

Mortgage loan Credit Collectibility as an Early Warning System in Credit Risk Mitigation (Study at Bank Mandiri in 2026)

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Abstract

This study aims to measure credit risk in Home Ownership Loan (MORTGAGE LOAN) financing at Bank Mandiri using collectibility indicators as an Early Warning System (EWS) against potential Non-Performing Loans (NPL). Using a descriptive quantitative approach, the study analyzed secondary data comprising 306 accounts in Collectibility 2A (Special Mention) as of May 13, 2026, with a total outstanding balance of Rp 142.44 billion. Results show that 53% of debtors currently in Kol 2A were previously in current status (Kol 1), indicating a new wave of credit quality deterioration undetectable by NPL ratios alone. A total of 30 accounts (9.8%) are in the critical segment with arrears exceeding Rp 10 million. These findings confirm that mid-tier collectibility movements can serve as effective early warning signals, enabling banks to adopt preventive rather than reactive risk management approaches.

Keywords: Credit Risk; Collectibility; Early Warning System; NPL; Mortgage Loan

JEL Classification: G21; G32; G28

1. Introduction

The housing sector is one of the pillars of national economic growth, directly linked to banking intermediation activities through the Home Ownership Loan (mortgage loan) instrument. Based on data from the Financial Services Authority (OJK), the outstanding Mortgage loan balance of Indonesian banks grew from Rp 545.97 trillion in 2020 to Rp 736.97 trillion at the end of 2024, an average annual growth of 7.8%. This growth was driven by government stimulus policies, such as the relaxation of the Loan-to-Value (LTV) ratio and interest subsidy programs, as well as rising housing demand driven by urban population growth ([OJK, 2025](#)). The rapid growth of the mortgage loan portfolio increases credit risk exposure, which banks must manage more carefully and systematically ([Nurpita, 2021](#)).

Based on data from Bank Indonesia and OJK in 2025-2026, home ownership loans remain one of the main drivers of consumer credit growth in Indonesia ([Bank Indonesia, 2024](#); [OJK, 2025](#)). However, the increase in credit volume is also accompanied by the need to strengthen risk management in order to maintain the quality of bank credit portfolios ([Mishkin, 2016](#)).

mortgage loan has unique risk characteristics compared to other credit products. The large financing value, very long tenors of 10 to 30 years, and the dependence on the debtor's

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consistent repayment capacity over a long period make mortgage loan a product with a complex credit risk profile. Declining debtor income, increasing household expenditure burdens, employment instability, and changes in macroeconomic conditions such as rising benchmark interest rates and inflation are factors that can directly weaken a mortgage loan debtor's repayment capacity ([Khomaria & Syah, 2024](#); [Sari, Siregar, & Harahap, 2020](#)). [Beltman et al. \(2025\)](#) affirm that the ability to predict financial stress in retail customers at an early stage is a crucial competitive advantage for the financial industry in maintaining the quality of credit portfolios.

Poorly managed credit risk will lead to an increase in Non-Performing Loans (NPL). [Rahmi and Herlina \(2021\)](#) proved that NPL has a significant negative effect on Return on Assets (ROA) at PT Bank Tabungan Negara, Tbk ($r = -0.669$). [Herlina and Suryaningprang \(2023\)](#) also found that NPL has a positive and significant effect on the Capital Adequacy Ratio (CAR) at 10 BUKU 3 banks listed on the IDX ($t = 39.89$; $\text{sig} = 0.000$), indicating that banks face the dual pressure of declining profitability and increased capital requirements.

Although NPL has become a standard credit risk indicator, this indicator has a fundamental weakness as a lagging indicator because it only reflects credit that has already become problematic (Kol 3-5) and is unable to provide early warning signals ([Fejes & Katits, 2025](#)). OJK data shows the national banking NPL ratio was at 2.20% from 2024 to Q1 2025, but this aggregate figure potentially masks credit pressures that are building beneath the surface.

