ECTOR COUNTY

APPRAISAL DISTRICT

2021

MINERAL APPRAISAL PARAMETERS

ECTOR COUNTY, TEXAS

MINERAL VALUE ADVISORY COMMITTEE

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ECTOR COUNTY APPRAISAL DISTRICT

MINERAL APPRAISAL PARAMETER POLICY

The Ector County Appraisal District has established policy to develop procedures to identify parametric data in the market that may be used to accurately estimate the market value of taxable mineral property. The established policies are designed to conform to Texas state law and approach the estimate of value in the same manner that potential buyers, sellers, investors, and lending institutions would use in measuring property potential, risk, and prudent value.

In the mass appraisal of mineral properties, like other properties, certain "benchmark" or "typical" properties or property parameters must be developed from significant market data. Since the whole property and not the product is the taxable property, the price of the produced product is useful only in so far as it may be used to estimate an income stream to calculate the present value of the future worth of the property. The first and primary "benchmark" parameter is the market price of the product. The true market of the product is closest measured by the "posted price" as established by Texas state law.

Other "benchmark" or "typical" parameters that are developed in the market value calculation are the discount rate, production decline rates, operating expenses, tax allowances, and specific individual property adjustments.

The "typical" or "benchmark" parameters that are used are developed from comparable properties and then applied with the individual characteristics of each property carefully considered in the appraisal. In addition, a full capitalization rate study applicable specifically to oil and gas investments is produced to formulate a standard base rate and property adjusted discount rate for the mineral appraisals.

Mineral appraisals are developed using the best market data available and generally accepted appraisal practices.

The "Manual for Discounting Oil and Gas Income" is published as a rule by the Texas Comptroller of Public Accounts in Section 9.4031, Comptroller of Public Accounts Property Tax Administration. "Oil and Natural Gas Escalation Forecast" is published in the Texas State Comptroller's Property Tax Division, Statement, annually.

(a) If a real property interest in oil or gas in place is appraised by a method that takes into account the future income from the sale of oil or gas to be produced from the interest, the method must use the average price of the oil or gas from the interest for the preceding calendar year multiplied by a price adjustment factor as the price at which the oil or gas produced from the interest is projected to be sold in the current year of the appraisal. The average price for the preceding calendar year is calculated by dividing the sum of the monthly average prices for which oil and gas from the interest was selling during each month of the preceding calendar year by 12. If there was no production of oil or gas from the interest during any month of the preceding calendar year, the average price for which similar oil and gas from comparable interests was selling during that month is to be used. Except as otherwise provided by this subsection, the chief appraiser shall calculate the price adjustment factor by dividing the spot price of West Texas Intermediate crude oil in nominal dollars per barrel or the spot price of natural gas at the Henry Hub in nominal dollars per million British thermal units, as applicable, as projected for the current calendar year by the United States Energy Information Administration in the most recently published edition of the Annual Energy Outlook by the spot price of West Texas Intermediate crude oil in nominal dollars per barrel or the spot price of natural gas at the Henry Hub in nominal dollars per million British thermal units, as applicable, for the preceding calendar year as stated in the same report. If as of March 1 of the current calendar year the most recently published edition of the Annual Energy Outlook was published before December 1 of the preceding calendar year, the chief appraiser shall use the projected current and preceding calendar year spot price of West Texas Intermediate crude oil in nominal dollars per barrel or the spot price of natural gas at the Henry Hub in nominal dollars per million British thermal units, as applicable, as stated in the Short-Term Energy Outlook report published in January of the current calendar year by the United States Energy Information Administration in the price adjustment factor calculations. The price for the interest used in the second through the sixth calendar year of the appraisal may not reflect an annual escalation or de-escalation rate that exceeds the average annual percentage change from 1982 to the most recent year for which the information is available in the producer price index for domestically produced petroleum or for natural gas, as applicable, as published by the Bureau of Labor Statistics of the United States Department of Labor. The price for the interest used in the sixth calendar year of the appraisal must be used in each subsequent year of the appraisal.

(b) The comptroller by rule shall develop and distribute to each appraisal office appraisal manuals that specify the formula to be used in computing the limit on the price for an interest used in the second through the sixth year of an appraisal and the methods and procedures to discount future income from the sale of oil or gas from the interest to present value.

(c) Each appraisal office shall use the formula, methods, and procedures specified by the appraisal manuals developed under Subsection (b).Added by Acts 1993, 73rd Leg., ch. 998, Sec. 1, eff. Sept. 1, 1993.Amended by:Acts 2007, 80th Leg., R.S., Ch. 911 (H.B. 2982), Sec. 2, eff. January 1, 2008.Acts 2011, 82nd Leg., R.S., Ch. 144 (S.B. 1505), Sec. 1, eff. January 1, 2012.Acts 2015, 84th Leg., R.S., Ch. 4 (S.B. 1985), Sec. 1, eff. January 1, 2016.

Glenn Hegar
Texas Comptroller of Public Accounts

Manual for Discounting Oil and Gas Income

April 2015

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(a) The Comptroller of Public Accounts adopts a Manual for Discounting Oil and Gas Income, with text as follows.

(b) Basis of the Manual for Discounting Oil and Gas Income.

(1) Tax Code Section 23.175, enacted by the 73rd Legislature, 1993, requires the comptroller's office to develop and distribute to each appraisal district an appraisal manual that specifies the methods and procedures to calculate the present value of oil and gas properties using discounted future income. The 82nd Legislature, 2011, amended Tax Code Section 23.175 to require the comptroller's office to specify the formula to be used in computing the limit on the price for an interest used in the second through the sixth year of an appraisal, beginning with the 2012 tax year. The formula is specified in subsection (p) of this section (Appendix 5).

(2) Section 23.175 also directs each appraisal district to use the specified methods and procedures.

(c) Introduction.

(1) This manual explains the concept of discounting, the discounted cash flow (DCF) equation, DCF appraisal, and three acceptable techniques for estimating a discount rate in the DCF method. The numbers used in the calculations are for illustrative purposes only.

(2) The three acceptable techniques for estimating discount rates are:

(A) market surveys;

(B) oil and gas sales analysis; and

(C) weighted average cost of capital (WACC), also called band of investment.

(3) Together, these techniques provide a range of discount rates. The appraiser must estimate the risk for each oil or gas property to assign a discount rate from the discount rate range.

(4) Subsections (l) – (o) of this section (Appendices 1-4) provide examples to illustrate DCF appraisal, the WACC estimating technique, a standard deviation analysis, and a description of property specific risk factors.

(d) Discounting.

(1) Because investors prefer immediate cash returns over future cash returns, investors pay less for future cash flows--they "discount" them. The amount investors discount the future cash flows depends on the length of time until the cash is due, the amount of risk that the cash will not be tendered when due, and the rate of return available from other comparably risky investments. This discounting procedure converts future income to present value, usually using annual discount factors. The discount factor for each successive year declines to reflect the reduced value of revenue received in the future. The appraiser calculates the present worth of the forecast revenue stream by multiplying the projected net income (cash flow) for each year by the calculated discount factor for that year. These discount factors are derived from the discount rate (also known as the yield rate), and the process is known as DCF analysis.

(2) The International Association of Assessing Officers in *Property Appraisal and Assessment Administration* (1990) defines discount rate as: "The rate of return on investment; the rate an investor requires to discount future income to its present worth. It is made up of an interest rate and an equity yield rate. Theoretical factors considered in setting a discount rate are the safe rate earned from a completely riskless investment (this rate may reflect anticipated loss of purchasing power due to inflation) and compensation for risk, lack of liquidity, and investment management expenses. The discount rate is most often estimated by band-of-investment analysis or a sales comparison analysis that estimates typical internal rates of return."

(3) The discount rate is a key variable in DCF analysis, making correct rate selection crucial. The market's expectations are critical when choosing a discount rate. According to the *Appraisal of Real Estate* by the Appraisal Institute (1992): "The selection of the yield discount rate is critical to DCF analysis. To select an appropriate rate an appraiser must verify and interpret the attitudes and expectations of market participants, including buyers, sellers, advisers, and brokers. Although the actual yield on an investment cannot be calculated until the investment is sold, an investor may set a target yield for the investment before or during ownership. Historical yield rates derived from comparable sales may be relevant, but they reflect past, not future, benefits in the mind of the investor and may not be reliable indicators of current yield. Therefore, the selection of yield rates for discounting cash flows should focus on the prospective or forecast yield rates anticipated by typical buyers and sellers of comparable investments. An appraiser can verify investor assumptions directly by interviewing the parties to comparable sales transactions or indirectly by estimating the income expectancy and likely reversion for a comparable property and deriving a prospective yield rate."

(e) Discounted cash flow appraisal.

(1) The DCF method is versatile and widely used to appraise income producing property. An appraiser using DCF first projects an anticipated net income for each year of the property's remaining economic life. Each annual cash flow is discounted to present value, and then all the present values are added to obtain the total market value of the real property interest being appraised.

(2) The DCF equation is expressed as follows.

$$PV = CF1 \times (PWF1) + CF2 \times (PWF2) + \ldots CFn \times (PWFn)$$

where:

PV=present value $;

CF=the cash flow or income for the period specified $;

PWF= the end of period present worth factor, equals $1/((1+i)^n)$;

i =discount rate (the period compound interest rate);

n =the period for the present worth factor being calculated.

(3) To estimate the present value (PV), an estimate of the income (cash flow) to be received in each period is necessary. The number of periods, n (usually years), used in the analysis is determined by the number of years that the mineral property is expected to produce a positive net income.

(4) There are many variations on the DCF formula. The formulas vary based on the time the money is received, i.e., continuously, beginning of period, middle of period or end of period. The period may be continuous, daily, monthly, quarterly, biannual or annual. Many oil properties are evaluated using an annual mid-period discounting variation of the DCF formula. The appropriate present-worth factor for mid-year DCF analysis is:

$$PWFMY = 1/((1 + i)^{(n - .5)})$$

where: PWFMY = mid-year present worth factor.

(5) Subsection (l) of this section (Appendix 1) illustrates how a DCF is calculated, using a midyear factor, for a mineral property.

(f) Discount rate components.

(1) Components. The discount rate used in DCF analysis has several components. These include:

(A) inflation rate;

(B) risk-free component;

(C) general risk premium; and

(D) property-specific risk premium.

(2) The inflation rate. The annual rate of price change for a basket of consumer goods. Inflation is normally measured by the Consumer Price Index for All Urban Consumers (CPI-U), calculated by the United States Bureau of Labor Statistics. The inflation rate is the most basic component of a discount rate. An investor's rate of return must equal the rate of inflation just to break even in real dollar terms.

(3) The risk-free component. A return to compensate the investor for a loss of liquidity. This component can also be defined as the risk-free rate minus the inflation rate. The risk-free rate is made up of the inflation rate plus a return to reimburse the investor for a loss of liquidity and is measured by the yield to maturity on federal government securities with a maturity period comparable to the investment under consideration (oil or gas reserves in this case). The market perceives these securities as risk-free for all practical purposes since they are issued by the United States government.

(4) General risk premium.

(A) A return to compensate the investor for assuming diversified company-wide risk. The WACC minus the risk-free rate is the general risk premium. The WACC is measured by weighting the typical oil company debt and equity costs by the typical oil company debt and equity capital structure percentages, and then adding the weighted costs. If one were appraising companies, the WACC would be the discount rate, since it reflects the market's expected yields from the stock and debt of a company. Calculation of a WACC will be explained in more detail later in this manual.

(B) For property tax purposes, appraisers estimate the value of individual mineral reserves, not the value of oil companies. Buyers of mineral reserves usually perceive these individual reserves as riskier than the stock and debt of an entire company. Companies can spread their risk over many individual mineral reserves and often over several kinds of assets (some of which are unrelated to the oil or gas business). This asset diversification reduces the company's risk and, as a result, the WACC derived from company financial data is usually lower than an individual producing property's discount rate. However, the WACC is always higher than the risk-free rate. This increase in the rate is a general risk premium to reward investors for assuming the diversified company-wide risk.

