initial UAAL	9 Years	\$6,853,491
Dec. 31, 2009	UAAL Layer	10 Years	(\$342,534)
Dec. 31, 2009	Plan Change	5 Years	\$922,323
Dec. 31, 2010	UAAL Layer	11 Years	\$1,384,710
Dec. 31, 2011	UAAL Layer	12 Years	\$1,538,611
Dec. 31, 2011	Plan Change	7 Years	\$329,053
Dec. 31, 2012	UAAL Layer	13 Years	\$1,248,582
Dec. 31, 2013	UAAL Layer	14 Years	(\$890,596)
Dec. 31, 2013	Plan Change	9 Years	\$276,869
Dec. 31, 2014	UAAL Layer	15 Years	(\$1,136,238)
Dec. 31, 2015	UAAL Layer	16 Years	\$3,208,762
Dec. 31, 2015	Plan Change	11 Years	\$370,882
Dec. 31, 2016	UAAL Layer	17 Years	\$1,311,627
Dec. 31, 2016	Plan Change	12 Years	\$630,515
Dec. 31, 2017	UAAL Layer	18 Years	\$303,484
Dec. 31, 2017	Plan Change	13 Years	\$719,359
Dec. 31, 2018	UAAL Layer	19 Years	\$1,959,840
Dec. 31, 2018	Plan Change	14 Years	\$772,523
Dec. 31, 2019	UAAL Layer	20 Years	(\$373,078)
Total Amortization Payment / (Credit):			\$19,088,185
Projected Payroll:			\$300,506,326
UAAL / (OAAL) Contribution Rate (Amortization as % of Payroll):			6.35%

UAAL Amortization and Explanatory Notes

UAAL amortization payments/credits (see column C below) are based on a fixed schedule that increases by the payroll assumption each year. If the employer makes additional contributions (either through a lump-sum contribution or an elected rate greater than the required rate), the outstanding balance of the oldest UAAL layer and associated future payments will be reduced. The assets and liabilities used in the calculation of the UAAL are as of Dec. 31, 2019, but the contribution rates are not effective until Jan. 1, 2021. Therefore, the UAAL is projected to Dec. 31, 2020 in the calculation of the contribution rate.

TCDRS does not charge any fees to employers, and employers are not assessed an interest fee on the UAAL. The “Adjustment Due to Decrease in Discount Period” (see column B below) shows the impact of one-year’s passage of time and reflects anticipated future returns on investments. During this period, both employer assets and liabilities are projected to grow at the same rate of interest (also referred to as the discount rate). The discount rate used in this calculation is 8%. Lowering the discount rate would increase required employer contribution rates.

The amortization of the Dec. 31, 2019 UAAL Layer does not begin until Dec. 31, 2020; however, the UAAL amount is adjusted based on the expected 2020 UAAL contributions.

Date Established	Description	Balance as of Dec. 31, 2019 (A)	Adjustment Due to Decrease in Discount Period (B)	Amortization Payment / (Credit) on Dec. 31, 2020 (C)	Projected Balance as of Dec. 31, 2020 (A) + (B) – (C)
Dec. 31, 2008	Initial UAAL	\$69,943,775	\$5,595,502	\$24,910,228	\$50,629,049
Dec. 31, 2009	UAAL Layer	(\$2,873,277)	(\$229,862)	(\$349,698)	(\$2,753,441)
Dec. 31, 2009	Plan Change	\$4,688,631	\$375,090	\$941,613	\$4,122,108
Dec. 31, 2010	UAAL Layer	\$12,413,447	\$993,076	\$1,413,670	\$11,992,853
Dec. 31, 2011	UAAL Layer	\$14,640,909	\$1,171,273	\$1,570,790	\$14,241,392
Dec. 31, 2011	Plan Change	\$2,137,258	\$170,981	\$335,934	\$1,972,305
Dec. 31, 2012	UAAL Layer	\$12,538,822	\$1,003,106	\$1,274,696	\$12,267,232
Dec. 31, 2013	UAAL Layer	(\$9,392,273)	(\$751,382)	(\$909,223)	(\$9,234,432)
Dec. 31, 2013	Plan Change	\$2,155,543	\$172,443	\$282,660	\$2,045,326
Dec. 31, 2014	UAAL Layer	(\$12,529,883)	(\$1,002,391)	(\$1,160,002)	(\$12,372,272)
Dec. 31, 2015	UAAL Layer	\$36,861,617	\$2,948,929	\$3,275,871	\$36,534,675
Dec. 31, 2015	Plan Change	\$3,324,826	\$265,986	\$378,638	\$3,212,174
Dec. 31, 2016	UAAL Layer	\$15,644,882	\$1,251,591	\$1,339,059	\$15,557,414
Dec. 31, 2016	Plan Change	\$5,999,769	\$479,982	\$643,701	\$5,836,050
Dec. 31, 2017	UAAL Layer	\$3,747,576	\$299,806	\$309,831	\$3,737,551
Dec. 31, 2017	Plan Change	\$7,224,128	\$577,930	\$734,404	\$7,067,654
Dec. 31, 2018	UAAL Layer	\$24,989,353	\$1,999,148	\$2,000,829	\$24,987,672
Dec. 31, 2018	Plan Change	\$8,147,076	\$651,766	\$788,681	\$8,010,161
Dec. 31, 2019	UAAL Layer	(\$4,448,689)	(\$355,895)	\$107,033	(\$4,911,617)
UAAL / (OAAL) as of Dec. 31, 2019:		\$195,213,490			