This phenomenon is clearly illustrated in Bank Mandiri's internal data. As of May 13, 2026, there are 306 mortgage loan accounts in Collectibility 2A (Kol 2A) status with a total outstanding balance of Rp 142.44 billion. More concerning, 53% of these debtors were previously in current status (Kol 1), indicating a new wave of credit quality deterioration not captured by the NPL ratio. A total of 30 accounts (9.8%) is in the critical segment with arrears exceeding Rp 10 million. This situation underscores the need for a more effective collectibility-based early detection instrument.

Credit collectibility can serve as an effective Early Warning System (EWS) instrument. [Fejes and Katits \(2025\)](#) affirm that early warning indicators based on collectibility movements are more effective than conventional lagging indicators. [Mawardi et al. \(2023\)](#) show that EWS implementation in Indonesian banks is proven effective in detecting potential risks earlier.

There is still a research gap that needs to be filled. Most previous studies have focused on measuring risk using NPL as the primary variable, without specifically examining the dynamics of mid-tier collectibility movements as NPL precursors. Research using actual debtor account data in the Kol 2A category as an early credit risk detection instrument remains very limited, especially in the Indonesian banking context. Therefore, this study fills that gap by analyzing 306 mortgage loan accounts in the Kol 2A category at Bank Mandiri, serving as a basis for developing a more preventive EWS approach to credit risk mitigation.

No prior research has used individual mortgage loan account data in the Collectibility 2A category as an Early Warning System instrument. Previous research has largely used NPL, financial ratios, or aggregate bank data, whereas this study uses individual data from 306 mortgage loan accounts in the Collectibility 2A category as an early credit risk detection instrument.

Based on the background described above, this study aims to: (1) analyze the distribution and characteristics of mortgage loan credit collectibility at Bank Mandiri; (2) measure mortgage

loan credit risk based on collectibility indicators; and (3) analyze the role of collectibility as an early warning system for potential NPL.

2. Literature Review

2.1 Credit Risk and Non-Performing Loans (NPL)

Credit risk is the risk arising from the debtor's failure to fulfill its obligations to the bank in accordance with the agreed agreement ([OJK, 2016](#)). Non-Performing Loan (NPL) is the ratio of total non-performing loans to total loans disbursed ([Dendawijaya, 2009](#)). Credit is categorized as non-performing if it is in Kol 3, Kol 4, and Kol 5. Although NPL is the main indicator, it lags because it only reflects credit that has already become problematic ([Fejes & Katits, 2025](#)).

[Rahmi and Herlina \(2021\)](#) in a study of PT Bank Tabungan Negara, Tbk for the period 2008-2020 found that NPL has a significant partial effect on ROA with a strong negative correlation ($r = -0.669$). [Herlina and Suryaningprang \(2023\)](#) found that, for 10 banks listed on the IDX for the period 2016-2021, NPL has a positive and significant effect on the Capital Adequacy Ratio (CAR) ($t = 39.89$; $\text{sig} = 0.000$). Both findings confirm that preventing NPL escalation from the mid-tier collectibility phase is crucial, not only for maintaining profitability but also to avoid unnecessary capital pressure.

2.2 Collectibility as an Early Warning System

Credit collectibility is a classification of credit quality based on the level of debtor payment smoothness, consisting of: Kol 1 (Current), Kol 2 (Special Mention), Kol 3 (Sub-standard), Kol 4 (Doubtful), and Kol 5 (Loss) ([OJK, 2016](#)). The mid-tier collectibility phase, such as Kol 2, is a critical stage that can become NPL if not addressed promptly ([Prihatina, 2022](#)).

In this study, collectibility is viewed as an early representation of changes in debtor credit quality. When a debtor experiences a status decline from Collectibility 1 to Collectibility 2A, the bank receives a signal that a change in payment behavior has occurred that has the potential to develop into a problem loan if not addressed immediately. Therefore, Collectibility 2A has a strategic role as an Early Warning System because it is able to provide risk information earlier than the NPL ratio, which only reflects risk after credit enters the non-performing category. The choice of Kol 2A — not NPL — as the research focus is based on the consideration that Kol 2A is the critical transition phase before problem loans form, so intervention at this phase has the potential to prevent further risk escalation.