(5) Property-specific risk premium. A return that compensates the investor for assuming the unique risks associated with a particular mineral producing property. The discount rate minus the WACC is the property-specific risk premium. Investors demand a premium above the WACC to compensate them for this individual property risk. For certain high-risk properties, this premium can be quite high. See subsection (o) of this section (Appendix 4) for a list of property-specific risk factors.

(6) Component summary. These discount rate components can be summarized:

INFLATION RATE
+ RISK FREE COMPONENT
+ GENERAL RISK PREMIUM
+ PROPERTY SPECIFIC RISK PREMIUM
= DISCOUNT RATE.

(A) There are other ways to "build up" a discount rate. This method's advantage is that the first three components are quantifiable from public data. The property-specific risk premium may be derived from available data in some cases, but in general, the appraiser must estimate it.

(B) Refer to subsection (o) of this section (Appendix 4) for mineral-property conditions that should be considered when estimating the property-specific risk premium.

(g) Using the three techniques.

(1) Components contained in the three techniques.

(A) Market surveys and sales analysis result in rates that include all of the discount rate components. However, in these two techniques, the rate included for the property-specific risk premium is the typical rate for the properties included in the survey or sales analysis. The appraiser must estimate the property-specific risk premium (unless the sales sample is directly comparable to the property being appraised) and adjust for atypically high or low risk. This means that the appraiser must reduce the risk premium for properties with less than the typical risk and increase the risk premium for properties with more than the typical risk.

(B) The third technique, WACC, produces a rate that does not contain a component for property-specific risk. Because it lacks this component, the typical WACC of potential purchasers sets a minimum value for a discount rate and the appraiser must calculate the typical WACC of potential purchasers to know this lower limit. On a case-by-case basis, the appraiser should exclude oil companies from the WACC calculation if they cannot participate in the market for the property he or she is currently appraising. For instance, small companies may not be able to bid on certain very valuable oil and gas properties because of insufficient capital. A typical WACC for larger oil companies would establish an appropriate minimum discount rate for appraising these properties.

(C) An investor should not buy a property at a lower discount rate than his or her WACC, otherwise the investor's net worth will decrease. The appraiser must add the property-specific risk premium to the typical WACC of potential purchasers to develop a discount rate. See subsection (o) of this section (Appendix 4) for a list of property-specific risk factors.

(2) Developing a range.

(A) Ideally, the appraiser should use these three techniques simultaneously to develop a range of discount rates. The typical WACC sets the lower limit, while surveys and direct sales analysis provide a set of discount rates that the appraiser can use as a database that will help to estimate a midrange discount rate and an upper limit to the discount rate. Examples of these techniques can be found in subsections (l) – (p) of this section (the appendices).

(B) Some mineral properties may appear to sell at or below the purchaser's WACC. There are several reasons that a mineral property may appear to change hands at a discount rate equal to or less than the WACC. When a buyer (or appraiser) reduces the cash flows to account for reserve recovery risk the discount rate will not reflect the risk, but the purchase price will. To calculate a discount rate that is comparable to discount rates from other sales, the appraiser must quantify the risk adjustment and add it back to the cash flows. This discount rate will be higher than the non-risk-inclusive rate.

(C) Atypical income tax deductions, or abnormally high or low overhead can also create an artificially high or low discount rate. When faced with market evidence that would indicate a discount rate at less than a company's cost of capital, the appraiser should review all other appraisal parameters to determine why an abnormally low discount rate is indicated. An understated income stream is the most obvious reason. The appraiser may be able to adjust the cash flows and derive a market discount rate or may delete the sale from consideration.

(h) Market surveys.

(1) An appraiser may use market surveys as an indicator of the discount rate. Many studies and surveys are published to help the appraiser estimate an appropriate discount rate or range of rates for appraising oil and gas properties. The Society of Petroleum Evaluation Engineers' (SPEE) Annual Survey and the Western States Petroleum Association's (WSPA) Analysis of Oil and Gas Property Transfers and Sales and Derivation of a Band of Investment are good examples.

(2) The SPEE survey asks producers', consultants', and bankers' opinions on future prices, cost escalation and economic indices (including the discount rate) used in petroleum property evaluation.

(3) The WSPA study, conducted by Richard J. Miller and Associates, consists of two parts: an analysis of oil and gas property transactions and sales occurring in California from 1984 through the current year and an analysis of the WACC or Band of Investment of a representative group of companies for the same years. The WACC analysis is based on public data.

(i) Developing a discount rate from sales.

(1) Basic steps. To develop a discount rate from sales requires three basic steps:

(A) obtain recent sales prices from a variety of oil and gas producing properties;

(B) develop cash flow projections for each property; and

(C) calculate the internal rate of return (IRR) for each sale. This is also known as the DCF return on investment (DCFROI).

(2) Sales sources. Information about sales can be obtained from a variety of sources, but the best source is the buyer or seller. Other sources that list sales of oil and gas property include the Texas Railroad Commission, Oil and Gas Journal 300, Strevig and Associates, private firms and oil and gas companies. It is important to remember that the sale of an oil or gas property must be a market transaction when developing a discount rate from sales.

(3) Cash flow projections. After obtaining verified sales prices, the appraiser develops cash flow projections for each property. To the extent possible, the appraiser must talk with the parties to each sale to determine their expectations of the property and take those into account when making projections. The validity of the derived discount rate is a direct function of the amount of information obtained from the buyer and seller about their cash flow projections. The appraiser must incorporate this information into his or her projections. If the appraiser's projections differ from the buyer's and seller's expectations, the discount rate derived from the sale will be invalid.

(4) Calculating the IRR.

(A) The third step in developing a discount rate from sales is to calculate the internal rate of return (IRR) for each sale. The IRR is the yield (discount) rate at which the present value of a cash income stream equals the present value of the cash expenditures (the sales price in our analysis) necessary to produce that income stream. This discount rate is prospective; it does not depend on the historical performance of the property, but on the market participants' expectations of future performance. The discount rate at which the present value of the cash flows equals the sales price can be determined by trial and error. However, there are several calculators and personal computer software packages that can solve for the discount rate (IRR).

(B) Although computational procedures may vary slightly, this measure is also referred to as the profitability-index and investor's method. The IRR recognizes that funds received now are more valuable than those received at some future time. The investment outlay can be regarded as borrowed funds and the pre-tax cash flow as the payment of principle plus compound interest on the investment.

(j) Weighted average cost of capital.

(1) Definition. A widely used method for deriving a pre-tax base discount rate for valuation purposes is the band of investment, or WACC technique. The basis for this analysis is the financial data from a broad sample of oil companies that derive a majority of their operating revenues from oil and gas production. Since petroleum property valuation typically involves discounting cash flows over a long period of time, a long-term cost of capital is most appropriate for developing an oil or gas property discount rate. Thus, the appraiser should incorporate a broad time series of data to approximate a long-term cost of capital.

(2) Required calculations. Four sets of calculations are required to determine the WACC.

(A) The typical capital structure is derived and expressed as a proportion of debt and equity.

(B) The typical cost of outstanding debt is calculated based on bond yields.

(C) The typical cost of equity is computed using the Capital Asset Pricing Model (CAPM) or another method such as the DCF Model.

(D) Debt and equity costs are weighted according to the typical capital structure percentages and added to derive a typical cost of capital.

(3) Capital structure.

(A) Capital structure describes in percentage terms the sources of funds (capital) used to purchase the assets necessary to operate a company. The capital structure of any company consists of debt and equity. The debt portion consists of long-term debt (represented by outstanding bonds) and preferred stock, while the equity portion consists of outstanding common stock. If the company is funded by debt and equity of equal value, the capital structure is 50 percent debt and 50 percent equity.

(B) To estimate a discount rate for mass-appraisal purposes, the appraiser should use the typical market capital structure for a representative group of major and independent oil companies that derive a majority of their operating revenues from oil and gas production.

(4) Cost of debt. The yield-to-maturity is the best approximation of the cost of debt capital. This yield is observable in the marketplace and can be found by referring to Standard and Poor's Corporation Bond Guide, Moody's Bond Report or a comparable publication.

(5) Cost of equity.

(A) The CAPM is the preferred approximation of equity cost since it considers both historical market yields and current expectations, plus a market-derived equity risk factor. The CAPM method measures the cost of equity by considering that an investor's required rate of return on common stock is comprised of a risk-free return plus a risk-adjustment factor related to the specific stock. This is represented by the following equation:

$$K = Rfc + B(Rm - Rfh)$$

where:

K = cost of equity (after tax), percent/year;

Rfc = current risk-free rate, percent/year;

Rm = historic market return on equities, percent/year;

Rfh = historic market return on long-term government bonds, percent/year;

B = BETA coefficient.

(B) The current risk-free rate (Rfc) is typically based on current long-term government securities, i.e., the yield-to-maturity observed on an annual basis on a default-free treasury bond, note, or bill of the relevant time period. For oil and gas property appraisal, the yield on a long-term bond is an appropriate measure of the risk-free rate.

(C) The historical market return on equities (Rm) on common stocks and the historical arithmetic mean on long-term government bond income returns (Rfh) can be obtained from Ibbotson Associates' Stock, Bonds, Bills and Inflation. The beta coefficient (B) measures market risk by regressing the stock's total return against the market's total return. A more detailed description of the beta calculation can be found in the Ibbotson Associates report. The beta coefficient value can be obtained from Value Line Publishing, Incorporated's The Value Line Investment Survey, Standard and Poor's Corporation's S&P Stock Reports and similar investment services.

(D) The difference between the historical risk-free (Rfh) and market (Rm) rates of return is a measure of the non-systematic or non-market related risk caused by changes specific to the companies comprising the stock rate of return sample and is, in effect, an equity risk premium. Note that two different risk-free rates of return are used in the CAPM. The current risk-free rate (Rfc) is used to acknowledge the expectational function of the model. The historical risk-free rate (Rfh) is used in conjunction with the historical market return for the same time period when calculating the equity risk premium.

(E) The cost of equity resulting from this model is a nominal (current dollar) after tax rate. Conversion to a nominal, pre-tax rate requires dividing the equity cost (K) by one minus the federal statutory income tax rate for petroleum companies. The income tax rate is presently 35 percent. This is represented by the following equation:

$$K(\text{pre-tax}) = K/(1 - .35).$$

If the appraiser calculates a typical effective income tax rate from a representative sample of petroleum companies that could participate in the market for the property that he or she is appraising, the appraiser may substitute that typical effective income tax rate for the statutory rate.

(6) Weighting debt and equity costs.

(A) Once capital structure, debt, and equity costs are determined, the final step in deriving the WACC is to weight the cost of debt and equity by the proportional share each has in the overall capital structure. This is represented by the following equations.

Wtd Avg. Cost of Equity = (Cost of equity percentage) × (Equity fraction)

Wtd Avg. Cost of Debt = (Cost of debt percentage) × (Debt fraction)

WACC = Wtd Avg. Cost of Equity + Wtd Avg. Cost of Debt

The WACC can also be described as follows:

INFLATION RATE
+ RISK FREE COMPONENT
= RISK FREE RATE

RISK FREE RATE
+ GENERAL RISK PREMIUM
= WACC

(B) The WACC estimating technique is illustrated in subsection (m) of this section (Appendix 2).

(7) Final discount rate selection.

(A) As discussed earlier, the typical WACC of potential purchasers sets the lower end of the discount rate range. To help establish the upper end of the discount rate range, the appraiser can calculate a standard deviation of all the discount rates indicated by the sales in the sales sample and the survey. One standard deviation above and below the mean contains 68 percent of all the observations in a normally distributed set of data. Two standard deviations above and below the mean contains over 99 percent of all the observations in a normally distributed set of data. The data may not be normally distributed. Even so, this kind of analysis may help the appraiser to establish the upper end of the discount rate range.