SECTION 2

Additional plan information

Members	Dec. 31, 2019	Dec. 31, 2018
Number of members:	6,644	6,476
Number of depositing members:	4,486	4,465
Average monthly salary:*	\$5,278	\$5,114
Average age:*	45.01	45.23
Average length of service in years:*	11.71	11.85

*Averages for depositing members.

Benefit Recipients

Number of benefit recipients:	2,892	2,740
Average monthly benefit:	\$2,556	\$2,456

Plan Assets

<i>Employees Saving Fund (ESF)</i>		<i>Subdivision Accumulation Fund (SAF)</i>	
This is the total sum balance of your members' accounts.		This is your employer account.	
Balance as of Jan. 1, 2019	\$345,317,399	Balance as of Jan. 1, 2019	\$1,053,290,001
Additions:		Additions:	
Member deposits	\$20,468,698	Employer contributions	\$56,978,593
Annual interest	\$22,932,833	Allocated net income/(loss)	\$217,627,640
Deductions:		Transfers from ESF	\$28,788,919
Transfers to the SAF	\$28,788,919	Deductions:	
Withdrawals	\$3,191,622	Retirement allowances	\$84,757,334
Net escheatments	(\$929)	Other transfers:	\$0
Fund balance as of Dec. 31, 2019	\$356,739,319	Fund balance as of Dec. 31, 2019	\$1,271,927,819

Development of Allocated Net Income/(Loss) in SAF

1) Prior year balance for allocation (includes ESF and SAF)	\$1,398,607,400
2) Allocated net income/(loss) (17.200% x Line 1)	\$240,560,473
3) Annual interest to ESF	\$22,932,833
4) Allocated net income/(loss) to SAF* (Line 2 – Line 3)	\$217,627,640

ACTUARIAL VALUE OF ASSETS

The assets used in the valuation are adjusted to reduce volatility in contribution rates by the application of a smoothing method. These smoothed assets are referred to as the actuarial value of assets. The method used to determine the actuarial value of the Subdivision Accumulation Fund is described in the Actuarial Methods section of Section 4.

Development of Actuarial Value of Assets

1) Subdivision Accumulation Fund (SAF) balance	\$1,271,927,819
2) Total unrecognized actuarial asset gain/(loss) in SAF (see below)	\$3,844,373
3) Actuarial value of SAF* (Line 1 – Line 2)	\$1,268,083,445
4) Employees Saving Fund (ESF) balance	\$356,739,319
5) Actuarial value of assets* (Line 3 + Line 4)	\$1,624,822,764

Development of Unrecognized Actuarial Asset Gain/(Loss) in SAF

Year Ended	Adjusted Actuarial Asset Gain/(Loss) for Year**		Percent Excluded	Gain/(Loss) Excluded
December 31, 2016	\$0	x	20.00%	\$0
December 31, 2017	\$0	x	40.00%	\$0
December 31, 2018	\$0	x	60.00%	\$0
December 31, 2019	\$4,805,467	x	80.00%	\$3,844,373
Total Unrecognized Actuarial Asset Gain/(Loss) in SAF *				= \$3,844,373

Development of Current Year Actuarial Asset Gain/(Loss) in SAF

1) Prior year balance for allocation (includes ESF and SAF)	\$1,398,607,400
2) Assumed allocated net income (8.000% x Line 1)	\$111,888,592
3) Actual allocated net income/(loss) (17.200% x Line 1)	\$240,560,473
4) Current year gain/(loss) to be recognized over five years* (Line 3 – Line 2)	\$128,671,881

* Small differences may occur due to the rounding of numbers.

** Gains/Losses are adjusted each year due to the application of the asset smoothing method, which increases the prior year's value with interest and offsets gains and losses.

RISK DISCUSSION

The results of any actuarial valuation are based on a set of assumptions. Although we believe the current assumptions provide a reasonable estimate of future expectations, it is almost certain that future experience will differ from the assumptions to some extent. In particular, it should be noted that financial markets have declined significantly since the valuation date. A “Down Market” example is shown in the Sensitivity to Future Returns section, although your plan’s results will vary. The important takeaway is that it is likely there will be future increases in your plan’s required contribution rate.

