

Final White Paper on Task 3, Step 4: Modeling Performance Defaults in Task 3

Fund Working Model

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**for the
California Integrated Waste Management Board
Financial Assurance and Corrective Action Contracted Study**

A default for purposes of the working model means the simulated failure of an owner/operator of a landfill in the study universe to timely perform required PCM and/or CA. This definition does not require that an owner/operator file for bankruptcy or declare (or be declared) insolvent. Rather, this definition of default recognizes that an entity in financial distress may have issues that interfere with its willingness or ability to expend money at a given point in time. This definition is similar to that used by those who study defaults professionally. [See footnotes 7 – 10; will add cites to the draft and final reports]

Key questions for modeling performance defaults include the following:

- (1) Should both privately and publicly owned landfills be considered as potential candidates for performance defaults?
- (2) Should PCM and CA obligations both be considered as potentially subject to performance defaults?
- (3) What role should FA play?
- (4) How should we model performance default rates and durations?
- (5) What do we know about default rates?

1. Should Potential Performance Defaults Be Included for Both Privately and Publicly Owned Landfills?

Reasons for treating both privately-owned and publicly-owned landfills as potential candidates for performance defaults include the following:

- Both types of entities are subject to financial distress¹
- Both types of entities are subject to financial assurance requirements
- A landfill may be owned or operated by either type of entity, or both, at any given point in time or over time²

Reasons for treating publicly and privately-owned landfills differently in terms of default include the following:

- public entities typically have longer lifetimes than private entities, and are more likely to endure than private entities
- public entities -- but not private entities -- can raise funds through taxing authorities and sale of bonds, both of which may be limited by state laws, such as the Paul Gann Initiative [Proposition 218 in 1996] which limits authority of local governments to impose taxes and property-related assessments, fees, and charges; requires the majority of voters to approve increases in general taxes, and reiterates that two-thirds must approve a special tax.

¹ See, the U.S. Government Accountability Office “State and Local Governments: Persistent Fiscal Challenges Will Likely Emerge within the Next Decade,” GAO-07-1080SP (July 18, 2007). Orange County is considered the largest municipality in U.S. history to have declared bankruptcy.

² A landfill owner and operator may be the same entity or different entities, with some publicly-owned landfills being operated by private entities as well as some publicly operated landfills on privately owned land (although the latter arrangement currently is much less common than the former arrangement).

For purposes of the working fund model, ICF recommends that both privately- and publicly-owned landfills be treated as potential candidates for default. See Section 4 below for further discussion.

2. Should the Model Address Performance Defaults of Both PCM and CA Obligations?

Reasons for treating both PCM and CA obligations as potentially subject to default:

- Financial distress can require delays and/or cutbacks in expenses across the board, including environmental outlays, whether for PCM or CA
- Some types of PCM and CA are the same. Depending on LF design/construction and applicable regulations, an expenditure for operating a landfill gas collection system may be considered as PCM at one LF (where such a system already was installed) while that expenditure may be considered CA at a different LF (where such a system was not initially required).

There are different perspectives that could provide rationales for treating PCM and CA differently in terms of default:

- Some might believe that because PCM expenditures are nearly certain to occur while CA expenditures are much less predictable, a landfill owner/operator could be more likely to default on CA than on PCM
- Some might believe that because CA expenditures may be more urgent and attract more attention than PCM outlays, a landfill owner/operator could be less likely to default on CA than on PCM
- Some might believe that because CA expenditures may be much greater in magnitude than PCM expenditures over a short time period, a landfill owner/operator could be more likely to default on CA than on PCM

For purposes of the working model, ICF recommends that both PCM and CA be treated as potential candidates for default. ICF is not aware of compelling data that would support an alternate approach.