(B) Very high-risk properties (for example, a one-well lease with high water production near the end of its economic life) may be discounted by the market at two standard deviations above the mean. Properties with lesser risk will have correspondingly lower discount rates. One standard deviation above the mean may establish an upper limit for properties in a typical risk-range. The mean or median of the discount rates from the sales analysis and the survey indicates the mid-range discount rate.

(C) For a standard deviation analysis to have meaning in selecting an upper limit to the discount rate range, the survey or sales data set must contain properties with broadly varying risk. A high-end discount rate selected by this method will not apply to very risky properties (it will be too low) unless these risky properties are represented in the sales data set used in the analysis.

(D) To select a discount rate for an individual property, the appraiser must assess the property-specific risk inherent in the property. Subsection (o) of this section (Appendix 4) lists risk factors that should be taken into account.

(k) Summary.

(1) This manual describes methods and procedures used to calculate the present value of oil and gas properties using discounted future income. The DCF method is the most widely used method to appraise mineral properties.

(2) Within the DCF equation, there are three generally accepted techniques for estimating a discount rate: market surveys, oil and gas sales analysis and WACC. Ideally, the appraiser should use these three techniques simultaneously to develop a range of discount rates.

(3) The evaluation of oil and gas properties demonstrates the importance of viewing a discount rate in the context of the entire appraisal, including the production decline rate, price, and cost parameters. The discount rate should not be considered an isolated variable, for it is only one component of a complex interaction of variables that collectively determine an estimate of value.

(l) Appendix 1: Discount Cash Flow Method (Working Interest Portion Only)

Year	(1) Net Oil Production (bbls)	(2) Oil Price ($/bbls)	(3) Gross Income ($)	(4) Op Exp+ SevTaxes ($)	(5) Net Income ($)	(6) Discount Factor @16.7%	(7) Discounted Cash Flow ($)
1	31,938	$ 19.75	$ 630,776	$ 159,015	$ 471,761	.925688	$ 436,703
2	25,550	20.54	524,797	159,341	365,456	.793220	289,887
3	20,440	21.36	436,598	160,692	275,906	.679709	187,536
4	16,352	22.22	363,341	162,946	200,395	.582441	116,718
5	13,081	23.10	302,171	165,982	136,189	.499093	67,971
6	10,465	24.03	251,474	169,733	81,741	.427671	34,958
7	8,372	24.99	209,216	174,115	35,101	.366471	12,863
						Subtotal	$ 1,146,636
				Salvage	$ 10,000	.339238*	3,392
						Total	$ 1,150,028

* End of year seven factor=$1/(1+.167)^7$

Calculation Procedures:

(1) Net Oil Production is Gross Oil Production times Net Revenue Interest (NRI). NRI equals 87.5 percent.

(2) Starting Oil Price, $19.75/bbl with an escalation rate of 4 percent/year.

(3) Gross Income equals Net Oil Production multiplied by Oil Price

(4) Op. Exp. + Sev. Taxes: Operating Expenses escalated at a rate of 4 percent/year; severance tax on oil is 4.6 percent/year

(5) Net Income equals Gross Income less Op. Exp. and Sev. Taxes

(6) Discount Factor (mid-year) @16.7 percent equals:

Year 1 $1/((1+.167)^{(1-.5)}) = .925688$

Year 2 $1/((1+.167)^{(2-.5)}) = .793220$

Year 3 $1/((1+.167)^{(3-.5)}) = .679709$

Year 4 $1/((1+.167)^{(4-.5)}) = .582441$

Year 5 $1/((1+.167)^{(5-.5)}) = .499093$

Year 6 $1/((1+.167)^{(6-.5)}) = .427671$

Year 7 $1/((1+.167)^{(7-.5)}) = .366471$

NOTE: The discount factor of 16.7 percent includes 1.7 percent for property taxes. Some appraisers handle property taxes as a deduction from gross income.

(7) DCF equals Net Income multiplied by the Discount Factor

Other factors that should be considered in the DCF method include capital expenditures, environmental remediation costs, and the present worth of the salvage value of equipment less well plugging costs.

(m) Appendix 2: Estimation of WACC

1. Derive the typical capital structure of a broad sample of potential purchasers as a proportion of debt and equity.

Data can be found in the 12/31/20xx issue of The Value Line Investment Survey under the headings "Petroleum (Integrated) Industry" and "Petroleum (Producing) Industry."

Outstanding Common Stock (Oil Company)

= 157,627,284 shares @ 12/31/20xx

Closing Common Stock Price

= $106.75/share

Common Stock Equity

= (157,627,284 shares) x ($106.75/share)

= $16,827,000,000 @ 12/31/20xx

Total Debt

= $6,791,000,000 @ 12/31/20xx

Total Capital

= Debt + Equity

= $6,791,000,000 + $16,827,000,000

= $23,618,000,000

Debt

= $6,791,000,000/$23,618,000,000

= .288 or 28.8 percent

Equity

= $16,827,000,000/$23,618,000,000

= .712 or 71.2 percent

The capital structure is 28.8 percent debt and 71.2 percent equity.

Repeat this procedure for each company in the sample.

2. Calculate the cost of outstanding debt

Data can be found using Standard & Poor's Bond Guide (12/20xx issue)

YTM = Yield-to-Maturity @ 12/31/20xx

Debt Instrument	Debt (MM$)	YTM (%/yr)	Debt x YTM
Debt A	$ 27	6.29	$ 170
Debt B	586	8.42	4,934
Debt C	132	7.52	993
Debt D	600	7.84	4,704
Debt E	265	4.95	1,312
Debt F	100	8.65	865
Debt G	300	7.87	2,361
Debt H	450	8.28	3,726
Debt I	123	8.70	1,070
Debt J	224	8.78	1,967
Debt K	300	8.29	2,487
Debt L	500	8.38	4,190
	$ 3,607		**$ 28,779**

Sum of Debt

= Debt (MM$) x YTM

= $28,779 MM

Cost of Debt

= Sum of Debt (MM$) / Debt (MM$)

= ($28,779 MM) / ($3,607 MM)

= 7.98 percent/year

Repeat this procedure for each company in the sample.

3. **Calculate the cost of equity**

Use the Capital Asset Pricing Model (CAPM) equation:

$$K = Rfc + B(Rm - Rfh)$$

where:

K = cost of equity (after tax), percent/year

Rfc = current risk-free rate, percent/year, can be found in the Federal Reserve Statistical Release (January of current year)

Rfh = historic market return on long-term government bonds, percent/year, can be found in Ibbotson & Associates: Stocks, Bonds, Bills and Inflation

Rm = historic market return on equities, percent/year, can be found in Ibbotson & Associates: Stocks, Bonds, Bills and Inflation

B = beta coefficient, can be found in The Value Line Investment Survey, 4th Qtr, 20xx

Given:

Rfc = 5.1 percent/year

Rfh = 5.5 percent/year

Rm = 12.4 percent/year

B = .80

$$K = Rfc + B(Rm - Rfh)$$
$$= 5.1 + .8(12.4-5.5)$$
$$= 10.6 \text{ percent/year}$$
$$K \text{ (pre-tax)} = 10.6/(1 - .34)$$
$$\text{Cost of equity} = 16.1 \text{ percent/year}$$

Repeat this procedure for each company in the sample.

4. **Calculate a typical WACC by plugging the mean (or other measure of central tendency) cost of debt, cost of equity and capital structure from the sample companies into the following formula:**

WACC = ((cost of debt) x (percent debt)) +
((cost of equity) x (percent equity))
= (7.98 x .288) + (16.1 x .712)
= 13.8 percent/year

(n) Appendix 3: Standard Deviation

The standard deviation is the square root of the average squared difference between the individual observations and the average value. The first step in the calculation of the standard deviation is to average the data arithmetically. The arithmetic average or mean value is denoted as z. An equation to calculate the mean value, z, of a data set is as follows:

$$z = 1/n(x1 + x2 + x3 + ... + xn)$$

where:

z = mean value of a data set of n values
x1 = unique value in data set
n = total number of values in data set

The standard deviation, usually denoted by the symbol, S, would be calculated using the following equation:

$$S = (((x1 - z)^2 + ... + (xn - z)^2)/(n-1))^{.5}$$

where:

S = standard deviation of a data set with n values
x1 = unique value in data set
xn = nth value in data set
n = total number in data set

Example: Procedure for calculating the standard deviation of a data set that has 10 sales with various internal rates of return (IRR).

Sales No.		IRR (%)	(x - z)	(x - z) ^2
1	x1	11.0	-4.7	22.09
2	x2	25.0	9.3	86.49
3	x3	6.0	-9.7	94.09
4	x4	16.0	0.3	0.09
5	x5	16.0	0.3	0.09
6	x6	22.0	6.3	39.69
7	x7	9.0	-6.7	44.89
8	x8	14.0	-1.7	2.89
9	x9	13.0	-2.7	7.29
10	x10	25.0	9.3	86.49
		157.0		**384.10**

Calculate the arithmetic average, z:

$z = 157.0/10 = 15.7$ IRR percent

Calculate the standard deviation, S:

$S = (384.1/(10-1))^{.5} = 6.5$ IRR percent

Range of 1 standard deviation

$= 15.7 \pm 6.5 = 9.2 < 15.7 < 22.2$

Range of 2 standard deviations

$= 15.7 \pm 6.5(2) = 2.7 < 15.7 < 28.7$

28.7 percent/year could be used as an upper limit to the discount rate range for high-risk properties.

(o) **Appendix 4: Property Specific Risk Factors**

A. One well lease

B. Oil lease with high water production

C. Lease near the end of its economic life

D. Gas well reservoir under partial or active water drive (recovery uncertain)

E. Curtailed gas well

F. Rapidly declining lease

G. Lease with less than six (6) months production history

H. Secondary Recovery Project in early stages before fill-up

I. Offshore oil or gas lease

J. Unusually high operating expenses (ex: paraffin problems, sour gas, etc.)

K. The appraiser should add to the base discount rate (WACC) for any other property specific factors that increase the investor's risk.

(p) Appendix 5: Formula for the Escalation or De-Escalation of Crude Oil and Natural Gas Prices

The formula to determine the maximum average annual escalation or de-escalation percentage for years two through six of an appraisal is:

$$((X/100)^{(1/Y)} - 1) \times 100 = \text{Percentage}$$

Where:

X = Most recent year annual average (not seasonally adjusted) Producer Price Index (PPI) for crude petroleum (domestic production) [Commodity Code 0561, Series ID# WPU0561] or natural gas [Commodity Code 0531] obtained from the Bureau of Labor Statistics during the month of January, which may contain preliminary statistics.

Y = Number of years from base year 1982 through the most recent year (most recent year minus base year).

The 100 denominator in the formula is the PPI annual average for domestically produced petroleum and natural gas in base year 1982.

Example Computation:

Most recent year = 2010

X = 218.6 for Crude Petroleum Domestic Production (Commodity Code 0561) [Series ID# WPU0561]

185.8 for Natural Gas (Commodity Code 0531)

Y = 2010 - 1982 = 28 years

1/Y = 1/28 = 0.035714286

Crude Petroleum (Domestic Production):

$((218.6/100)^{0.035714286} - 1) \times 100 = 2.832$ percent

Natural Gas:

$((185.8/100)^{0.035714286} - 1) \times 100 = 2.237$ percent

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Glenn Hegar
Texas Comptroller of Public Accounts

2020 Property Value Study

Discount Rate Range for Oil and Gas Properties

August 2020

2020 Property Value Study

Discount Rate Range for Oil and Gas Properties

The Texas Comptroller of Public Accounts conducts a Property Value Study (PVS) that includes oil and gas property appraisals. These appraisals are conducted according to methods and procedures outlined in the Comptroller's *Manual for Discounting Oil and Gas Income*, as required by Property Tax Code Section 23.175.

As part of the PVS, the Texas Comptroller's Property Tax Assistance Division (PTAD) calculates a range of discount rates used to discount the projected future income of oil and gas produced from individual properties. For the 2020 PVS, PTAD will use a range of 10.52 to 17.79 percent unless property-specific risk requires use of a discount rate outside this range.