[Beltman et al. \(2025\)](#) show that a machine learning-based EWS approach is capable of detecting retail customer credit deterioration long before formal payment delays occur. [Mawardi et al. \(2023\)](#) show that Z-score-based EWS in Indonesian Islamic banks is effective in identifying bank stability and crisis phases. Meanwhile, [Fejes and Katits \(2025\)](#) affirm that mid-tier collectibility movements are a more effective approach than conventional lagging indicators in banking credit risk management.

2.3 Conceptual Framework

Based on the literature review presented in Sections 2.3.1 through 2.3.5, the conceptual framework of this study is built on the relationship between collectibility movements as early signals and potential NPL as the outcome to be prevented, as depicted in the following model:

Collectibility Shift (Kol 1 → Kol 2A) → Early Warning Signal → Potential NPL

Previous research on EWS and credit risk is summarized in the following table:

2.3.1 Early warning system in retail banking ([beltman et al., 2025](#))

[Beltman et al. \(2025\)](#) examined the effectiveness of machine learning-based Early Warning Systems (EWS) for retail banking customers in the financial industry. Using Logistic Regression, Gradient Boosting, and Random Forest algorithms, their study demonstrated that an EWS applied to retail customers could detect financial distress significantly earlier than conventional indicators, enabling banks to place at-risk customers on a watch list before formal defaults occur. The key finding is that behavior-based EWS approaches, built from transaction and payment pattern data, outperform backward-looking credit metrics. A notable limitation of their study is that it relied on data from a single Dutch bank and did not specifically focus on mortgage credit (MORTGAGE LOAN) portfolios.

2.3.2 Behavior-Based Early Warning Indicators in Credit Risk ([Fejes & Katits, 2025](#))

[Fejes and Katits \(2025\)](#) conducted a credit risk analysis focused on commercial banking and concluded that behavior-based early warning indicators are more effective than reactive, lagging indicators in identifying potential credit deterioration. Their study affirms that monitoring mid-tier collectibility movements provides more actionable intelligence than waiting for credits to enter the non-performing category. A limitation of this research is its reliance on aggregate banking data rather than individual debtor account data, which limits its granularity for portfolio-level risk intervention.

2.3.3 EWS in Indonesian Islamic Banks ([Mawardi et al., 2023](#))

[Mawardi et al. \(2023\)](#) applied a Markov-switching dynamic model to examine early warning systems for Indonesian Islamic Commercial Banks and Islamic Rural Banks from December 2007 to April 2022. Using the Z-score as a proxy for banking stability, they found that both types of Islamic banks have a greater probability of remaining in a stable (tranquil) regime, though Islamic Commercial Banks recover from crises faster than Islamic Rural Banks. The study confirms that Z-score-based EWS is effective in identifying bank stability and crisis phases. Its limitation lies in not utilizing individual debtor account data and focusing on Islamic banks specifically, which may limit generalizability to conventional mortgage loan portfolios.

2.3.4 NPL and Bank Profitability ([Rahmi & Herlina, 2021](#))

[Rahmi and Herlina \(2021\)](#) investigated the effect of Capital Adequacy Ratio (CAR), Non-Performing Loan (NPL), BOPO, Net Interest Margin (NIM), and Loan to Deposit Ratio (LDR) on Return on Assets (ROA) at PT Bank Tabungan Negara, Tbk for the period 2008–2020. The study found that NPL has a significant partial effect on ROA with a strong negative correlation ($r = -0.669$), confirming that rising NPL directly reduces bank profitability. The research was focused on measuring the impact of NPL after the fact, rather than developing an early detection system, which represents its primary limitation.

2.3.5 NPL and Capital Adequacy ([Herlina & Suryaningprang, 2023](#))

[Herlina and Suryaningprang \(2023\)](#) analyzed the Capital Adequacy Ratio (CAR) of 10 BUKU 3 commercial banks listed on the Indonesia Stock Exchange for the period 2016–2021, using panel data regression. The study revealed that NPL has a positive and significant effect on CAR ($t = 39.89$; $\text{sig} = 0.000$), meaning that banks with higher NPL are required to hold greater capital buffers. This dual pressure on both profitability and capital underscores the strategic

importance of early NPL prevention. The study's limitation is its focus on aggregate capital adequacy outcomes rather than on developing proactive risk detection mechanisms.