3. Role of Financial Assurance

For some types of analyses, it may be important to consider not only default on the part of the owner/operator but also the availability and coverage offered by required financial assurance. For this study, ICF needs to consider both owner/operator performance defaults and FA coverage for the following reasons:

- (1) FA currently is not required for post-30 PCM, but is assumed for the purpose of the working model to continue because -- based on CIWMB direction -- a future rulemaking is anticipated to go forward requiring financial assurances to extend throughout the entire PCM period. The model fund would cover defaults of PCM for the entire PCM period.
- (2) FA for CA has not been demonstrated for all members of the study cohort at this time. In addition, ICF cannot predict the degree to which the FA for all 282 LFs will be sufficient to meet the actual costs of CA. For the purposes of the working fund model, the FA for CA will be assumed to be provided by all owners/operators of the 282 LFs.

How best to handle the role of FA for purposes of the working model will require further development.

4. How to Model Performance Default Rates?

ICF recommends a relatively simple approach to simulating the effects of performance defaults for the working model, given limited budget and calendar time. ICF is considering modeling two types of defaults:

- (1) “random” defaults and
- (2) event-driven defaults

Random defaults capture the reality that financial distress can appear seemingly without cause, although there may be endogenous causes such as poor planning, poor decisions, poor execution, and even financial fraud on the part of senior management. Event-driven defaults capture the reality that an exogenous cause – such as orders to perform CA; earthquakes, floods, drought, and fires – may lead to financial distress by requiring increased outlays and/or by depressing revenues.

Both types of defaults could affect more than a single LF. Financial distress at a county, for example, could cause defaults at multiple landfills where the county has responsibility; similarly, financial distress at a private solid waste landfill company could cause defaults at different landfills owned by that firm.³ The 282 LFs in the study universe are the responsibility of 116 parties (i.e., 36 private sector and 80 public sector parties), as follows:

³ Some landfills in this study are owned by commercial companies that are nationwide in scope. For example, of the 300 landfills nationwide owned by Waste Management/USA Waste, 15 are on the list of 282 LFs that are the focus of this study. Some view the risks posed by large commercial companies as a concern, while others view large commercial firms as bringing financial stability to an industry that previously had a large participation of small businesses with few assets.

- There are a total of 71 facilities with 36 private sector responsible parties: 41 landfills are associated with 6 responsible parties, leaving 30 other landfills and 30 responsible parties for a total of 36 private sector responsible parties. Waste Management, Inc./USA Waste has 15 facilities and Allied Waste/BFI 13.
- There are 211 facilities with 80 public sector responsible parties: 158 landfills are associated with 27 responsible parties, leaving 53 other landfills and 53 responsible parties for a total of 80 public sector responsible parties. The county of San Bernardino has 20 facilities, the County of Kern 15, the County of Riverside 12, and the County of Imperial 9, and the Federal government has 17.

Event-driven defaults may reflect regional traumas such as severe earthquakes, flooding, fires, and rainstorms. These severe, although rare, events can result in financial distress for both privately- and publicly-owned landfills in a defined geographic area.

One question to resolve is whether to apply default rates to each individual LF and/or to the parties responsible for the LFs. Or, we could use each of the two approaches and compare the results. We may want or need to employ a hybrid approach because CA-driven defaults will occur, just as CA does, on an individual LF basis.

Another similar issue is whether to use a different default rate for LFs (or responsible parties) in the government sector versus LFs (or responsible parties) in the private sector. We will determine this issue after completing our research into data on default rates.

Random Defaults. ICF proposes to account for random defaults by having the model apply a default rate⁴ per year to each landfill (or responsible party) in our study of X% for private

⁴ The rate (or a distribution of potential rates with the same mean) will be chosen to represent an average institutional default rate, and may vary by year based on available data between, say, 0.2% and 2%, for example.

sector and Y% for the public sector. (Note: X and Y have not been determined yet and may turn out to be the same or similar).