This report summarizes this year's methodology for the discount rate range determination. For more detailed information, please contact the **Property Tax Assistance Division at 800-252-9121**.

Oil and Gas Property Appraisal

One of the primary economic parameters in oil and gas property appraisals is the discount rate used to convert future income streams to a present-day value. The process of discounting converts the value of cash projected to be received in the future to the current price investors would pay for the right to receive the income. This appraisal method is called a discounted cash flow analysis and it is a widely accepted appraisal method for oil and gas properties.

Each year, PTAD calculates a discount rate based upon the **overall mean weighted average cost of capital (WACC)** of a sample of petroleum companies. To account for inherent risk associated with oil and gas production from a single property rather than a company-wide portfolio of producing properties, PTAD adds two percentage points to the **overall mean WACC** to establish the **base discount rate** for each oil and gas property in the annual PVS. Other property-specific risk considerations may warrant additional risk adjustments (increase or decrease) that are used to calculate an **adjusted discount rate** for each property. The **adjusted discount rate** will usually fall within the discount rate range determined each year.

In accordance with International Association of Assessing Officers (IAAO) guidelines, PTAD adds the county and school district ad valorem total tax rates to the **adjusted discount rate** to determine a **property-specific discount rate** (city and special district tax rates are not included). The **property-specific discount rate** is then applied in the PTAD appraisal to discount the projected future income of oil and gas produced from the property.

Discount Rate

There are three generally accepted methods for estimating a discount rate: analysis of oil and gas property sales, market surveys and the weighted average cost of capital. These methods are discussed in the following paragraphs. For simplicity, the sales analysis and market survey methods are presented together.

The Oil and Gas Property Sales Analysis and Market Survey Methods

The Western States Petroleum Association and the California Independent Petroleum Association commissioned an annual analysis of fully disclosed oil and gas property sales that occurred in California. The sales data were compiled by Richard J. Miller & Associates. This sales analysis ended in 2006. See the Manual for Discounting Oil and Gas Income, (i) Developing a discount rate from sales for more information.

The Society of Petroleum Evaluation Engineers (SPEE) conducts an annual opinion poll market survey. Responses from petroleum company executives, industry consultants and energy banks concerning property acquisitions and divestitures offer insight into the discount rates used to analyze properties in the market.

TABLE 1

Petroleum Companies' Financial Information Used for WACC Method

Company Name	Total Capital	Total Equity	Total Convertible Preferred Stock	Total Long-Term Debt	Equity % of Capital	Convertible Preferred Stock % of Capital	Long-Term Debt % of Capital	Beta Factor	After Income Tax Cost of Equity, %	Before Income Tax Cost of Equity, %	Cost Of Convertible Preferred Stock %	Cost of Debt %	Before Income Tax WACC %	
Apache	$18,091,949,311	$9,536,949,311	$0	$8,555,000,000	52.71	0.00	47.29	1.70	12.46	15.77	0.00	4.95	10.65	
Cabot	$7,989,267,116	$6,856,242,116	$0	$1,133,025,000	85.82	0.00	14.18	1.20	9.46	11.97	0.00	3.85	10.82	
Chevron	$252,369,672,504	$228,551,672,504	$0	$23,818,000,000	90.56	0.00	9.44	1.20	9.46	11.97	0.00	2.63	11.09	
Cimarex	$7,319,235,811	$5,333,989,811	$0	$1,985,246,000	72.88	0.00	27.12	1.50	11.26	14.25	0.00	3.26	11.27	
Conoco Phillips	$85,805,484,744	$71,015,484,744	$0	$14,790,000,000	82.76	0.00	17.24	1.45	10.96	13.87	0.00	3.00	12.00	
Devon	$14,145,780,000	$9,851,780,000	$0	$4,294,000,000	69.64	0.00	30.36	1.90	13.66	17.29	0.00	3.81	13.20	
Diamondback	$20,518,626,450	$15,147,626,450	$0	$5,371,000,000	73.82	0.00	26.18	1.40	10.66	13.49	0.00	3.58	10.89	
EOG	$53,123,179,451	$48,962,260,451	$0	$4,160,919,000	92.17	0.00	7.83	1.50	11.26	14.25	0.00	2.55	13.33	
Exxon Mobil	$396,085,500,000	$369,743,500,000	$0	$26,342,000,000	93.35	0.00	6.65	1.10	8.86	11.21	0.00	2.53	10.63	
Hess	$27,842,311,648	$20,654,311,648	$46,000,000	$7,142,000,000	74.18	0.17	25.65	1.90	13.66	17.29	8.00	4.15	13.90	
Marathon	$16,390,280,000	$10,889,280,000	$0	$5,501,000,000	66.44	0.00	33.56	2.00	14.26	18.05	0.00	3.49	13.16	
Murphy	$7,983,001,092	$5,179,620,092	$0	$2,803,381,000	64.88	0.00	35.12	1.80	13.06	16.53	0.00	5.29	12.58	
Noble	$19,450,570,000	$11,973,570,000	$0	$7,477,000,000	61.56	0.00	38.44	1.70	12.46	15.77	0.00	3.86	11.19	
Ovintiv	$14,976,531,368	$8,002,531,368	$0	$6,974,000,000	53.43	0.00	46.57	1.90	13.66	17.29	0.00	4.33	11.25	
Parsley Energy Inc	$7,920,725,663	$5,737,893,663	$0	$2,182,832,000	72.44	0.00	27.56	1.70	12.46	15.77	0.00	4.80	12.75	
Pioneer	$27,058,375,290	$25,219,375,290	$0	$1,839,000,000	93.20	0.00	6.80	1.45	10.96	13.87	0.00	2.79	13.12	
Range	$4,799,242,841	$1,100,871,841	$0	$3,698,371,000	22.94	0.00	77.06	1.55	11.56	14.63	0.00	8.92	10.23	
SM Energy	$4,335,530,183	$1,264,335,183	$0	$3,071,195,000	29.16	0.00	70.84	2.30	16.06	20.32	0.00	6.79	10.74	
TOTAL	$986,205,263,472	$855,021,294,472	$46,000,000	$131,137,969,000	1251.96	0.17	547.87	29.25	216.12	273.57	8.00	74.58	212.80	
ENTRIES					18	1	18	18	18	18	1	18	18	
AVERAGE					69.55	0.17	30.44	1.63	12.01	15.20	8.00	4.14	11.82	WACC
STANDARD DEVIATION					20.32	0.04	20.32	0.31	1.87	2.37	1.89	1.62	1.17	
													13.82 Base Discount Rate	after 2% Risk Premium added

The Weighted Average Cost of Capital (WACC) Method

Each year PTAD calculates the WACC for several petroleum companies operating in Texas that are listed on the New York Stock Exchange or the Over-The-Counter stock market. PTAD calculates a discount rate based upon the average of the companies' WACC.

For the 2020 PVS, PTAD compiled year-end 2019 financial data for 18 petroleum companies to calculate the WACC for each company. Results of the WACC calculations are presented in **Table 1**. The overall mean WACC for the 18 companies is 11.82 percent with a standard deviation of 1.17 percent. Information on the methodology used to calculate a WACC can be reviewed in the Comptroller's *Manual for Discounting Oil and Gas Income*.

Base Discount Rate for All Oil and Gas Properties in the Property Value Study

PTAD adds two percentage points to the overall mean WACC of 11.82 percent to establish the base discount rate of 13.82 percent for the 2020 PVS. The two percentage points account for inherent risk associated with oil and gas production from an individual property. Other considerations may warrant additional property-specific risk or risk reduction in determining the adjusted discount rate for an individual property.

Adjusted Discount Rate

The base discount rate may be adjusted to reflect a wide variety of property-specific risks. PTAD considers specific risks associated with a property to determine its adjusted discount rate. Some common examples of risk routinely considered by PTAD and the associated adjustments are shown below.

Limited History

Limited production history is frequently cited as the major risk associated with appraising oil and gas properties. Decline curve analysis requires sufficient production history and some knowledge of the reservoir drive mechanism to enhance the confidence level for reserve forecasts.

Type of Risk	Added Percentage Points
Limited History:	
Less than one year	3
One to two years	2
Two to three years	1
More than three years	0

Single Completion Leases

Single completion leases have a greater chance of early abandonment because they do not involve or exhibit the potential for production from additional zones in a single well bore. Multiple completion wells are not adjusted for this risk.

Type of Risk	Added Percentage Points
Single Completion Lease	1

Offshore Leases

Offshore properties often involve production and economic risks greater than those associated with onshore properties.

Type of Risk	Added Percentage Points
Offshore Lease	2

Enhanced Oil Recovery (EOR) Leases

This recovery method, by definition, involves complex production methods and additional economic risks. Early-stage projects have a high degree of uncertainty for success, and pilot projects experience unusual risks associated with expansion throughout the field.

Type of Risk	Added Percentage Points
EOR Projects	Varies from 1 to 3 based on an individual project's ranking in the *Oil and Gas Journal* biennial EOR Survey

Other Adjustments

Other risk adjustments may be applied to individual properties at the appraiser's discretion.

Type of Risk	Adjustment Trend
Short Remaining Life (< 2 years)	may increase risk
High or Increasing Water Cut	may increase risk
Gas Curtailment	may increase risk
Environmental Concerns	may increase risk
Erratic Production	may increase risk
Long History, Stable Production	may decrease risk

Reconciling Results into the Discount Rate Range

This year's discount rate range of 10.52 to 17.79 percent is defined at the lower end by PTAD's base discount rate. PTAD establishes the upper end of the discount rate range by reconciling sales, survey and study data as shown in **Table 2**. The upper end of the discount rate range is the average of the "high-end" values listed in the Upper Discount Rate Range column. Similarities are evident when comparing the statistical results of the data; however, differences in the data highlight contrasting views in the market.

TABLE 2

Summary of Findings from Annual Sales Analysis, Market Survey and the Property Value Study

Study Author	Discount Rate	Standard Deviation	Discount Rate Range			Data Points
			Lower		Upper	
Society of Petroleum Evaluation Engineers*	10.00	N/A	8.00	to	15.00	32
Texas Comptroller of Public Accounts / Property Tax Assistance Division**	15.81	0.88	13.04	to	20.57	4,138
Average	12.91	0.88	10.52		17.79	

* *Discount Rate based on 32 survey responses: Survey of Parameters Used in Property Evaluation, June 2019*

** *Discount Rate based on the appraisal of 4,138 properties (average, excluding ad valorem taxes): 2019 Property Value Study*

Conclusions

A range of discount rates adjusted for individual property risk is appropriate for the appraisal of the wide variety of oil and gas properties in Texas. Use of a particular adjusted discount rate should be tailored to the appraiser's perception of risk associated with a specific property. Based upon the reconciliation of data from the sales analysis, market survey, WACC and study results, PTAD concludes that a discount rate range of 10.52 to 17.79 percent is generally suitable for the appraisal of oil and gas properties in the 2020 Property Value Study unless property-specific risk requires use of a discount rate outside this range. PTAD adds the appropriate ad valorem tax rates to the adjusted discount rate to determine the property-specific discount rate that is applied in PTAD's appraisal to discount the projected future income of oil and gas produced from the property.