Based on previous studies, it can be seen that most research on credit risk has focused on the use of NPL indicators, financial ratios, and credit risk prediction models at the aggregate banking level. EWS research has developed, but is generally applied to the banking sector in general. Meanwhile, research that utilizes debtor account data in the Kol 2A category as a credit risk detection instrument for mortgage loan portfolios is still relatively limited.

3. Research Methodology

3.1 Approach and Data Sources

This study uses a descriptive quantitative approach. The data source is secondary data from the internal data of PT Bank Mandiri (Persero) Tbk., namely aggregate mortgage loan credit collectibility data (Kol 2A) consisting of 306 accounts as of May 13, 2026, including outstanding balance data, arrears, and collectibility shift history.

3.2 Operational Definition of Variables

This study focuses on the analysis of Collectibility 2A as an Early Warning System in identifying potential credit risk in the mortgage loan portfolio. The main variables analyzed are collectibility, arrears, outstanding balance, and the debtor's collectibility history. The complete operational definitions are presented in the following table:

Table 2. Operational Definition of Variables

Variable	Operational Definition	Indicators	Scale
Collectibility	Credit quality status based on payment smoothness	Debtor's credit is classified as Kol 1 (Current), Kol 2A/2B/2C (Special Mention), Kol 3 (Substandard), Kol 4 (Doubtful), or Kol 5 (Loss)	Ordinal
Collectibility History	Credit quality status in the previous period	Debtor's credit status in the previous period was recorded as Kol 1, Kol 2A, Kol 2B, or Kol 2C	Ordinal
Arrears	Payment obligations not yet fulfilled by the debtor	Debtor has an outstanding payment obligation measured in Indonesian Rupiah (IDR) that has not yet been fulfilled as of the observation date	Ratio
Outstanding Balance	Remaining principal credit that must still be paid	The remaining principal credit balance owed by the debtor to the bank is measured in Indonesian Rupiah (IDR)	Ratio

Risk Category			Level of potential default based on arrears value	Debtor is categorized as Easy Coll (<Rp500K arrears), Medium (Rp500K–Rp5M), High (Rp5M–Rp10M), or Critical (>Rp10M) based on arrears value	Ordinal
Early System	Warning	Early signal of credit quality decline before NPL		A debtor's collectibility status has shifted from Kol 1 (Current) to Kol 2A (Special Mention), signaling an early decline in credit quality before NPL classification	Nominal

Source: Processed by researcher (2026)

3.3 Data Analysis Technique

Data analysis was carried out through four stages. First, descriptive analysis to describe the distribution of mortgage loan credit collectibility and the pattern of credit quality movements between periods. Second, risk segmentation based on the magnitude of arrears into four categories as presented in the following table:

Table 3. Risk Classification Based on Arrears

Arrears Value	Risk Category
< Rp 500,000	Easy Coll (Low)
Rp 500,000 – Rp 5,000,000	Medium
Rp 5,000,000 – Rp 10,000,000	High
> Rp 10,000,000	Critical

Source: Processed by researcher (2026)

Third, EWS analysis identifies changes in collectibility from Kol 1 to Kol 2A as early signals of potential NPL increases. Fourth, risk concentration analysis per branch to identify areas requiring priority attention. The risk classification based on arrears above is applied consistently throughout the analysis in Chapter 4.

4. Results and Discussion

4.1 General Overview of Research Data

This study uses secondary data from PT Bank Mandiri (Persero) Tbk. relating to the Home Ownership Loan (mortgage loan) portfolio in the Collectibility 2A category. This data is used to analyze the role of Collectibility 2A as an Early Warning System (EWS) in identifying potential credit risk before it develops into problem loans.

The research object was focused on mortgage loan debtors in the Collectibility 2A category as of May 13, 2026. The selection of the Collectibility 2A category is based on the assumption

that this category represents the early phase of credit quality decline, with the potential to provide early signals of future increases in credit risk.