ICF does not propose to specify different default rates for entities based on their financial strength, despite historic data showing higher rates of financial distress associated with smaller organizations. Firm failure rates have been found to decrease as firms increase in size, as measured by their net worth. A range of estimated annual failure rates for different size firms for the period 1984 through 1990 (latest available data) is provided in Exhibit 1 below.⁵ As shown in the exhibit, the failure rate decreases significantly as net worth increases. Nevertheless, ICF does not have readily available the net worth data needed to implement this approach. In addition, ICF expects that various stakeholders may have different perspectives on the appropriate way to handle businesses with operations beyond the state of California. Thus, we will not include different default rates for businesses of different sizes in the working model.

Exhibit 1
Estimated Firm Failure Rates

Net Worth (\$ million)	Failure Rate (%)
0-10	1.53
10-20	1.24
20-100	1.02
100-400	0.81
400-1 billion	0.55
> 1 billion	0.14

Event-Driven Defaults. ICF proposes the following:

⁵ Source ICF Incorporated, *Analysis of Assurance Provided by Current and Proposed Financial Assurance Mechanisms* (November 1993).

- (1) for landfills simulated to undergo CA, ICF proposes to apply a multiple (e.g., twice) of the random default rate per year during the CA period to account for potential CA-driven defaults (i.e., cost shocks) , and
- (2) for other event-driven defaults (e.g., severe rain/wind storms, flooding, wildfires, earthquakes), ICF proposes to apply a Z% default rate per year to groups of 6-10 landfills (e.g., those in the same county, for simplicity).⁶

An alternative approach to simulating CA-driven defaults would be to compare the magnitude of each simulated CA “cost shock” to estimated revenue or assets for each LF responsible party. Such an approach requires detailed financial data for all the responsible parties and projections of such data into the future. This latter approach goes well beyond what is feasible and necessary for the working model.

5. What Should be the Duration of Performance Defaults?

The model must not only simulate the year when a default starts but also how long the default lasts. It may make sense for the duration to vary with the type of default: random defaults would have the shortest duration, CA-driven defaults would last longer, and regional disaster defaults would last the longest. Or CA-driven defaults might last longer than regional defaults. Ideally, the working model will let CIWMB staff change the default durations for further analyses. ICF currently anticipates that default durations -- subject to change – would likely run 5+-years maximum.

CIWMB staff asked ICF to consider including in the model the possibility of permanent defaults, which are defaults that have no end dates. In other words, a permanent default indicates

⁶ Approach to this still under consideration.

simulating that a responsible party never returns to paying for PCM and/or CA. ICF believes that such scenarios are only remotely possible because the 282 study landfills and the property they sit on will retain some net value. ICF also believes that parties responsible for the LFs will continue in one form or another. Including permanent default as an option in the working model may raise significant complications in the model, which are best minimized at this time.

6. What Do We Know Now About Default Rates?

Default rates should be expected to be low in absolute terms. The most important reason for a low default rate is the nature of the solid waste disposal “business.” This business shares certain characteristics with public utilities such as water, sewer, and power companies. These businesses have certain features of so-called “natural monopolies.” These businesses tend to have steady demands that are relatively predictable but require substantial capital investments. Not only is solid waste disposal a low default industry, the 282 LFs subject to financial assurance exclude firms that chose to close prior to 1988; survivor bias should give the 282 LFs better default performance than a cohort of LFs that includes those closed prior to 1988. A final point: default rates tend to be low in general.

Private Sector Default Rates. The analysis of corporate defaults has had many researchers trying different predictive models out on various datasets. Recent studies, for example, have included the following:

- One study identified 842 defaults between January 1, 1981 to December 31, 2002 associated with 6,776 large U.S. corporations, using credit rating histories from Standard & Poor's (reported average annual default rate of 1.66%).⁷
- Another study included 916 publicly-traded firms in the industrial machinery and instrument sector from 1962 to 2004, of which 67 filed for bankruptcy and 153 were classified as defaulting.⁸
- Another study included 241 defaults for 1,990 publicly-traded non-financial North American firms over the period January 1987 to October 2000, finding that the means of annual default probabilities ranged from 0.69% to 3.11% as the U.S. entered the 2000-2001 recession.⁹
- An often-cited study compiled data on 15,018 firms (excluding financial firms) publicly traded in the U.S. with 1,449 defaults covering the period 1980-2003.¹⁰
- Moody's KMV offers a proprietary service for predicting defaults drawing on data for over 51,000 private U.S. and Canadian firms and 3,764 defaults over the period 1989-2002.¹¹

Dun & Bradstreet published nationwide failure rates per year per 10,000 concerns in its *Business Failure Record*.¹² Exhibit 2 shows some reported rates for different groups of organizations.