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Texas Comptroller of Public Accounts

Taxes

Property Tax Assistance

2020 Property Value Study

CAD Summary Worksheet

068-Ector

Category	Number of Ratios **	2020 CAD Rept Appraised Value	Median Level of Appr	Coefficient of Dispersion	% Ratios w /in (+/ -) 10 % of Median	% Ratios w /in (+/ -) 25 % of Median	Price - Related Differential
A. SINGLE-FAMILY RESIDENCES	400	7,099,373,352	0.99	7.19	79.22	91.33	1.00
B. MULTI-FAMILY RESIDENCES	32	712,079,510	0.94	19.55	35.44	76.62	1.08
C1. VACANT LOTS	0	199,037,068	*	*	*	*	*
C2. COLONIA LOTS	0	0	*	*	*	*	*
D2. FARM/ RANCH IMP	0	8,460,319	*	*	*	*	*
E. RURAL-NON-QUAL	0	81,355,719	*	*	*	*	*
F1. COMMERCIAL REAL	60	2,526,550,223	0.93	13.96	43.65	77.52	1.00
F2. INDUSTRIAL REAL	0	658,569,269	*	*	*	*	*
G. OIL, GAS, MINERALS	30	1,442,600,517	1.00	11.13	80.13	93.17	1.06
J. UTILITIES	2	518,864,830	0.61	45.90	*	*	0.77

MINERAL PROPERTY
APPRAISAL PARAMETERS

PRODUCING MINERAL PROPERTY
PRESENT VALUE OF FUTURE WORTH
CALCULATION

PRODUCTION WITH DECLINE
X
CALCULATED PRICE OF PRODUCT
=
GROSS INCOME

ESTIMATED GROSS INCOME
-
SEVERENCE AND ESTIMATED
AD VALOREM TAX
-
ESTIMATED ANNUAL OPERATING COSTS
=
NET INCOME

TOTAL NET INCOME
(ALL YEARS OF ECONOMIC LIFE)
X
DISCOUNT FACTOR
PRESENT WORTH FACTOR
(CAPITAL + RISK)
=
PRESENT VALUE

CONSTANT RATE PRESENT WORTH FACTORS

MID YEAR BASIS

YEAR	10%	12%	14%	15%	18%	20%	25%	YEAR
1	0.953463	0.944911	0.936586	0.932505	0.920575	0.912871	0.894427	1
2	0.866784	0.843671	0.821567	0.810874	0.780148	0.760726	0.715542	2
3	0.787986	0.753278	0.720673	0.705108	0.661142	0.633938	0.572433	3
4	0.716351	0.672569	0.632169	0.613137	0.560290	0.528252	0.457947	4
5	0.651228	0.600508	0.554535	0.533163	0.474822	0.440235	0.366357	5
6	0.592025	0.536168	0.486434	0.463620	0.402392	0.366862	0.293086	6
7	0.538205	0.478722	0.426696	0.403148	0.341010	0.305719	0.234469	7
8	0.489274	0.427430	0.374295	0.350563	0.288991	0.254766	0.187575	8
9	0.444797	0.381634	0.328329	0.304837	0.244908	0.212305	0.150060	9
10	0.404361	0.340745	0.288008	0.265076	0.207549	0.176921	0.120048	10
11	0.367601	0.304237	0.252639	0.238501	0.175889	0.147434	0.096038	11
12	0.334183	0.271640	0.221613	0.200346	0.149059	0.122861	0.076831	12
13	0.303803	0.242536	0.194397	0.174292	0.126321	0.182385	0.061464	13
14	0.276184	0.216558	0.170524	0.151558	0.107052	0.085320	0.049172	14
15	0.251877	0.193348	0.149583	0.131790	0.090722	0.071100	0.039337	15
16	0.228251	0.172632	0.131213	0.114600	0.076883	0.059250	0.031470	16
17	0.287581	0.154136	0.115099	0.099652	0.065155	0.049375	0.025176	17
18	0.188638	0.137621	0.100964	0.086654	0.055216	0.041146	0.028141	18
19	0.171489	0.122876	0.088565	0.075351	0.046793	0.034288	0.016113	19
20	0.155899	0.109711	0.077689	0.065523	0.039655	0.028574	0.012898	20
21	0.141726	0.097956	0.068148	0.056976	0.033606	0.023811	0.010312	21
22	0.128842	0.087461	0.059779	0.049545	0.028480	0.019843	0.008250	22
23	0.117129	0.078898	0.052438	0.043082	0.024135	0.016536	0.006600	23
24	0.186481	0.069723	0.045998	0.037463	0.020454	0.013780	0.005280	24
25	0.096881	0.062253	0.040349	0.032576	0.017334	0.011483	0.004224	25

2021 - MINERALS PRICING - TPTC SECTION 23.175 (a)

The Energy Information Administration (EIA) of the U.S. Department of Energy has released its' January 2021 Short-Term Energy Outlook (STEO) concerning crude oil and natural gas prices for use in calculation of the price adjustment factors. For appraisal year 2021, the January STEO publication will be used to calculate the price adjustment factors (PAF's) as a secondary source per Texas Property Tax Code Section 23.175(a).

PAF using the AEO released on February 3, 2021:

Crude Oil PAF = $ 44.72 / $ 38.76 = 1.15377

Natural Gas PAF = $ 2.49 / $ 2.57 = 1.51208

Price Escalator Factor 2021:

Years 2021-2025

Oil: 1.000624%

Gas: .989516%

Years 2026 and after:

Oil: FLAT

Gas: FLAT

GAS PRICE AVERAGE 2020 - $ 2.07 p/mcf

ECTOR COUNTY APPRAISAL DISTRICT

2021
OIL AND PRICE DATA

AVERAGE POSTED PRICE 2020 ANNUAL

	WTI
CONOCO (Conoco Phillips 66)	36.21
VALERO MARKETING	36.08
PLAINS ALL AMERICAN	36.07
SHELL	36.21
ENERGY TRANSFER	36.00
FLINT HILLS RESOURCES (KOCH)	36.01
ENTERPRISE CRUDE OIL	36.04

West Texas Sour (WTS) Differential 1.1% Addition from WTI Price or $.40 per/barrel

REFERENCE (Default) BASE PRICE 2021 **WTI $ 35.99** **WTS $ 36.39**

Subject to adjustments for specific gravity, basic sediments, and water, trucking, gathering & other related charges. May be subject to bonus premiums and a market condition factor.

Adjustments for severance and ad valorem property taxes have not been included in these listed prices.

No adjustments to market price will be made without price verification.

2021 – Price Adjustment Factor Oil – 1.15377

Default Price Adjusted per 2020 PAF **$ 41.52** **$ 41.99**

ECTOR COUNTY APPRAISAL DISTRICT

2021 ADJUSTED GROSS OIL PRICES (APPRAISAL YEARS 1-25)

YEAR	WTI	WTS	PERCENTAGE CHANGE
*	41.52	41.99	
1	47.90	48.45	Start-PAF Applied
2	47.93	48.48	1.0006%
3	47.96	48.50	1.0006%
4	47.99	48.53	1.0006%
5	48.01	48.56	1.0006%
6	48.04	48.59	1.0006%
7	48.07	48.59	FLAT
8	48.07	48.59	FLAT
9	48.07	48.59	FLAT
10	48.07	48.59	FLAT
11	48.07	48.59	FLAT
12	48.07	48.59	FLAT
13	48.07	48.59	FLAT
14	48.07	48.59	FLAT
15	48.07	48.59	FLAT
16-25	48.07	48.59	FLAT

*Gross oil prices have an increased price adjustment factor of 1.0006% for Year-1. Adjustments for severance and ad valorem property taxes not included in listed prices.

ECTOR COUNTY APPRAISAL DISTRICT

2021 ESCALATED GROSS GAS PRICES (APPRAISAL YEARS 1-25)

YEAR	GAS	PERCENTAGE CHANGE
Pr. Yr. Avg. *	2.07	
1	3.13	Start-PAF Applied
2	3.10	.9895%
3	3.06	.9895%
4	3.03	.9895%
5	3.00	.9895%
6	2.97	.9895%
7	2.94	FLAT
8	2.94	FLAT
9	2.94	FLAT
10	2.94	FLAT
11	2.94	FLAT
12	2.94	FLAT
13	2.94	FLAT
14	2.94	FLAT
15	2.94	FLAT
16-25	2.94	FLAT

*Gross gas prices have a decreased price adjustment factor of .9895% for Year-1.
Adjustments for severance and ad valorem property taxes not included in listed prices.

REFERENCE (Default) PRICE PAF Applied $3.13

ECTOR COUNTY APPRAISAL DISTRICT

2021 Lease Equipment Schedule

WELL SCHEDULE	MAX TYPE	SALVAGE DEPTH	VALUE
01	OIL	3,000	4,000
02	OIL	5,000	6,000
03	OIL	7,000	9,000
04	OIL	10,000	12,000
05	OIL	15,000	18,000
06	GAS	2,000	3,000
07	GAS	4,000	7,000
08	GAS	8,000	1,000
09	GAS	10,000	15,000
10	GAS	15,000	25,000
11	W INJ	5,000	3,000
12	W INJ	7,000	4,000
13	W INJ	10,000	6,000
14	W INJ	15,000	9,000
15	CO2 INJ	5,000	5,000
16	CO2 INJ	7,000	6,000
17	CO2 INJ	10,000	9,000
18	CO2 INJ	15,000	12,000
19	S.W.D.		2,000

Schedule salvage value will be discounted to present worth based on the economic life of the property. Net Salvage will be at a 6% discount rate. Maximum life 25 years.

January 1, 2021

COST OF CAPITAL STUDY

Weighted Average Cost of Capital

For the Year 2021

For Incorporation into the Ector County Appraisal District's 2021 Mineral Appraisal Manual

Analysis and Report prepared by:

George K. Lagassa, PhD, ASA

Mainstream Associates
26 Maple Road
North Hampton, New Hampshire 03862

Prepared for:

Ector County Appraisal District

Odessa, Texas

February 10, 2021

MAINSTREAM ASSOCIATES

26 Maple Road
Post Office Box 947
North Hampton, New Hampshire 03862

February 10, 2021

Ms. Anita Campbell
Executive Director
Ector County Appraisal District
1301 East 8th Street
Odessa, Texas 70761

Dear Ms. Campbell,

Enclosed, in duplicate, is my report "Weighted Average Cost of Capital for the Year 2021", for incorporation into the Ector County Appraisal District's 2021 Mineral Appraisal Manual.

Please do not hesitate to contact me if you have any questions or concerns about its form or content. Thank you for your continued confidence in the quality of our work and for continuing to use Mainstream Associates for this assignment.

Sincerely,

George K. Lagassa, PhD, ASA

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COST OF CAPITAL

Valuation of liquid pipeline operating properties using the discounted cash flow technique requires determining the correct discount rate to apply to future cash flows from the subject pipeline properties. This is typically the opportunity cost of capital or the return on investment otherwise available in the marketplace, if it were not invested in the subject properties. The opportunity cost of capital is the return that must be provided by the subject property in order to attract capital investment.

Recognizing that capital can come from both debt and equity contributions to an investment, financial theory develops the cost of capital using a band of investment technique or a weighted average cost of capital (WACC), where the expected return to each band of capital contribution is weighted, based on relative contribution, and then summed for a total weighted average cost of capital. In this report, we explain the various determinants of WACC for petroleum and liquid pipeline operating property and develop the expected WACC for varying sizes of investors in such properties, as of January 1, 2021[1]. Our results are shown in **Figure 1**, below. The rest of this report explains the various factors that contributed to the conclusions in **Figure 1**.

Figure 1
Estimated Cost of Capital (WACC)
Integrated Petroleum Industry
As of January 1, 2021

Market Cap	After Tax Cost of Debt	%age of Debt	Average Cost of Equity	%age of Equity	WACC
Large Cap	2.65%	35%	10.10%	65%	7.49%
Mid Cap	2.65%	35%	10.92%	65%	8.03%
Low Cap	2.65%	35%	11.59%	65%	8.46%
Micro Cap	2.65%	35%	13.43%	65%	9.66%

[1] However, much of the data used to support this report were reported in *Value Line* on November 27, 2020 and Jan 29, 2021, and generally uses data as of Q4 2020.