In total, the number of accounts under study is 306 accounts with a total outstanding balance of Rp 142,440,569,642. All data has been anonymized in accordance with applicable banking regulations. Table 4.1 below presents a general overview of the research data:

Table 4 General Overview of Research Data

Description	Value
Number of Accounts	306 accounts
Total Outstanding Balance	Rp 142,440,569,642
Total Credit Limit	Rp 181,890,000,000
Data Period	May 13, 2026
Data Source	Internal Data of Bank Mandiri
Collectibility Category	Kol 2A (Special Mention)

Source: Bank Mandiri data, processed (2026)

4.2 Analysis Of Mortgage Loan Debtor Collectibility Shifts in Kol 2A

4.2.1 Debtor Characteristics Based on Arrears

Based on the arrears value, all 306 Kol 2A accounts are grouped according to the risk categories established in Table 3. The following is the distribution:

Table 5: Debtor Characteristics Based on Arrears

Arrears Category	Value Range	No. of Accounts	Percentage
Easy Coll	< Rp 500,000	22	7.2%
Medium Risk	Rp 500,000 – Rp 5,000,000	168	54.9%
High Risk	Rp 5,000,000 – Rp 10,000,000	86	28.1%
Critical	> Rp 10,000,000	30	9.8%
Total	-	306	100%

Source: Bank Mandiri data, processed (2026)

The medium risk segment dominates with 168 accounts (54.9%), followed by high risk (86 accounts, 28.1%), critical (30 accounts, 9.8%), and easy coll (22 accounts, 7.2%). These findings indicate that most Kol 2A debtors are already under payment pressure, requiring active monitoring.

4.2.2 Debtor Characteristics Based on Branch Distribution

The distribution of Kol 2A accounts by branch shows an uneven risk concentration. The following table presents the 10 branches with the highest exposure:

Table 6 Debtor Distribution by Branch (Top 10)

Branch	Accounts	Total Outstanding Balance	Arrears/Balance Ratio
Soekarno-Hatta	39	Rp 24,900,000,000	0.76%
Asia Afrika Utara	18	Rp 13,800,000,000	0.84%
Kiara Condong	19	Rp 13,700,000,000	0.93%
Buah Batu	25	Rp 10,100,000,000	1.17%
Binacitra	34	Rp 10,000,000,000	1.15%
Jamika	6	Rp 7,700,000,000	0.96%
Metro	26	Rp 7,200,000,000	1.70%
Soreang	10	Rp 6,200,000,000	0.93%
Majalaya	6	Rp 5,400,000,000	0.75%
Alun-Alun	9	Rp 5,300,000,000	0.85%

Source: Bank Mandiri data, processed (2026)

The Soekarno-Hatta branch recorded the highest exposure with 39 accounts and a total outstanding balance of Rp 24.9 billion, followed by Asia Afrika Utara (18 accounts, Rp 13.8 billion) and Kiara Condong (19 accounts, Rp 13.7 billion). The risk concentration across these three branches requires management's attention and priority handling.

4.2.3 Debtor Characteristics Based on Outstanding Balance

The outstanding balance reflects the amount of the credit exposure the debtor still owes. The descriptive statistics of the outstanding balance of 306 Kol 2A accounts are presented as follows:

Table 7 Outstanding Balance Statistics for Kol 2A Debtors

Description	Value
Number of Accounts	306
Total Outstanding Balance	Rp 142,440,569,642
Average Outstanding Balance	Rp 465,491,404
Highest Outstanding Balance	Rp 1,800,000,000
Lowest Outstanding Balance	Rp 12,500,000

Source: Bank Mandiri data, processed (2026)

The average outstanding balance per account reaches Rp 465,491,404, indicating a fairly large exposure value per debtor. The variation between the highest outstanding balance (Rp 1.8 billion) and the lowest (Rp 12.5 million) shows portfolio heterogeneity that requires different handling approaches.