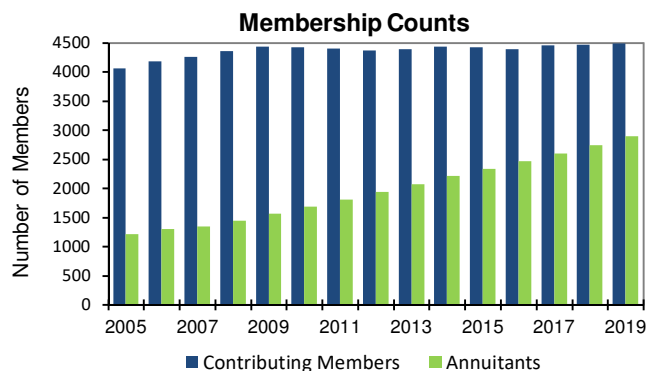
Factors Affecting Future Results

There are a number of factors that affect future valuation results. To the extent actual experience for these factors varies from the assumptions, this will likely cause either increases or decreases in the plan’s future funding level and required contribution rate. Examples of factors that can have a significant impact on valuation results are:

- Investment return
- Payroll variation
- Mortality (how long retirees live)
- Termination (members leaving active employment)

For example, if actual returns fall short of the current assumption of 8% per year, this will cause an increase in the required contribution rate and a decrease in the plan’s funded percentage, all other things being equal. Conversely, if the return exceeds 8%, this will decrease the required contribution rate and increase the funded percentage.

The magnitude of the increase or decrease in the required contribution rate for an individual plan is affected by its maturity level. Plans that joined TCDRS decades ago will generally have accumulated a larger amount of assets relative to their payroll and are considered more mature than younger plans that more recently joined TCDRS. Accumulating assets to pay for future benefit obligations is a good thing, but it does mean changes in the investment markets will have a larger impact on the required contribution rate for these plans as they mature. One measure of maturity is the relationship of annuitants to active contributing members. The following graph shows a historical perspective of this relationship for your plan.



Sensitivity to Future Returns

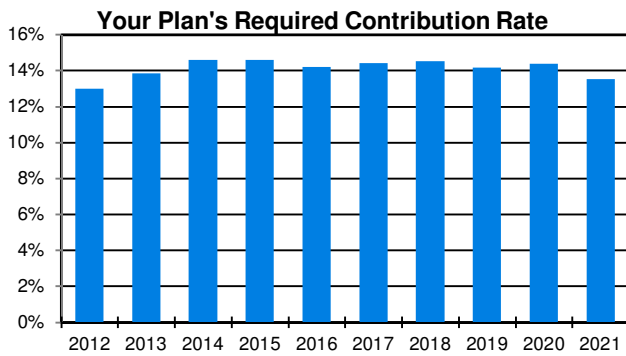
The following analysis is designed to give you an idea of how much your required rate might change from year to year under different economic scenarios. Potential investment results were generated using TCDRS’ current target asset portfolio and capital market assumptions to estimate the 25th, 50th and 75th percentile investment returns. The 75th percentile represents a down market scenario, meaning we expect that there is a 75% chance that actual returns will be greater. Lower-than-assumed returns equate to higher required rates. The 25th percentile represents an up-market scenario.

Projection of Required Contribution Rate			
Year	Up Market 25 th Percentile	Average 50 th Percentile	Down Market 75 th Percentile
2021	13.50%	13.50%	13.50%
2022	11.82%	12.56%	13.25%
2023	9.03%	11.35%	13.30%
2024	5.42%	9.81%	13.38%
2025	3.03%	8.52%	13.97%

Note that the further the projection is in the future, the more uncertainty there is in these estimates. Actual results may be outside of the ranges shown depending on future returns and other factors. These estimates assume no changes in your benefit provisions or the underlying assumptions and are not designed for budgeting purposes. They are based on your plan’s current maturity level. As your plan matures over time, investment return fluctuations are expected to have an increased impact on the variance in the required contribution rate.

Historical Variation in Required Contribution Rate

The following graph shows how your required contribution rate has varied over the last ten years.



Understanding and Reducing Future Risk

For employers that want to reduce future variations in their required contribution rate, one effective method is adopting an elected rate that is greater than the required contribution rate (or increasing their existing elected rate). An elected rate provides a buffer so that future adverse experience is less likely to impact the actual contribution rate paid and also provides stronger funding to the plan.

Employers that want to better understand the magnitude of potential fluctuations in their required contribution rate should contact their TCDRS employer services representative.