WEIGHTED AVERAGE COST OF CAPITAL

The basic formula for the Weighted Average Cost of Capital (WACC) is as follows:

$WACC = (\%D \times R_D) + (\%P \times R_P) + (\%E \times R_E)$

Where: WACC = Weighted Average Cost of Capital

%D = relative contribution of debt to the capital structure

R_D = market-based return on debt

%P = relative contribution of preferred shares to the capital structure

R_D = market-based return on preferred shares

%E = relative contribution of common equity to the capital structure

R_D = market-based return on common equity

Thus, determination of the WACC requires determination of the following contributing factors:

(1) Capital Structure (i.e., percent contribution of each capital source)

(2) Expected Return on Debt

(3) Expected Return on preferred shares

(4) Expected return on common equity

For the development of information about each of these factors we rely almost exclusively on the most current available (November 27, 2020 and January 29, 2021) *Value Line Investment Survey*, which reports past and projected future financial expectations for participants in the Integrated Petroleum, Petroleum Producing, Oil and Gas Distribution, and Diversified Natural Gas Industries. The *Value Line Investment Survey* is a well-respected investment advisory service that monitors the performance of thousands of companies and is typically used by analysts as a source of information about the strength and financial expectations of particular industries and particular companies.

Market costs of debt are taken from *Federal Reserve Statistical Release H.15, Selected Interest Rates,* which reports current and historical data with respect to market interest rates on corporate and municipal bonds, US treasuries, and bank loans.

For the development of the cost of equity, we find guidance in the computations performed by Aswath Damadoran, professor of corporate finance and valuation at the Stern School of Business at New York University (see pages.stern.nyu.edu/adamador) and in the most recent *Cost of Capital Navigato*r developed by Duff & Phelps, as updated on February 9, 2021.

CAPITAL STRUCTURE

Capital structure is the relative contribution of each type of capital – debt, preferred shares, and common shares -- to the typical investment in the Integrated Petroleum, Petroleum Producing, Oil and Gas Distribution, and Diversified Natural Gas industries[2]. As shown in **Figure 2**, using data from the *Value Line Investment Survey*, we have determined the capital structure of 35 companies active in these industries to be approximately 65% equity and 35% debt, as of Jan 2021. Currently, preferred shares are rarely utilized to raise capital in this industry, and only one of the benchmark companies selected made use of preferred shares.

Note that *Value Line* provides data with respect to the book value of debt and preferred issuances and the market value of equity. Typically, the market value of debt and preferred stock are very close to book value, leading us to conclude that the use of book capital structure for debt and preferred stock supports a reasonable indicator of the market capital structure.

The mean (average) and median (center of the distribution) represent two measures of central tendency. The mean debt percentage is 34.6%, while the median debt percentage is 40.6%. Given the wide range between these two measures of central tendency, we supplement the measures with an adjusted mean from which we exclude the highest equity ratio (Brigham Minerals) and the lowest equity ratio (Antero Resources). With these excluded from the analysis, the adjusted mean debt portion shows a *de minimus* decrease from 34.6% to 34.5%, and the median debt portion decreases from 40.6% to 39.1%. Based on these measures of central tendency, as of January 1, 2021, we conclude that the typical capital structure is 65% equity and 35% debt.

[2] Data are collected for all three industries but referred to herein as the Integrated Petroleum Industry.

Figure 2
Integrated Petroleum Industry
Capital Structures

	Company	Symbol	LT Debt (millions)	Pfd Stock (millions)	Shr Equity (millions)	% LT Debt	%Pfd St	% Equity
1	Apache Corp.	APA	$8,523	$0	$3,420	71.4%	0.0%	28.6%
2	Antero Resources	AR	$3,158	$0	$1,053	75.0%	0.0%	25.0%
3	Brigham Minerals	MNRL	$5	$0	$485	1.0%	0.0%	99.0%
4	Cabot Oil & Gas	COG	$974	$0	$6,796	12.5%	0.0%	87.5%
5	Cenovus	CVE.TO	$7,797	$0	$7,275	51.7%	0.0%	48.3%
6	Chevron Corp	CVX	$34,280	$0	$166,117	17.1%	0.0%	82.9%
7	Cimarex Energy	XEC	$1,986	$0	$3,473	36.4%	0.0%	63.6%
8	Concho Resources	CXO	$3,856	$0	$10,828	26.3%	0.0%	73.7%
9	Conoco Phillips	COP	$14,905	$0	$48,402	23.5%	0.0%	76.5%
10	CVR Energy	CVI	$1,683	$0	$1,497	52.9%	0.0%	47.1%
11	Delek US Holdings	DK	$2,441	$0	$1,096	69.0%	0.0%	31.0%
12	Devon Energy	DVN	$4,300	$0	$4,799	47.3%	0.0%	52.7%
13	Diamondback	FANG	$5,656	$0	$9,348	37.7%	0.0%	62.3%
14	EQT Corp.	EQT	$4,596	$0	$3,765	55.0%	0.0%	45.0%
15	Exxon-Mobil	XOM	$46,888	$0	$161,349	22.5%	0.0%	77.5%
16	Hess Corp.	HES	$8,838	$0	$14,377	38.1%	0.0%	61.9%
17	HollyFrontier Corp	HFC	$3,176	$0	$3,916	44.8%	0.0%	55.2%
18	Imperial Oil	IMO	$3,724	$0	$12,509	22.9%	0.0%	77.1%
19	Kinder Morgan	KMI	$32,700	$0	$30,946	51.4%	0.0%	48.6%
20	Magnolia Oil & Gas	MGY	$391	$0	$2,206	15.1%	0.0%	84.9%
21	Marathon Oil	MRO	$5,503	$0	$3,142	63.7%	0.0%	36.3%
22	Marathon Petrol.	MPC	$29,377	$0	$26,501	52.6%	0.0%	47.4%
23	MDU Resources	MDU	$2,269	$0	$5,121	30.7%	0.0%	69.3%
24	Murphy Oil	MUR	$2,987	$0	$1,456	67.2%	0.0%	32.8%
25	National Fuel Gas	NFG	$2,630	$0	$3,840	40.6%	0.0%	59.4%
26	Oneok	OKE	$14,249	$0	$14,376	49.8%	0.0%	50.2%
27	Ovintiv	OVV	$7,142	$0	$3,099	69.7%	0.0%	30.3%
28	PDC Energy	PDCE	$1,526	$0	$1,591	49.0%	0.0%	51.0%
29	Phillips 66	PSX	$12,966	$0	$27,352	32.2%	0.0%	67.8%
30	Royal Dutch B (ADR)	RDSB	$91,200	$0	$122,375	42.7%	0.0%	57.3%
31	Suncor Energy Inc	SU	$15,424	$0	$29,939	34.0%	0.0%	66.0%
32	Targe Resources	TRGP	$7,652	$297	$4,942	59.4%	2.3%	38.3%
33	Total SA (ADR)	TOT	$61,500	$0	$108,004	36.3%	0.0%	63.7%
34	Valero Energy	VLO	$14,577	$0	$22,702	39.1%	0.0%	60.9%
35	Whiting Petroleum	WLL	$425	$0	$626	40.4%	0.0%	59.6%
	TOTAL/AVERAGE		$459,304	$297	$868,723	34.6%	0.0%	65.4%
	ADJ MEAN		$456,141	$297	$867,185	34.5%	0.0%	65.5%
	MEDIAN		$2,630	$0	$3,840	40.6%	0.0%	59.4%

COST OF DEBT

The typical cost of debt for the liquid petroleum industry was estimated by determining the bond ratings set by Moody's for 29 of the 35 benchmark companies from the Integrated Petroleum Industry as listed in the *Value Line Investment Survey.* **Figure 3** indicates those ratings and the corresponding S & P and Fitch ratings.

Figure 3
S & P., Moody's and Fitch Bond Ratings
29 Benchmark Companies

	Company	Symbol	S+P Rating	Moody's Rating	Fitch
1	Apache Corp.	APA	BB+	Ba1	BB+
2	Antero Resources	AR	B+	B1	B+
3	Brigham Minerals	MNRL		NA	
4	Cabot Oil & Gas	COG		NA	
5	Cenovus	CVE	BBB-	Baa3	BBB-
6	Chevron Corp	CVX	AA	Aa2	AA
7	Cimarex Energy	XEC	BBB-	Baa3	BBB-
8	Concho Resources	CXO	BBB-	Baa3	BBB-
9	Conoco Phillips	COP	A-	A3	A-
10	CVR Energy	CVI	BB-	Ba3	BB-
11	Delek US Holdings	DK	BB-	Ba3	BB-
12	Devon Energy	DVN	BB+	Ba1	BB+
13	Diamondback	FANG	BB+	Ba1	BB+
14	EQT Corp.	EQT	BB-	Ba3	BB-
15	Exxon-Mobil	XOM	AA=	Aa1	AA+
16	Hess Corp.	HES	BB+	Ba1	BB+
17	HollyFrontier Corp	HFC		NA	
18	Imperial Oil	IMO		NA	
19	Kinder Morgan	KMI	BBB	Baa2	BBB
20	Magnolia Oil & Gas	MGY	B+	B1	B+
21	Marathon Oil	MRO	BBB-	Baa3	BBB-
22	Marathon Petrol.	MPC	BBB	Baa2	BBB
23	MDU Respurces	MDU		NA	
24	Murphy Oil	MUR	BB-	Ba3	BB-
25	National Fuel Gas	NFG	BBB-	Baa3	BBB-
26	Oneok	OKE	BBB-	Baa3	BBB-
27	Ovintiv	OVV	BB+	Ba1	BB+
28	PDC Energy	PDC	BB	Ba2	BB
29	Phillips 66	PSX	A-	A3	A-
30	Royal Dutch B (ADR)	RDSB	AA	Aa2	AA
31	Suncor Energy Inc	SU	BBB+	Baa1	BBB+
32	Targa Resources		BB-	Ba3	BB-
33	Total SA (ADR)	TOT	A-	A3	A-
34	Valero Energy	VLO	BBB	Baa2	BBB
35	Whiting Petroleum	WLL	CCC	Caa2	
	MEDIAN		BBB-	Baa3	BBB-

In early December 2020 Moody's Seasoned Baa U. S. corporate bond yield was reported to be 3.16%, down from the 3.88% reported for December 31, 2019. The reported monthly yield as of January 2021 had crept up to 3.25%. Given the slightly lower rating of the median benchmark bond, we select 3.3% as a fair measure of the required return on debt for the Integrated Petroleum Industry. This rate of return is further adjusted to reflect anticipated debt issuance costs of 1.5%, indicating a total cost of debt of 3.35%. Since interest on debt is sheltered from federal income taxes, the actual cost to the investor is less on an after-tax basis. Assuming an income tax rate of 21%, as established by the federal tax code, the after-tax cost of debt is 3.35% X (1-21%) or 2.65%.

COST OF EQUITY

Unlike capital structure and return on debt, the cost of equity is not easily observable in the market and needs further analysis in order to be estimated. Several methods exist for measuring this cost. We use the following four methods:

(1) the Build-Up Method,

(2) the Capital Asset Pricing Model (CAPM),

(3) the Discounted Cash Flow Model (based on Dividend Growth)

(4) the Discounted Cash Flow Model (based on Average Annual Total Returns)

(1) The Build-Up Method

The build-up method is additive, requiring us to sum various components to derive the estimated cost of equity capital.

The first component is the risk-free rate, which represents the base return that investors in the marketplace perceive as obtainable with essentially no risk. This is measured by the yield on long-term U.S. Treasury Coupon Bonds. Ideally the selected bond term matches the life of the investment being appraised. In this instance, we believe 20 years is a reasonable choice. As reported in *Federal Reserve Statistical Release H.15, Selected Interest Rates*, the nominal market yield to maturity on 20-year U. S. Treasury securities reported for January 2020 was 1.61%. The nominal yield to 30-year treasuries on the same date was 1.8%. The Duff & Phelps *Cost of Capital Navigator* indicates a spot 20-year treasury yield of 1.45% and a 30-year yield of 1.65%. We adopt 1.5% as a reasonable estimate of the risk-free rate as of Q1 2020.