4.2.4 Debtor Characteristics Based on Collectibility Shift

Analysis of the debtor's collectibility history in the previous month produces a picture of the pattern of credit quality shifts. The following is the distribution of collectibility shifts:

Table 8: Collectibility Shift from April to May 2026

Previous Period Collectibility	Kol May 2026	Number of Accounts	Percentage
Kol 1 (Current)	Kol 2A	162	53.0%
Kol 2A	Kol 2A	125	40.8%
Kol 2B	Kol 2A	17	5.6%
Kol 2C / Kol 3	Kol 2A	2	0.6%
Total	-	306	100%

Source: Bank Mandiri data, processed (2026)

The most significant finding is that 162 accounts (53%) came from Kol 1 (Current). This phenomenon indicates a new wave of credit quality deterioration not detected by the NPL ratio. Meanwhile, 125 accounts (40.8%) remaining in Kol 2A show persistent and unresolved pressure.

4.2.5 Debtor Distribution Based on Arrears Value

The distribution of arrears values provides a picture of the financial burden carried by Kol 2A debtors as a whole:

Table 9 Debtor Distribution Based on Arrears Value

Category	Number of Accounts	Total Arrears (Rp)	Percentage
Easy Coll (< Rp 500,000)	22	6,215,000	0.4%
Medium (Rp 500K – Rp 5M)	168	420,912,000	29.9%
High (Rp 5M – Rp 10M)	86	472,872,160	33.6%
Critical (> Rp 10M)	30	508,120,000	36.1%
Total	306	1,408,119,160	100%

Source: Bank Mandiri data, processed (2026)

The total arrears from 306 accounts reach Rp 1,408,119,160. Although the critical group accounts for only 9.8% of accounts, it bears 36.1% of the total arrears, indicating a disproportionate concentration of financial risk in this segment.

4.3 Debtor Risk Segmentation Analysis

Based on the established risk classification, all 306 accounts are grouped into four segments. The complete segmentation results with descriptions of required actions are presented below:

Table 10 Risk Segmentation of Kol 2A Debtors

Segment	Arrears Category	Accounts	Percentage	Notes
Easy Coll	< Rp 500,000	22	7.2%	Easy to resolve
Medium	Rp 500K – Rp 5M	168	54.9%	Active monitoring
High	Rp 5M – Rp 10M	86	28.1%	Immediate action
Critical	> Rp 10 million	30	9.8%	Top priority
Total	-	306	100%	-

Source: Bank Mandiri data, processed (2026)

Risk segmentation findings reveal that 38.0% of accounts (116 accounts) are in the high- and critical-risk categories, indicating that nearly two out of five Kol 2A debtors require immediate attention. If not intervened, this group has the greatest potential to move to the NPL category in subsequent periods.

4.4 Risk Exposure Analysis Based on Outstanding Balance

To understand the relationship between risk segmentation and credit exposure more comprehensively, the following statistics for Kol 2A debtors are presented:

Table 11 Statistics of Kol 2A Debtors

Description	Value
Number of Accounts	306
Total Outstanding Balance	Rp 142,440,569,642
Average Outstanding Balance	Rp 465,491,404
Highest Outstanding Balance	Rp 1,800,000,000
Lowest Outstanding Balance	Rp 12,500,000

Source: Bank Mandiri data, processed (2026)

The average outstanding balance reaching Rp 465 million per account, combined with a total outstanding balance of Rp 142.4 billion, shows that this portfolio has significant financial exposure for the bank. The following presents the relationship between risk segmentation and credit exposure in full:

Table 12 Relationship Between Risk Segmentation and Credit Exposure

Category	No. of Accounts	Total Arrears (Rp)	% Accounts	% Arrears
Easy Coll	22	6,215,000	7.2%	0.4%
Medium	168	420,912,000	54.9%	29.9%
High	86	472,872,160	28.1%	33.6%
Critical	30	508,120,000	9.8%	36.1%

Total	306	1,408,119,160	100%	100%
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Source: Bank Mandiri data, processed (2026)

Table 4.9 reveals an important imbalance: the critical group, which consists of only 9.8% of accounts, bears 36.1% of total arrears. This confirms that although relatively small in number, the financial exposure from the critical segment is highly material for the bank.