SECTION 3

Plan Provisions

PLAN PROVISIONS

The following summary reflects your plan as of Jan. 1, 2020. Further descriptions of the plan provisions follow. No future plan provision changes are assumed for purposes of this valuation. Future plan provision changes may be adopted by the plan but are not reflected in these valuation results.

Basic Plan Options	
Employee Deposit Rate	7%
Employer Matching (Future Deposits)	200%
Prior Service Credit	150%
Retirement Eligibility	
Age 60 (Vesting)	8 years of service
Rule of	75 years total age + service
At Any Age	30 years of service
Optional Benefits	
Partial Lump-Sum Payment at Retirement	No

Membership

All full- and part-time employees must participate in TCDRS, regardless of the number of hours they work in a year or their age. Only those employees who are classified as “temporary” are excluded from enrollment.

Termination of Membership

TCDRS membership is terminated by death, retirement, withdrawal of account balance from the plan or attainment of the age under which distribution must occur under federal law.

Employee Deposits

TCDRS is a savings-based plan. Every paycheck, a portion of each employee’s pay — from 4% to 7% as set by the employer — is deposited into their TCDRS account. Your employees’ current deposit rate is 7%. By law, employee accounts earn 7% interest annually.

Service

Employees receive a month of service for each month that they make a deposit into their account. Service may also be granted for periods of employment prior to the employer joining TCDRS and for military or certain other service.

Within TCDRS, periods of service with any TCDRS participating employer are generally combined. Also, service periods with other Texas public retirement plans participating with TCDRS in the Texas Proportionate Retirement Program are combined to satisfy TCDRS retirement eligibility and vesting requirements.

Eligibility Requirements

Service Retirement Benefits

The amount of service an employee needs to earn a future benefit is called the vesting requirement. When an employee is vested he or she has the right to a monthly benefit at age 60 or older. Employers may choose 5-, 8- or 10-year vesting. The vesting requirement for your employees is 8 years of service. In addition, employees may retire before age 60 if they meet one of the following requirements, set by the employer:

- “Rule of” eligibility — Under these rules, a vested employee can retire if their age plus years of service time add up to at least 75 or 80. Your plan requirement is Rule of 75.
- 20-year or 30-year retirement at any age — This lets employees retire when they have at least 20 or 30 years of service time. Your plan requirement is 30 years of service.

Retirees elect to receive their lifetime benefit by choosing from one of seven actuarially equivalent payment options.

Disability Retirement Benefits

A member who is vested and who is totally and permanently disabled is eligible for a disability retirement benefit. A member who is not vested is eligible for disability retirement benefits if the total and permanent disability was a result of an on-the-job injury.

Survivor Benefits

Benefits are payable to the beneficiaries or estate of a deceased member. The eligibility requirement for an employer-provided Survivor Benefit is four years of TCDRS service. Otherwise the Survivor Benefit is the deceased member’s account balance.

Determination of Retirement Benefits

Employer Matching Rate

A member’s retirement benefit is calculated based on the employee’s account balance and the employer matching. The current employer matching rate for future deposits is 200% for your employees. The employee’s account balance with employer matching is converted to an annuity at retirement and then he or she receives a payment every month for the rest of his or her life.

Payment Options

Retirees elect to receive their monthly lifetime benefit by choosing from one of the following seven actuarially equivalent payment options.

- **Single Life option** – Monthly payments cease upon death of the retiree. This option provides the highest monthly benefit.
- **Guaranteed Term Benefit options** – The two guaranteed term benefit options are 10-Year Guaranteed Term and 15-Year Guaranteed Term. These options provide a lifetime monthly benefit to the retiree. In addition, if the retiree passes away within 10 or 15 years of the retirement date, the beneficiary will receive the monthly benefit until the end of the guaranteed term.
- **Dual Life options** – The four dual life options are 100% to Beneficiary, 75% to Beneficiary, 50% to Beneficiary and 100% to Beneficiary With Pop-Up. Under each of these options, after the death of the retiree, the beneficiary receives a monthly lifetime benefit equal to the selected percentage of the retiree’s benefit payment. Under the 100% to Beneficiary With Pop-Up option, if the beneficiary dies before the retiree, the monthly benefit amount will “pop up” to a higher monthly amount, as if the retiree had retired under the Single Life option.

All options pay a death benefit equal to the excess of the person’s account at retirement over the total monthly benefits that have been paid.

Each employer may elect the partial lump-sum option. This payment option allows the retiring member to receive an immediate lump-sum payment not to exceed his or her account balance, and choose a reduced monthly lifetime benefit from any of the payment options.

Annuity Purchase Rates (Factors for Conversion to Monthly Annuity Payments)

For benefits based on member deposits made prior to Jan. 1, 2018 (including interest on those deposits, employer matching and other employer credits), benefit credits are converted into monthly benefit payments using the UP-1984 Table with an age set back of five years for retirees and an age set back of 10 years for beneficiaries, and an interest rate of 7.0%.