Computation of the return on equity by the build-up method requires adding two other components of systematic risk: the equity risk premium and the size risk premium. In addition, unsystematic risk is accounted for by a company or industry risk premium generally more specific to the company or industry in question. In this instance, where we are dealing with an entire industry not any particular company, the final adder is an industry risk premium (IRP). Thus, the formula for measuring the cost of equity capital by the build-up method is as follows:

K_e = RFR + ERP + SRP + IRP, where

K_e = cost of equity capital

RFR = the risk-free rate

ERP = the equity risk premium (systematic risk inherent in equity markets)

SRP = the size risk premium

IRP = industry risk premium

The equity risk premium can be computed on a historical basis or on a forward-looking basis. Looking to historical market performance, the equity risk premium represents the long-term historical (since 1926) average premium paid to investors in the stock market over and above the risk-free rate. As reported by Duff & Phelps and used in their most recent *Cost of Capital Navigator,* the long-term-supply side equity risk premium (1926 – present) is 6.0%, indicating a base cost of capital (prior to other adders) of 1.5% + 6.0% = 7.5%. Damadoran adopts a more future oriented, forward looking approach and has computed an ERP of 5.43%, based on smoothed net cash earnings (ten-year average) in the market as of January 1, 2021, which when added to the estimated RFR of 1.5% in January, 2021 supports a base equity return of 6.93%. For purposes of this analysis we take the mean of the two estimated ERPs (6.0% and 5.43%) to be the correct ERP, or 5.71%, indicating a total base cost of capital of 1.5% + 5.71% or 7.21%[3].

The industry risk premium is added to reflect the impact on capital costs associated with the crude petroleum and natural gas industry by comparison to the stock market as a whole. This is measured by the industry beta which indicates the extent to which a particular industry tracks the variability of the stock market as a whole. A beta of 1 indicates equal volatility, a beta of less than one indicates less volatility than the market as a whole, and a beta greater than 1 indicates greater volatility. In **Figure 6** below we note that as of this date the mean beta for 33 of the 35 benchmark petroleum industry members presented is 1.3, and the median beta is 1.4. The calculated industry-wide average beta for SIC 131 is 1.33. For purpose of this analysis we adopt 1.35 as the appropriate industry beta. The associated industry risk premium (based on the estimated ERP of 5.71%) is 2.00% (i.e., 5.71% x 1.35 – 5.71% = 2.00%).

The size risk premium attempts to account for the fact that the market views smaller firms as less liquid and riskier and demanding of higher returns. *Duff & Phelps Valuation Yearbook* asserts that this relationship between size and expected returns cuts across all industries and measures the additional effect of firm size on expected total equity returns across industry broken into size deciles. These deciles are also grouped into four groups – large cap, mid-cap, low-cap, and micro-cap. During the several years that we have prepared this cost of capital analysis, the size premium has generally remained stable in each of these categories. However, over the past few years the total capitalization range for each category shifted up, with the cut off for large caps increasing from approximately $9.2 billion to $13.1 billion.

For purposes of this analysis, we have utilized the capitalization thresholds set forth by Duff & Phelps' most recent Cost of Capital Navigator and applied as the matching size premia, the average of the size premia for its component deciles. These are shown in **Figure 4**, below.

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[3] Following the market stresses of 2008, Duff & Phelps now also compute a normalized risk-free rate and equity risk premium, which are intended to reflect the sustainable average return on long-term U.S. government bonds without the impact of flight to quality or the impact of monetary intervention to maintain lower risk-free rates. As of January 1, 2021 Duff & Phelps estimated the normalized risk free rate to be 2.5% and the normalized equity risk premium to be 5.5%, indicating a base cost of equity of 8.0% .

Figure 4
Duff & Phelps Size Categories and Estimated Risk Premia

Name	Decile	Size Range (in millions)	Size Premium
Large-Cap	1 - 2	>$13,177.828	0.00%
Mid-Cap	3 - 5	$2,445.693 to $13,177.828	0.78%
Low-Cap	6 - 8	$451.955 to $2,444.745	1.43%
Micro-Cap	9 - 10	$2.194 to 451.800	3.21%

Figure 5 adds the risk-free rate, the equity risk premium, the industry risk premium, and the size risk premium for these four different categories and indicates the cost of equity as computed using the Build-up Method.

Figure 5
Cost of Equity by the Build-Up Method

Size	Risk Free Rate	Equity Risk Prem	Industry Risk Premium	Size Risk Prem	Total Cost of Equity
Large-Cap	1.50%	5.71%	2.00%	0.00%	9.21%
Mid-Cap	1.50%	5.71%	2.00%	0.78%	9.99%
Low-Cap	1.50%	5.71%	2.00%	1.43%	10.64%
Micro-Cap	1.50%	5.71%	2.00%	3.21%	12.42%

(2) The Capital Asset Pricing Model (CAPM)

The capital asset pricing model is among the most widely used methods for measuring the cost of equity. Like the build-up method, it is additive to the risk-free rate, but adds an equity risk premium that differentiates between systematic risk and unsystematic risk. Unsystematic risk does not merit a reward, but systematic risk is rewarded with a risk premium that is proportionate to the degree of covariance (volatility) of the subject asset or investment and the market as a whole. The measure of this covariance is *beta* and the formula for calculating the cost of equity using CAPM is as follows:

$$Ke = RFR + (Beta \times ERP) + SRP$$

For our analysis using the build-up method, we determined a risk-free rate of 1.5%, and an estimated equity risk premium (ERP) of 5.71%. If we use these data and the same industry beta of 1.35, the CAPM calculation will necessarily produce the exact same results. Thus, in the interests of more balanced results, for purposes of our CAPM analysis we utilize the normalized risk-free rate (2.5%) and normalized equity risk premium (5.5%) recommended by Duff & Phelps as of January 1, 2021, the same industry beta (1.35), and the same average size risk premia (SRP) for four company size categories. **Figure 7** indicates the cost of equity as computed using the CAPM approach based on these inputs.

Figure 6
Value Line Beta
33 Benchmark Companies

	Company	Symbol	Value Line Beta
1	Apache Corp.	APA	1.90
2	Antero Resources	AR	1.20
3	Brigham Minerals	BP	NMF
4	Cabot Oil & Gas	COG	0.90
5	Cenovus	CVE	1.60
6	Chevron Corp	CVX	1.30
7	Cimarex Energy	XEC	1.35
8	Concho Resources	CXO	1.35
9	Conoco Phillips	COP	1.35
10	CVR Energy	CVI	1.10
11	Delek US Holdings	DK	1.30
12	Devon Energy	DVN	1.60
13	Diamondback	FANG	1.50
14	EQT Corp.	EQT	0.95
15	Exxon-Mobil	XOM	1.15
16	Hess Corp.	HES	1.45
17	HollyFrontier Corp	HFC	1.30
18	Imperial Oil	IMO	1.45
19	Kinder Morgan	KMI	1.25
20	Magnolia Oil & Gas	MGY	1.25
21	Marathon Oil	MRO	1.65
22	Marathon Petrol.	MPC	1.70
23	MDU Respurces	MDU	1.10
24	Murphy Oil	MUR	1.80
25	National Fuel Gas	NFG	0.85
26	Oneok	OKE	1.60
27	Ovintiv	OVV	1.70
28	PDC Energy	PDC	1.40
29	Phillips 66	PSX	1.30
30	Royal Dutch B (ADR)	RDSB	1.30
31	Suncor Energy Inc	SU	1.35
32	Targa Resources	TRGP	1.80
33	Total SA (ADR)	TOT	1.15
34	Valero Energy	VLO	1.55
35	Whiting Petroleum	WLL	NMF
	MEDIAN		**1.40**
	MEAN		**1.30**

Figure 7
Cost of Equity by CAPM Approach

Size	Risk Free Rate	Equity Risk Premium	Industry Ave. BETA	Size Risk Prem	Total Cost of Equity
Large-Cap	2.50%	5.5%	1.35	0.00%	9.93%
Mid-Cap	2.50%	5.5%	1.35	0.78%	10.71%
Low-Cap	2.50%	5.5%	1.35	1.43%	11.36%
Micro-Cap	2.50%	5.5%	1.35	3.21%	13.14%

(3) Discounted Cash Flow Model (based on Gordon Growth formula)

One reasonable estimate of the cost of equity is the return an investor might expect from owning a share of stock. This may be computed using the Gordon Growth Model, invented by Myron J. Gordon in 1959 to assist in determining the value of a stock. Essentially, Gordon's formula determines the intrinsic value of a stock, based on anticipated dividend size and their expected future growth rate. Given a per share dividend to be paid one year into the future and assuming a fixed dividend growth rate in perpetuity, the Gordon formula computes the present value of the infinite series of dividend payments. For this exercise, the formula is manipulated to solve for expected return on equity in the market. Thus, the Gordon growth formula, reconfigured to solve for the cost of equity, is as follows:

Ke = (D1/P0) + g, where

Ke = the market cost of equity

D1 = the dividends for the next period

P0 = the present market price of the equity

G = the estimated future dividend growth rate

Figure 8, below, shows the results of our analysis and indicates a mean and median cost of equity of 8.96% and 10.1% respectively. In **Figure 9** we further modify the formula by defining G as the estimated future growth in total earnings, as earnings tend to drive the price of stocks and may better reflect the additional return to equity resulting from increased stock price. Taking this approach, the average cost of equity is slightly higher at 11.4% and the median is 13.3%.

The estimated cost of equity developed using projected earnings growth is slightly higher but still supportive of the equity return based on projected dividend growth. Since dividend declarations are discretionary, we prefer the results using projected dividend growth. Mindful that the projected earnings growth supports a higher result, we conclude that the result using the median dividend growth rate is the more reliable approach. We round down to 10%.

Figure 10 further refines this figure by adding the size risk premium for each category of market capitalization.

Figure 8
Cost of Equity by Gordon Growth Formula
(based on Dividend Growth Rate)

	Company	Symbol	Dividend Yield	Dividends Growth Rate	Ke
1	Apache Corp.	APA	0.60%	2.0%	2.60%
2	Antero Resources	AR	0.00%	0.0%	0.00%
3	Brigham Minerals	MNRL	8.60%	NMF	
4	Cabot Oil & Gas	COG	2.80%	18.0%	20.80%
5	Cenovus	CVE	0.00%	NMF	
6	Chevron Corp	CVX	5.80%	2.5%	8.30%
7	Cimarex Energy	XEC	2.60%	9.0%	11.60%
8	Concho Resources	CXO	1.50%	35.0%	36.50%
9	Conoco Phillips	COP	3.80%	9.5%	13.30%
10	CVR Energy	CVI	0.00%	-11.5%	-11.50%
11	Delek US Holdings	DK	0.00%	-2.0%	-2.00%
12	Devon Energy	DVN	3.50%	NMF	
13	Diamondback	FANG	2.50%	24.0%	26.50%
14	EQT Corp	EQT	0.00%	NMF	
15	Exxon-Mobil	XOM	9.10%	1.0%	10.10%
16	Hess Corp.	HES	2.10%	0.0%	2.10%
17	HollyFrontier Corp	HFC	6.10%	5.0%	11.10%
18	Imperial Oil	IMO	3.90%	6.0%	9.90%
19	Kinder Morgan	KMI	7.70%	13.0%	20.70%
20	Magnolia Oil & Gas	MGY	0.00%	0.0%	0.00%
21	Marathon Oil	MRO	3.00%	0.0%	3.00%
22	Marathon Petrol.	MPC	5.70%	5.5%	11.20%
23	MDU Respurces	MDU	3.30%	1.5%	4.80%
24	Murphy Oil	MUR	5.30%	0.0%	5.30%
25	National Fuel Gas	NGF	4.20%	4.0%	8.20%
26	Oneok	OKE	6.00%	6.0%	12.00%
27	Ovintiv	OVV	3.20%	8.0%	11.20%
28	PDC Energy	PDC	0.00%	0.0%	0.00%
29	Phillips 66	PSX	6.00%	8.5%	14.50%
30	Royal Dutch B (ADR)	RDSB	4.30%	-5.0%	-0.70%
31	Suncor Energy Inc	SU	4.30%	5.5%	9.80%
32	Targa Resouirces	TRGP	1.90%	NMF	
33	Total SA (ADR)	TOT	7.60%	2.5%	10.10%
34	Valero Energy	VLO	7.00%	3.5%	10.50%
35	Whiting Petroleum	WLL	0.00%	0.0%	
	MEAN				8.96%
	MEDIAN				10.10%