4.5 Analysis of Collectibility 2A as an Early Warning System

4.5.1 First Evidence: Decline from Kol 1 to Kol 2A

The first evidence confirming the effectiveness of Kol 2A as an EWS is the massive shift from Kol 1 to Kol 2A in one period. The following data presents the details:

Table 13 Collectibility History of Kol 2A Debtors

Collectibility History	Number of Accounts	Percentage	Notes
From Kol 1 (Current)	162	53.0%	Newly declined
Remained in Kol 2A	125	40.8%	Persistent
From Kol 2B/2C/3	19	6.2%	Partial improvement
Total	306	100%	-

Source: Bank Mandiri data, processed (2026)

More than half of debtors (162 accounts or 53%) currently in Kol 2A were previously in current status. This shows that Kol 2A effectively captures changes in credit quality before NPLs occur — a signal that would not be detected if banks relied solely on the NPL ratio as a single indicator.

4.5.2 Second Evidence: Emergence of Significant Arrears

Total arrears from 306 Kol 2A accounts reach Rp 1,408,119,160. This fact shows that debtors are already exhibiting clear signs of payment difficulties. Credit risk has already emerged and is measurable, even though it has not yet become non-performing credit formally. This is the essence of the collectibility-based EWS function: risk is detected before it becomes a more serious problem.

4.5.3 Third Evidence: Presence of High and Critical Risk Groups

Based on risk segmentation, 116 accounts (37.9%) are in the high- and critical-risk categories. These findings show that nearly a third of the mortgage loan portfolio in the Kol 2A category already has a level of risk that requires special attention. Although these debtors have not yet entered the NPL category, the high and critical risk groups indicate symptoms of credit quality deterioration that are already apparent. Therefore, collectibility information can be utilized as an EWS for banks to conduct monitoring and risk mitigation before an increase in problem loans occurs.

4.5.4 Fourth Evidence: All Debtors Have Not Yet Entered the NPL Category

All 306 accounts are still in Kol 2A, not Kol 3-5. This is the strongest evidence that Kol 2A provides a preventive intervention window before NPL is formed. If banks act at this stage, the

potential increase in the NPL ratio can still be prevented through restructuring, debtor assistance, or other corrective actions.

4.5.5 Synthesis of Collectibility 2A as an EWS

The four pieces of evidence above collectively confirm that Kol 2A functions effectively as an Early Warning System. The synthesis of findings is presented in the following table:

Table 14 Synthesis of Collectibility 2A as an EWS

Evidence	Finding	EWS Implication
Evidence 1	162 (53%) debtors came from Kol 1 (Current)	Kol 2A captures decline before NPL occurs
Evidence 2	Total arrears of Rp 1,408,119,160	Financial pressure is real even though not yet classified as problem loans
Evidence 3	116 accounts (37.9%) in high and critical risk	Nearly a third of the portfolio requires immediate special attention
Evidence 4	All 306 accounts have not yet entered NPL (Kol 3-5)	Kol 2A provides a preventive intervention window before NPL is formed

Source: Processed by researcher (2026)

These findings are consistent with research by Beltman et al. (2025) showing that EWS based on retail customer payment behavior data can provide earlier warnings. Mawardi et al. (2023) also show that early detection through EWS is proven effective in improving banks' readiness to take corrective action. Meanwhile, [Fejes and Katits \(2025\)](#) affirm that mid-tier collectibility movements are the critical point as an intervention window before credit truly becomes problematic. The collectibility-based approach as an EWS enables banks to shift from reactive risk management patterns to a more preventive and measured approach ([Silitonga & Manda, 2022](#)).

4.6 General Discussion

Based on the analysis, this study finds several pieces of evidence indicating that Collectibility 2A plays an important role as an Early Warning System (EWS) in managing mortgage loan credit risk at Bank Mandiri. First, the results of the collectibility shift analysis show that 162 accounts, or 52.94% of debtors currently in the Collectibility 2A category, were previously in the Collectibility 1 (Current) category. This finding indicates that credit quality deterioration can occur even when the debtor previously had a good payment history, making changes in collectibility status an early indicator of emerging credit risk. This is consistent with [Beltman et al. \(2025\)](#), who demonstrated that behavioral signals preceding formal defaults can be captured well in advance through an EWS framework, and with [Fejes and Katits \(2025\)](#), who affirm that mid-tier collectibility movements are more effective early indicators than lagging metrics such as NPL.