For benefits based on member deposits made on Jan. 1, 2018, or later (including interest on those deposits, employer matching and other employer credits), benefit credits are converted into monthly benefit payments using a custom generational mortality table (see below for details) and an interest rate of 7.0%. The rates in this mortality table vary based on the member’s year of birth, so the conversion factors also vary by year of retirement.

Annuity Purchase Rates (2014 TCDRS Unisex Mortality Table)	<p>Average of the male and female rates for service retirees for member mortality. 30%/70% male/female blend for beneficiary mortality.</p> <p>Males –The RP-2000 Combined Mortality Table for males projected to 2014 with scale AA and then projected with 110% of the MP-2014 Ultimate scale thereafter, with a one-year set-forward.</p> <p>Females –The RP-2000 Combined Mortality Table for females projected to 2014 with scale AA and then projected with 110% of the MP-2014 Ultimate scale thereafter, with no age adjustment.</p>
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Monthly benefits are calculated by dividing the total benefit credits by the associated annuity purchase rate. Sample annuity purchase rates for the single life form of payment are shown below:

Table 1
Sample Annuity Purchase Rates

Sample Retirement Age	Annuity Purchase Rate for Single Life Benefit			
	Pre-2018 Deposits	Post-2017 Deposits 2020 Retirement Date	Post-2017 Deposits 2030 Retirement Date	Post-2017 Deposits 2040 Retirement Date
50	147.2259	155.2309	156.5194	157.7373
55	138.8321	147.2718	148.9675	150.5769
60	128.9240	137.1731	139.3300	141.3890
65	117.4861	125.0176	127.6430	130.1663
70	104.6995	110.8674	113.9168	116.8715
75	91.2252	94.7558	98.1199	101.4138

SECTION 4

Actuarial procedures and assumptions

THE ACTUARIAL VALUATION

Each year Milliman, TCDRS' independent consulting actuarial firm, analyzes your plan to determine your employer contribution rate. We study your workforce and estimate the benefits you will pay to your employees. We estimate how much the benefits you will provide are worth in today's dollars — this is what's known as the present value of your plan's future benefits. We then compare the assets you have already invested with what you will need to pay for benefits. Based on this comparison, we determine how much you will need to pay each year to fund those benefits.

Please keep in mind that the ultimate cost of a retirement program is based on the actual benefits paid to the employees. The actuarial valuation assumptions and methods are used to allocate the contributions to the plan over various time periods, but ultimately do not impact the true cost of the plan.

The actuarial procedures and assumptions used in this valuation are described in this section. The actuarial assumptions are intended to estimate the future plan experience of the members and benefit recipients of your retirement plan. Any variations in future plan experience from that expected under these assumptions will result in corresponding changes in the estimated costs of the plan's benefits.

The economic and demographic assumptions have been established based on the experience study for TCDRS, details of which can be found in the Investigation of Experience report located on www.TCDRS.org. The assumptions applicable to your plan regarding merit salary increase rates, mortality rates, retirement rates and termination of employment rates are illustrated in Tables 2 through 6. The numerical rates provided in the tables represent the likelihood of these events occurring. The following provides additional information regarding the actuarial methods and assumptions.

ACTUARIAL METHODS

Actuarial Cost Method — Entry age actuarial cost method, level percent of payroll.

Plan Funding — The change in the unfunded actuarial accrued liability (UAAL) attributable to each year is amortized over a closed 20-year period as a level percent of covered payroll, except for the following situations. 1) The UAAL attributable to benefit increases in a given year is amortized over a closed 15-year period as a level percent of covered payroll. 2) If there is an overfunded actuarial accrued liability, the amortization period is an open 30-year period. 3) If a UAAL decrease occurs due to extra employer contributions (lump sum or elected rate greater than required rate), that decrease is offset against the oldest existing actuarial loss layer.

Records and Data — The data regarding active employees, retired employees, survivors and the financial information used in this valuation were supplied by TCDRS, and are accepted for valuation purposes without audit. Certain adjustments are made in cases of missing information.

Actuarial Value of Assets — The actuarial value of assets is equal to the employer assets (ESF plus SAF) adjusted for a five-year recognition of the difference between the expected and actual interest credited to the employer assets for each year. Effective with the 2019 valuation, the prior year's deferred actuarial gains and losses are increased by one year's interest based on the prior year's investment return assumption. In cases where the sum of the prior deferred actuarial gains and losses is an actuarial gain, any current year actuarial loss is offset against the oldest actuarial gain. If any of the current year actuarial loss remains after the initial offset, the remainder is offset against the next oldest gain, and so on. If the sum of prior deferred actuarial gains and losses is an actuarial loss and there is an actuarial gain for the current year, the current year gain is offset against the prior actuarial losses in a similar fashion.