Figure 9
Cost of Equity by Gordon Growth Formula
(based on Earnings Growth Rate)

	Company	Symbol	Dividend Yield	Earnings Growth Rate	Ke
1	Apache Corp.	APA	0.60%	8.5%	9.1%
2	Antero Resources	AR	0.00%	14.5%	14.5%
3	Brigham Minerals	MNRL	8.60%	NMF	
4	Cabot Oil & Gas	COG	2.80%	11.5%	14.3%
5	Cenovus	CVE	0.00%	NMF	
6	Chevron Corp	CVX	5.80%	9.5%	15.3%
7	Cimarex Energy	XEC	2.60%	-5.0%	-2.4%
8	Concho Resources	CXO	1.50%	6.0%	7.5%
9	Conoco Phillips	COP	3.80%	10.5%	14.3%
10	CVR Energy	CVI	0.00%	5.5%	5.5%
11	Delek US Holdings	DK	0.00%	-1.0%	-1.0%
12	Devon Energy	DVN	3.50%	NMF	
13	Diamondback	FANG	2.50%	0.5%	3.0%
14	EQT Corp.	EQT	0.00%	NMF	
15	Exxon-Mobil	XOM	9.10%	2.5%	11.6%
16	Hess Corp.	HES	2.10%	NMF	
17	HollyFrontier Corp	HFC	6.10%	NMF	
18	Imperial Oil	IMO	3.90%	5.5%	9.4%
19	Kinder Morgan	KMI	7.70%	18.5%	26.2%
20	Magnolia Oil & Gas	MGY	0.00%	NMF	
21	Marathon Oil	MRO	3.00%	14.0%	17.0%
22	Marathon Petrol.	MPC	5.70%	3.0%	8.7%
23	MDU Respurces	MDU	3.30%	11.5%	14.8%
24	Murphy Oil	MUR	5.30%	33.0%	38.3%
25	National Fuel Gas	NFG	4.20%	8.0%	12.2%
26	Oneok	OKE	6.00%	10.0%	16.0%
27	Ovintiv	OVV	3.20%	-16.5%	-13.3%
28	PDC Energy	PDC	0.00%	NMF	
29	Phillips 66	PSX	6.00%	4.0%	10.0%
30	Royal Dutch B (ADR)	RDSB	4.30%	9.0%	13.3%
31	Suncor Energy Inc	SU	4.30%	10.5%	14.8%
32	Targa Resources	TRGP	1.90%	NMF	
33	Total SA (ADR)	TOT	7.60%	8.5%	16.1%
34	Valero Energy	VLO	7.00%	2.5%	9.5%
35	Whiting Petroleum	WLL	0.00%	NMF	
	MEAN				11.4%
	MEDIAN				**13.3%**

Figure 10
Gordon Growth DCF Cost of Equity
by Market Capitalization

Market Capitalization	Estimated Cost of Equity	Size Premium	Total Cost of Equity
Large-Cap	10.0%	0.00%	10.0%
Mid-Cap	10.0%	0.80%	10.80%
Low-Cap	10.0%	1.42%	11.42%
Micro-Cap	10.0%	3.16%	13.16%

(4) Discounted Cash Flow Model (based on Forecast Average Annual Total Returns)

As an alternative DCF method, similar to the dividend growth model, we use the Annual Total Returns forecasted in *Value Line,* which considers returns based on forecast dividend income and capital appreciation in stock values. *Value Line* forecasts future total returns based on a low stock price and a high stock price scenario. We take the mean of the two projections as shown in **Figure 11**, below. The difference between the two is minimal and we select the median of 22.5%. Again, after adjusting for the size risk premium, the total estimated cost of equity is broken out by market capitalization in **Figure 12** below.

Figure 11
Cost of Equity Based on *Value Line*
Projected Annual Total Return

	Company	Symbol	*High*	*Low*	*Ke*
1	Apache Corp.	APA	11.0%	-4.0%	3.50%
2	Antero Resources	AR	45.0%	23.0%	34.00%
3	Brigham Minerals	BP	38.0%	22.0%	30.00%
4	Cabot Oil & Gas	COG	32.0%	22.0%	27.00%
5	Cenovus	CVE	27.0%	9.0%	18.00%
6	Chevron Corp	CVX	15.0%	6.0%	10.50%
7	Cimarex Energy	XEC	19.0%	10.0%	14.50%
8	Concho Resources	CXO	27.0%	14.0%	20.50%
9	Conoco Phillips	COP	15.0%	7.0%	11.00%
10	CVR Energy	CVI	43.0%	30.0%	36.50%
11	Delek US Holdings	DK	39.0%	25.0%	32.00%
12	Devon Energy	DVN	34.0%	20.0%	27.00%
13	Diamondback	FANG	10.0%	-1.0%	4.50%
14	EQT Corp.	EQT	24.0%	8.0%	16.00%
15	Exxon-Mobil	XOM	25.0%	16.0%	20.50%
16	Hess Corp.	HES	26.0%	14.0%	20.00%
17	HollyFrontier Corp	HFC	24.0%	11.0%	17.50%
18	Imperial Oil	IMO	22.0%	13.0%	17.50%
19	Kinder Morgan	KMI	41.0%	30.0%	35.50%
20	Magnolia Oil & Gas	MGY	23.0%	4.0%	13.50%
21	Marathon Oil	MRO	50.0%	33.0%	41.50%
22	Marathon Petrol.	MPC	25.0%	14.0%	19.50%
23	MDU Respurces	MDU	24.0%	15.0%	19.50%
24	Murphy Oil	MUR	50.0%	31.0%	40.50%
25	National Fuel Gas	NFG	35.0%	22.0%	28.50%
26	Oneok	OKE	41.0%	28.0%	34.50%
27	Ovintiv	OVV	13.0%	2.0%	7.50%
28	PDC Energy	PDC	33.0%	17.0%	25.00%
29	Phillips 66	PSX	28.0%	17.0%	22.50%
30	Royal Dutch B (ADR)	RDSB	37.0%	24.0%	30.50%
31	Suncor Energy Inc	SU	46.0%	35.0%	40.50%
32	Targa Resources	TRGP	34.0%	19.0%	26.50%
33	Total SA (ADR)	TOT	26.0%	15.0%	20.50%
34	Valero Energy	VLO	20.0%	10%	15.00%
35	Whiting Petroleum	WLL	17%	-1%	8.00%
		Mean			22.56%
		Median			22.50%

Figure 12
Annual Total Return DCF Cost of Equity
by Market Capitalization

Market Capitalization	Median Cost of Equity	Size Premium	Total Cost of Equity
Large-Cap	22.5%	0.00%	22.50%
Mid-Cap	22.5%	0.80%	23.3%
Low-Cap	22.5%	1.42%	23.92%
Micro-Cap	22.5%	3.16%	25.66%

(5) Cost of Equity Summary

We have estimated the cost of equity by four different techniques. None of these cost estimates account for expected equity flotation costs of approximately 4.0%[4], which are factored in to **Figure 13**, summarizing all of the costs of equity discussed above. Of the four metrics for cost of equity we have more confidence in the first two (Build-Up and CAPM), as they are based on actual past experience, while the latter two (Gordon Growth and Annual Total Growth) are based on speculative projections of future growth that may be inaccurate.

We note that the indicated equity returns based on the forecast increase in common stock prices over the next five years are extremely high and not well supported by equity returns indicated by the other approaches. Indeed, the overheated stock market under President Donald Trump may be partly attributed to central bank bond market intervention, requiring some "normalization". The need for such normalization is amplified by the fiscal stimulus package already in place with significant increases expected in the near term. Therefore, we have no confidence in the equity return estimates developed by this approach and give it no weight (0%) in developing a final cost of capital estimate. We weigh the Build-Up method and CAPM results at 35% each, and weigh the Gordon Growth results at 30%. The final estimated cost of equity reflects this weighting, also after adjusting for flotation costs.

Figure 13
Indicated Cost of Equity
by Market Capitalization
(Including Flotation Costs @ 4.0%)

Market Cap	Build-Up	CAPM	DCF Gordon Growth	DCF Annual Total	Indicated Cost of Equity
Large-Cap	9.21%	9.93%	10.00%	22.50%	
w/flotation cost	**9.59%**	**10.34%**	**10.42%**	**23.44%**	**10.10%**
Mid-Cap	9.99%	10.71%	10.80%	23.30%	
w/flotation cost	**10.41%**	**11.15%**	**11.25%**	**24.27%**	**10.92%**
Low-Cap	10.64%	11.36%	11.42%	23.92%	
w/flotation cost	**11.08%**	**11.83%**	**11.90%**	**24.92%**	**11.59%**
Micro-Cap	12.42%	13.14%	13.16%	25.66%	
w/flotation cost	**12.94%**	**13.68%**	**13.71%**	**26.73%**	**13.43%**

[4] See California State Board of Equalization, *Capitalization Rate Study: Lien Date 2019.*

WEIGHTED AVERAGE COST OF CAPITAL (WACC)

2021 CURRENT CORPORATE TAX RATES
for TAX YEAR ENDED 12-31-2020

Taxable Income Bracket	Tax Rate
AVERAGE of CORPORATE TAX RATE	**21%**

WEIGHTED AVERAGE COST OF CAPITAL (WACC)

2021 CURRENT INDIVIDUAL TAX RATES

For TAX YEAR ENDED 12-31-2020

Taxable Income Bracket*	Tax Rate
$0 - $9,875	10%
$9,876 - $40,125	12%
$40,126 - $85,525	22%
$85,526 - $163,300	24%
$163,301 - $207,350	32%
$207,351 - $518,400	35%
>$518,401	37%
AVERAGE of SINGLE INDIVIDUAL TAX RATES	24.57%
CALLED AVERAGE OVERALL TAX RATE	25%

*Single Filing and Trusts

WEIGHTED AVERAGE COST OF CAPITAL (WACC)

2021 CONVERSION TO PRE-TAX RATE
for TAX YEAR ENDED 12-31-20

CAPITAL ASSET PRICING MODEL (CAPM)

COST OF EQUITY – LARGE CAP
LARGE CAP = 9.21
9.21/(1-.25) [Average Overall Tax Rate = 25%]
COST of EQUITY = 12%

DEBT PRE-TAX BASIS = 3.35%

COST of EQUITY * PERCENTAGE of EQUITY
12% * 65% = 7.80%

DEBT PRE-TAX BASIS * PERCENTAGE of DEBT
3.35% * 35% = 1.1725% / YEAR

7.80% + 1.1725% = 8.97%
CALLED BASE RATE ON PRE-TAX BASIS = 9% (ROUNDED)

Added Price Risk Rate – 1%

Called Base Rate – **10%**

ECTOR COUNTY APPRAISAL DISTRICT

2021 Discount Rate Schedule

GROSS W T I - $ 35.99
GROSS W T S - $36.39
GROSS GAS - $ 2.07

PAF W T I - $ 41.52
PAF W T S - $ 41.99
PAF GAS - $ 3.13

CALLED BASE RATE: **10%**

DECLINE RATE	ADJUSTMENT
0 - 25%	BASE RATE
25 – 35%	+ 1%
35 – 45%	+ 2%
45% - 55%	+ 3%
55% +	+ 4%

SINGLE WELL OIL LEASE	+ 3%
SHORT PRODUCTION HISTORY (LESS THAN 1 YEAR)	+ 3%
	26% MAX

2021* Oil price adjustment factor 1.0006%
2021* Gas price adjustment factor .9895%

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