⁷ Til Schuermann & Samuel Hanson, *Estimating Probabilities of Default*, Federal Reserve Bank of New York, Staff Report No. 190 (July 2004).

⁸ Todd B. Walker, *Estimating Default with Discrete Duration and Structural Models* (First Version: October 2005).

⁹ Sanjiv R. Das, Darrell Duffie, & Nikunj Kapadia, *Common Failings: How Corporate Defaults are Correlated*, FDIC Center for Financial Research Working Paper No. 2004-04 (September 2004).

¹⁰ Sreedhar T. Bharath & Tyler Shumway, *Forecasting Default with the KMV-Merton Model* (December 17, 2004).

¹¹ Douglas W. Dwyer, Ahmer E. Kocagil, & Roger M. Stein, *The Moody's KMV EDF™ Riskcalc™ v3.1 Model: Next-Generation Technology for Predicting Private Firm Credit Risk* (April 5, 2004).

¹² Dun & Bradstreet Corporation, *Business Failure Record: 1996 Final and 1997 Preliminary* (undated). This is the last edition produced of this report.

Exhibit 2
Dun and Bradstreet Reported Failure Rates, 1996-7
(per 10,000)

	<u>1996</u>	<u>1997</u>
U.S.	80	88
California	149	176
Electric, Gas, and Sanitary	61	75
Transportation	69	74
Insurance Carriers	37	46

Exhibit 2 shows a much higher rate of failures for California than the U.S. as a whole. Most states had reported failure rates less than 100 per 10,000 (i.e., 1%). In addition to California, other high failure rate states in 1996 and 1997 (latest published data) included Arkansas, Colorado, Hawaii, Idaho, Kansas, Oklahoma, and Washington. ICF chose to show in Exhibit 2 the failure rates for electric, gas, and sanitary services as a possible proxy for MSW disposal. We also included transportation services in Exhibit 2 on the theory that parties responsible for MSW disposal may also operate fleets of collection trucks. Although the failure rates for those two industries appear quite similar, with only two years of data reported ICF believes that solid inferences should not be drawn. Finally, ICF included failure rates for insurance carriers, which were expected to be low. ICF hesitates to draw failure rates from these 1996-7 Dun and Bradstreet data for this study because of the large divergence between U.S. and California rates and because only two years of data are readily available.

Exhibit 3 shows more extensive, nationwide failure rate data from Dun & Bradstreet for the period 1984-1997.

Exhibit 3
Dun & Bradstreet Failure Data (1984-1997)

Year	Failure Rate per 10,000 Concerns
1997	88
1996	80
1995	82
1994	86
1993	109
1992	110
1991	107
1990	74
1989	65
1988	98
1987	102
1986	120
1985	115
1984	107
Mean	95.93
Median	100.00
25%-ile	83.00
75%-ile	108.50
Min	65.00
Max	120.00
Variance	280.38
Std Dev	16.74

The above data series shows how failure rates vary over the time period, from 0.65% in 1989 to 1.2% in 1986 with an average failure rate close to 1%

Moody's publishes selected data on default rates of corporate bond issuers, drawing upon its proprietary database of ratings and defaults for industrial and transportation companies, utilities, financial institutions, and national governments that have issued long-term debt to the

public.¹³ Although Moody's does not report the data by industry sector, Moody's does calculate one-year default rates for its entire universe. ICF calculated statistics for this series, which are presented in Exhibit 4. Means and statistics are presented for the period: 1970 to 1999.