Economic Assumptions

TCDRS system-wide economic assumptions:

Real rate of return	5.25%
Inflation	2.75%
Long-term investment return	8.0%

The assumed long-term investment return of 8% is net after investment and administrative expenses and is expected to enable the system to credit each employer's Subdivision Accumulation Fund (SAF) with a nominal annual rate of 8% on the combined ESF and SAF funds, less the amount credited to the employer's ESF. Under the TCDRS Act, the ESF is credited with a nominal annual rate of 7%. It is assumed interest will be credited at the nominal annual rate of 8% for calculating the actuarial accrued liability and the normal cost contribution rate for the retirement plan of each participating employer.

The annual salary increase rates assumed for individual members vary by length of service and by entry-age group. The annual rates consist of a general wage inflation component of 3.25% (made up of 2.75% inflation and 0.5% productivity increase assumptions) and a merit, promotion and longevity component that on average approximates 1.6% per year for a career employee. (See Table 2 for Merit Salary Increases.)

Employer-specific economic assumptions:

Growth in membership	0.00%
Payroll growth	3.25%

The payroll growth assumption is for the aggregate covered payroll of an employer.

Table 2
Merit Salary Increases*

Years of Service	Entry Age			
	Before 30	Ages 30–39	Ages 40–49	50 and later
0	5.00%	4.50%	4.00%	3.50%
1	4.25	3.75	3.25	2.75
2	3.85	3.35	2.85	2.35
3	3.50	3.00	2.50	2.00
4	3.15	2.65	2.25	1.85
5	2.90	2.55	2.15	1.70
6	2.65	2.30	1.95	1.55
7	2.45	2.10	1.75	1.40
8	2.30	1.95	1.60	1.25
9	2.15	1.80	1.45	1.10
10	2.00	1.70	1.40	1.05
11	1.90	1.60	1.25	1.00
12	1.80	1.50	1.15	0.95
13	1.70	1.40	1.05	0.90
14	1.60	1.30	0.95	0.85
15	1.50	1.23	0.90	0.80
16	1.40	1.15	0.85	0.75
17	1.30	1.05	0.80	0.70
18	1.23	0.97	0.75	0.65
19	1.15	0.90	0.70	0.60
20	1.10	0.85	0.65	0.55
21	1.05	0.80	0.60	0.50
22	1.00	0.75	0.55	0.50
23	0.95	0.70	0.50	0.50
24	0.90	0.65	0.50	0.50
25	0.85	0.60	0.50	0.50
26	0.80	0.60	0.50	0.50
27	0.75	0.60	0.50	0.50
28	0.70	0.60	0.50	0.50
29	0.65	0.60	0.50	0.50
30 & Up	0.60	0.60	0.50	0.50

* These rates do not include the wage inflation rate of 3.25% per year. For example, a member who entered the system at age 20 and is in the first year of service is assumed to receive an 8.41% total annual increase in his salary. The 8.41% is a combination of the 5.00% merit increase and the 3.25% wage inflation. Note that the two components are compounded, so it is a slightly different result than just adding the two percentages.

DEMOGRAPHIC ASSUMPTIONS

TCDRS system-wide demographic assumptions:

Replacement of Terminated Members — New employees are assumed to replace any terminated members and have similar entry ages.

Disability — The rates of disability used in this valuation are illustrated in Table 3. Members who become disabled are eligible to commence benefit payments regardless of age. Rates of disability are in a custom table based on TCDRS experience.

Table 3
Annual Rates of Disability*

Age	Work Related Male and Female	All Other Causes Male and Female	Age	Work Related Male and Female	All Other Causes Male and Female
less than 25	0.000%	0.000%	43	0.004%	0.058%
25	0.000	0.000	44	0.004	0.063
26	0.000	0.000	45	0.004	0.069
27	0.000	0.000	46	0.005	0.076
28	0.000	0.008	47	0.006	0.084
29	0.000	0.008	48	0.0007	0.095
30	0.000	0.009	49	0.009	0.109
31	0.000	0.010	50	0.010	0.125
32	0.000	0.010	51	0.012	0.142
33	0.000	0.011	52	0.013	0.162
34	0.000	0.014	53	0.015	0.183
35	0.001	0.018	54	0.018	0.203
36	0.001	0.022	55	0.018	0.222
37	0.002	0.028	56	0.018	0.238
38	0.002	0.033	57	0.018	0.250
39	0.002	0.038	58	0.018	0.259
40	0.002	0.042	59	0.018	0.270
41	0.003	0.047	60 & Above	0.018	0.000
42	0.003	0.053			

* The probability of disability from all other causes is applicable for members who are vested but not eligible for service retirement. Before a member is vested, only the work-related disability provisions are applicable.