Second, the research results show that the Collectibility 2A debtor portfolio has total arrears of Rp 1.41 billion. This value shows that symptoms of payment difficulties have begun to emerge in the group of debtors studied, even though the credit has not yet entered the category of problem loans. This condition signals a potential increase in credit risk that requires the bank's attention. [Prihatina \(2022\)](#) similarly found that mid-tier collectibility categories such as Kol 2

represent a critical transition phase, and that the arrears accumulated at this stage are indicative of future NPL formation if left unaddressed.

Third, the results of risk segmentation show that there are 116 accounts or 37.9% of debtors in the high and critical risk categories. In other words, nearly a third of debtors in the Collectibility 2A portfolio have shown a level of risk that requires special attention. This finding shows that the Collectibility 2A category not only reflects payment delays but also identifies groups of debtors with a greater potential to experience future credit quality deterioration. This aligns with [Rahmi and Herlina \(2021\)](#), who demonstrated that unchecked credit deterioration leads to significant negative effects on bank profitability ($r = -0.669$), and with [Herlina and Suryaningprang \(2023\)](#), who showed that rising NPL increases the capital burden on banks ($t = 39.89$; $\text{sig} = 0.000$), both of which underscore the urgency of early-stage intervention.

Fourth, although showing arrears and increased credit risk, all debtors in the study remain in the Collectibility 2A category and have not yet been included in the Non-Performing Loan (NPL) category. This condition shows that risk information has emerged earlier before the credit truly enters the category of problem loans. This confirms the EWS principle articulated by [Mawardi et al. \(2023\)](#), in which early stability signals allow banks to intervene before a crisis regime develops, and corroborates [Dendawijaya's \(2009\)](#) definition of NPL as only reflecting credit already classified as non-performing (Kol 3–5), which by definition arrives too late for preventive action.

Based on these four findings, it can be concluded that Collectibility 2A has characteristics consistent with the Early Warning System concept in credit risk management. Information on changes in collectibility status, arrears levels, and risk segmentation can provide early signals to banks about the potential for credit quality deterioration before it is reflected in the Non-Performing Loan (NPL) ratio. Therefore, Collectibility 2A can be utilized as an Early Warning System instrument that helps Bank Mandiri in conducting monitoring, supervision, and risk mitigation measures earlier to prevent an increase in problem loans.

These research findings reinforce the view that a preventive approach in credit risk management is more effective than a reactive approach that only focuses on credit that has already entered the non-performing category. Thus, the use of Collectibility 2A as part of an early credit risk detection system can be one of the strategies that supports efforts to maintain the quality of the mortgage loan credit portfolio and minimize the bank's potential losses in the future.

5. Conclusion

This study aimed to analyze the role of Collectibility 2A as an Early Warning System in Bank Mandiri's mortgage loan portfolio. The results show that more than half of the debtors experienced a decline from the current category to Collectibility 2A, had total arrears of Rp 1.41 billion, and comprised high- and critical-risk groups, amounting to 37.9% of total debtors.

Based on these results, this study concludes that Collectibility 2A can be used as an Early Warning System to detect potential increases in credit risk before credit enters the Non-Performing Loan (NPL) category. Therefore, collectibility information can be used as the basis for decision-making in mortgage loan credit risk monitoring and mitigation activities.

This study recommends that Bank Mandiri optimize periodic collectibility monitoring as an integral part of its credit risk management framework, making Kol 2A the primary intervention

point to prevent escalation to NPL. Future research is recommended to integrate data from all collectibility categories (Kol 1-5) from multiple periods and to consider macroeconomic variables as moderating factors, building on the financial distress prediction framework demonstrated by [Prayoga, Herlinawati, and Herlina \(2026\)](#).

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