Exhibit 4
Moody's Corporate Default Rates

Year	One-Year Default Rate
1999	2.19%
1998	1.27%
1997	0.68%
1996	0.54%
1995	1.07%
1994	0.57%
1993	0.96%
1992	1.33%
1991	3.29%
1990	3.52%
1989	2.42%
1988	1.31%
1987	1.49%
1986	1.90%
1985	1.06%
1984	0.91%
1983	0.95%
1982	1.03%
1981	0.16%
1980	0.34%
1979	0.09%
1978	0.35%
1977	0.35%
1976	0.17%
1975	0.36%

¹³ Moody's Investors Service, *Historical Default Rates of Corporate Bond Issuers, 1920-1999* (January 2000). Note that municipal debt issuers are not included.

Exhibit 4
Moody's Corporate Default Rates

Year	One-Year Default Rate
1974	0.27%
1973	0.45%
1972	0.45%
1971	0.28%
1970	2.72%
Mean	
Median	
25%-ile	
75%-ile	
Min	
Max	
Variance	
Std Dev	

In addition, and relevant to the long time frame of analysis for this study, Moody's also presents its calculations of "average cumulative default rates" from 1 to 20 years for the 80-year period 1920-1999. These data are based on analyzing the experiences of cohorts of issuers. For example, Moody's calculated that the default rate for all corporate issuers was 13.98% after 20 years. Although these data are not directly applicable to the study, they illustrate an important point – over very long periods of time, the cumulative risk of default can become very significant. This study addresses long time frames both until post-30 PCM commences and during post-30 PCM.

Public Sector Defaults. Data on public sector defaults are much more limited than data on corporate defaults. A 2003 study by Fitch Ratings determined that default rates for bonds issued between 1987 and 1997 were much lower (i.e., 0.14%) than default rates on bonds issued between 1979 and 1986 (i.e., 1.5%). See Exhibit 5. For bonds issued in the entire period of

1979-1997, the cumulative default rate was 0.84%. Fitch's 2003 study also determined default rates by sector and found that the cumulative default rate on environmental facility bonds issued from 1979-1994 increased to 0.89% from the 0.31% found in its earlier 1999 study [add references]. Fitch stated that the increase reflected deregulation of flow control in the mid-1990s. Unfortunately, Fitch does not calculate annual default rates which could be compared to the rates shown in Exhibit 4. Instead, Fitch reports its calculations using a cumulative default metric; Fitch calculates defaults for yearly cohorts of municipal issuers that indicate a rate of default over a certain time period (e.g., 10 years). Fitch's metric also cannot be meaningfully compared to the average cumulative default rates for corporate issuers calculated by Moody's.

Exhibit 5
Fitch's Cumulative Municipal Default Rates
(Through 2002)

Year of Issuance	Cumulative Default Rate
1979	0.84%
1980	0.98%
1981	0.99%
1982	1.33%
1983	2.59%
1984	2.22%
1985	2.73%
1986	1.72%
1987	0.91%
1988	1.16%
1989	0.92%
1990	0.65%
1991	0.37%
1992	0.35%

Exhibit 5
Fitch's Cumulative Municipal Default Rates
(Through 2002)

Year of Issuance	Cumulative Default Rate
1993	0.36%
1994	0.39%
1995	0.36%
1996	0.50%
1997	0.46%
Mean	1.04
Median	0.91
25%-ile	0.43
75%-ile	1.25
Min	0.35
Max	2.73
Variance	0.57
Std Dev	0.76

Moody's also has published data concerning public sector defaults. [add reference] However, Moody's analysis was limited to those bonds for which it supplied ratings. The resulting self-selection bias is clear and acknowledged by Moody's. As a result, Moody's database includes only 18 defaults, whereas Fitch's analysis included 2,339 cases of municipal defaults between 1980 and 2002. (Fitch has had much more involvement in rating municipal obligations than has Moody's.) Thus, although it is tempting to use Moody's one-year annual default rate of 0.0043% (for Moody's rated issuers), ICF does not recommend doing so.

Conclusions. [to be inserted after completion of research and analysis]