Mortality

Depositing members	90% of the RP-2014 Active Employee Mortality Table for males and 90% of the RP-2014 Active Employee Mortality Table for females, projected with 110% of the MP-2014 Ultimate scale after 2014.
Service retirees, beneficiaries and non-depositing members	130% of the RP-2014 Healthy Annuitant Mortality Table for males and 110% of the RP-2014 Healthy Annuitant Mortality Table for females, both projected with 110% of the MP-2014 Ultimate scale after 2014.
Disabled retirees	130% of the RP-2014 Disabled Annuitant Mortality Table for males and 115% of the RP-2014 Disabled Annuitant Mortality Table for females, both projected with 110% of the MP-2014 Ultimate scale after 2014.

Family Composition — For current retirees, beneficiary information is supplied by TCDRS. For purposes of calculating the Survivor Benefit for current depositing and non-depositing members, male members are assumed to have a female beneficiary who is three years younger. Female members are assumed to have a male beneficiary who is three years older.

Service Retirement — Members eligible for service retirement are assumed to retire at the rates shown in Table 4.

Table 4
Annual Rates of Service Retirement *

Age	Male	Female	Age	Male	Female
40–44	4.5%	4.5%	62	20.0%	20.0%
45–49	9.0	9.0	63	15.0	15.0
50	10.0	10.0	64	15.0	15.0
51	9.0	9.0	65	25.0	25.0
52	9.0	9.0	66	25.0	25.0
53	9.0	9.0	67	22.0	22.0
54	10.0	10.0	68	20.0	20.0
55	10.0	10.0	69	20.0	20.0
56	10.0	10.0	70	22.0	22.0
57	10.0	10.0	71	22.0	22.0
58	12.0	12.0	72	22.0	22.0
59	12.0	12.0	73	22.0	22.0
60	12.0	12.0	74**	22.0	22.0
61	12.0	12.0			

* Deferred members are assumed to retire (100% probability) at the later of:
a) age 60
b) earliest retirement eligibility.

**For all eligible members ages 75 and later, retirement is assumed to occur immediately.

Employer-specific demographic assumptions:

Other Terminations of Employment — The rate of assumed future termination from active participation in the plan for reasons other than death, disability or retirement are illustrated in Table 5. The rates vary by length of service, entry-age group (age at hire) and sex. No termination after eligibility for retirement is assumed.

Table 5
Annual Rates of Termination

Years of Service	Entry Age 20		Entry Age 30		Entry Age 40		Entry Age 50	
	Male	Female	Male	Female	Male	Female	Male	Female
0	23.38%	25.34%	19.46%	21.14%	16.59%	17.92%	15.61%	16.87%
1	15.96	17.36	13.44	14.56	11.41	12.39	10.78	11.62
2	11.90	12.88	10.08	10.92	8.54	9.31	8.05	8.75
3	9.45	10.22	8.05	8.75	6.86	7.42	6.44	7.00
4	7.77	8.47	6.72	7.28	5.74	6.16	5.39	5.81
5	6.93	7.56	6.02	6.58	5.11	5.60	4.83	5.25
6	6.16	6.65	5.39	5.81	4.55	4.97	4.27	4.69
7	5.46	5.95	4.83	5.25	4.13	4.48	3.85	4.20
8	4.55	4.90	4.06	4.34	3.43	3.71	3.22	3.50
9	4.34	4.69	3.92	4.20	3.29	3.57	3.15	3.36
10	3.85	4.13	3.50	3.78	2.94	3.22	2.80	3.01
11	3.36	3.64	3.08	3.36	2.66	2.87	2.45	2.66
12	3.08	3.29	2.80	3.08	2.38	2.59	2.24	2.45
13	2.73	2.94	2.52	2.80	2.17	2.38	2.03	2.24
14	2.45	2.59	2.31	2.45	1.96	2.10	1.82	1.96
15	2.10	2.31	2.03	2.17	1.68	1.89	1.61	1.75
16	1.82	1.96	1.75	1.89	1.47	1.61	1.40	1.54
17	1.61	1.75	1.54	1.68	1.33	1.40	1.26	1.33
18	1.40	1.47	1.33	1.47	1.12	1.26	1.05	1.19
19	1.19	1.33	1.19	1.33	1.05	1.12	0.98	1.05
20	1.10	1.24	1.10	1.24	0.96	1.03	0.91	0.98
21	1.00	1.14	1.00	1.14	0.86	0.93	0.84	0.91
22	0.91	1.05	0.91	1.05	0.77	0.84	0.77	0.84
23	0.87	0.98	0.87	0.98	0.73	0.80	0.73	0.78
24	0.83	0.91	0.83	0.91	0.69	0.76	0.69	0.73
25	0.78	0.84	0.78	0.84	0.64	0.71	0.64	0.67
26	0.74	0.77	0.74	0.77	0.60	0.67	0.60	0.62
27	0.70	0.70	0.70	0.70	0.56	0.63	0.56	0.56
28	0.66	0.63	0.66	0.63	0.52	0.59	0.52	0.50
29	0.62	0.56	0.62	0.56	0.48	0.55	0.48	0.45
30 & Later	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Withdrawals — Members who terminate may either elect to leave their account with TCDRS or withdraw their funds. The probability that a member elects a withdrawal varies by length of service and vesting schedule. Rates applied to your plan are shown in Table 6. For non-depositing members who are not vested, 100% are assumed to elect a withdrawal.

**Table 6
Probability of Withdrawal**

Years of Service	Probability	Years of Service	Probability
0	100%	15	40%
1	100	16	38
2	100	17	36
3	100	18	33
4	100	19	30
5	100	20	28
6	100	21	26
7	100	22	24
8	47	23	22
9	46	24	20
10	45	25	18
11	44	26	16
12	43	27	14
13	42	28	12
14	41	29*	10

* Members with more than 29 years of service are not assumed to refund.

SECTION 5

Glossary

For your convenience, certain terms used in this report are listed below.

Actuarial Accrued Liability This refers to the present value of future benefits less the present value of future normal cost contributions.

Actuarial Assumptions Factors that actuaries use in estimating the cost of funding your plan. Examples of actuarial assumptions are mortality rates, assumed investment return and employee turnover rates. These assumptions are used to estimate the cost of funding your plan.

Actuarial Experience Investigation The process actuaries use to help set actuarial assumptions.

Actuarial Valuation The process an actuary uses to calculate your required employer contribution rate.

Actuarial Value of Assets The value of cash, investments and other property belonging to a pension plan, as used by the actuary for the purpose of an actuarial valuation.

Annuity Purchase Rates The factors used to convert benefit credits to a monthly benefit when a member retires. Monthly benefits are calculated by dividing the total benefit credits by the associated annuity purchase rate. Sample annuity purchase rates for the standard form of payment are shown in Section 3.

Benefit Recipients This group includes both retirees and survivor beneficiaries receiving monthly payments.

Employer Contribution Rate The percentage of your covered payroll needed to fund your current and past earned benefits.

Normal Cost Rate The percentage of your organization's covered payroll needed to fund benefits for your current employees over their careers. See also entry-age actuarial cost method.

UAAL Rate UAAL stands for unfunded actuarial accrued liability. The rate is the percentage of your covered payroll needed to fund benefits not funded by your normal cost rate. See also entry-age actuarial cost method.

Required Rate This is the sum of the normal cost rate and the UAAL rate.

Elected Rate To help keep employer contribution rates more stable, a plan may choose to pay an elected rate, a rate that is greater than the required contribution rate. Adopting an elected rate may create a cushion in the event the plan has negative experience and may make budgeting easier.

Retirement Plan Rate This is the greater of the required or elected rate.

Entry-Age Actuarial Cost Method An actuarial cost method under which the expected future benefits of each individual are funded on a level basis over the individual's employment. The portion of the present value of future benefits allocated to a valuation year is called the normal cost. The portion of the present value not provided for at the valuation date by the present value of future normal costs (PVFNC) is called the actuarial accrued liability.

ESF The Employees Saving Fund. This is the fund where your employees' accounts are maintained.

Funded Ratio This is the ratio of your plan's actuarial value of assets to actuarial accrued liability. The funded ratio assumes on-going contributions. It does not represent the financial status of a terminating plan. It is a snapshot in time and moves from year to year.

Members This group includes both employees and former employees that have accounts at TCDRS. In other words, depositing and non-depositing persons with a TCDRS account.

Overfunded Actuarial Accrued Liability (OAAL)

OAAL refers to the excess, if any, of the actuarial value of assets over the actuarial accrued liability. (See also "Unfunded Actuarial Accrued Liability.")

Payroll Payroll includes the portion of your organization's payroll earned by your employees who deposit a portion of their paychecks to TCDRS.

Plan Assets The assets set aside to pay your plan's future benefit payments.

Plan Experience What actually happens to your plan assets and covered employees over time.

Present Value of Future Benefits The estimated value, in today's dollars, of the future benefits that the actuary expects will be paid under your plan. Actuaries calculate this amount using actuarial assumptions.

Present Value of Future Normal Cost Contributions

The portion of the present value of future benefits allocated to a valuation year based on your workforce entry and exit ages is called normal cost. This is the current value of normal cost contributions for all future years.

SAF Subdivision Accumulation Fund. This is the fund where your employer account is maintained.

Unfunded Actuarial Accrued Liability (UAAL)

The UAAL is the excess, if any, of the actuarial accrued liability over the actuarial value of assets. (See also "Overfunded Actuarial Accrued Liability.")