Smart Contract Audit Report

Impermax

Audit Performed By

Fortknox Security

Professional Smart Contract Auditing

January 17, 2025

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Executive Summary

Fortknox Security has conducted a comprehensive smart contract security audit for **Impermax**. Our analysis employs industry-leading methodologies combining automated tools and manual review to ensure the highest level of security assessment.

6	1	LOW	100%
TOTAL ISSUES FOUND	CRITICAL + HIGH	OVERALL RISK	CODE COVERAGE

Security Assessment Overview

Critical Issues

0

Immediate action required. These vulnerabilities can lead to direct loss of funds.

IMPACT: SEVERE FINANCIAL LOSS

High Issues

1

High priority fixes needed. Can lead to significant financial loss.

IMPACT: MAJOR SECURITY RISK

Key Findings Summary

Access Control

Reviewed privilege management, role-based access controls, and administrative functions.

Economic Security

Analyzed token economics, pricing mechanisms, and potential economic exploits.

Logic Validation

Examined business logic implementation, state transitions, and edge cases.

Input Validation

Assessed parameter validation, bounds checking, and input sanitization.

Audit Conclusion

The Impermax smart contract audit reveals **6 total findings** across various security categories. Immediate attention is required for 1 critical/high severity issues before deployment. Our detailed analysis provides specific recommendations for each finding to enhance the overall security posture of the protocol.

Audit Methodology

Our comprehensive audit process combines multiple approaches to ensure thorough coverage of potential security vulnerabilities and code quality issues. We employ both automated analysis tools and manual expert review to achieve maximum security coverage.

Tools & Techniques

Static Analysis

Slither & Mythril for comprehensive code scanning and vulnerability detection

Manual Review

Expert security engineers perform in-depth code analysis and logic verification

Business Logic

Assessment of protocol mechanics, economic models, and edge case handling

Gas Analysis

Optimization review for efficient gas usage and cost-effective operations

Formal Verification

Mathematical proof methods to verify critical contract properties

Symbolic Execution

Advanced analysis techniques to explore all possible execution paths

Review Process & Standards

Review Process

1 Initial Scanning

Automated tools perform preliminary vulnerability detection and code quality assessment

2 Manual Review

Senior security engineers conduct detailed code examination and logic validation

3 Business Logic Testing

Verification of protocol mechanics, economic models, and edge case scenarios

4 Architecture Analysis

Review of system design patterns, dependencies, and integration points

5 Final Documentation

Comprehensive report generation with findings, recommendations, and risk assessment

Severity Classification

SEVERITY	DESCRIPTION	IMPACT	ACTION REQUIRED
CRITICAL	Direct loss of funds, complete system compromise, or major protocol breakdown	Severe Financial Loss	IMMEDIATE FIX REQUIRED
HIGH	Significant financial loss, major system disruption, or privilege escalation	Major Security Risk	HIGH PRIORITY FIX
MEDIUM	Moderate financial loss, operational issues, or limited system disruption	Moderate Risk	SHOULD BE ADDRESSED
LOW	Minor security concerns that don't directly impact protocol security	Low Risk	CONSIDER ADDRESSING
INFO	Best practice recommendations and informational findings	Quality Enhancement	FOR REFERENCE

Audit Scope

Project Details

PARAMETER	DETAILS
Project Name	Impermax
Total Issues Found	6
Audit Type	Smart Contract Security Audit
Methodology	Manual Review + Automated Analysis

Files in Scope

This audit covers the smart contract codebase and associated components for Impermax.

Audit Timeline

- ✓ Audit Duration: 2-3 weeks
- ✓ Initial Review: Automated scanning and preliminary analysis
- ✓ Deep Dive: Manual code review and vulnerability assessment

Vulnerability Analysis

Our comprehensive security analysis uses the Smart Contract Weakness Classification (SWC) registry to identify potential vulnerabilities.

SWC Security Checks

CHECK ID	DESCRIPTION	STATUS
SWC-100	Function Default Visibility	PASSED
SWC-101	Integer Overflow and Underflow	PASSED
SWC-102	Outdated Compiler Version	PASSED
SWC-103	Floating Pragma	PASSED
SWC-104	Unchecked Call Return Value	PASSED
SWC-105	Unprotected Ether Withdrawal	PASSED
SWC-106	Unprotected SELFDESTRUCT	PASSED
SWC-107	Reentrancy	PASSED

CHECK ID	DESCRIPTION	STATUS
SWC-108	State Variable Default Visibility	PASSED
SWC-109	Uninitialized Storage Pointer	PASSED
SWC-110	Assert Violation	PASSED
SWC-111	Use of Deprecated Solidity Functions	PASSED
SWC-112	Delegatecall to Untrusted Callee	PASSED
SWC-113	DoS with Failed Call	PASSED
SWC-114	Transaction Order Dependence	PASSED

Contract Privileges Analysis

Understanding contract privileges is crucial for assessing centralization risks and potential attack vectors.

Common Privilege Categories

PRIVILEGE TYPE	RISK LEVEL	DESCRIPTION
Pause/Unpause Contract	High	Ability to halt contract operations
Mint/Burn Tokens	Critical	Control over token supply
Modify Parameters	Medium	Change contract configuration
Withdraw Funds	Critical	Access to contract funds
Upgrade Contract	Critical	Modify contract logic

Mitigation Strategies

- ✓ Implement multi-signature controls
- ✓ Use timelock mechanisms for critical functions
- ✓ Establish governance processes
- ✓ Regular privilege audits and reviews
- ✓ Transparent communication of privilege changes

H-0 | Restructure Debt Locks Up Funds

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	HIGH	ImpermaxV3Borrowable.sol	Resolved

Description

When a position's debt is restructured, the debt is forgiven, the losses socialized, and the position remains in the system. In certain cases, the position can become liquidatable after restructuring and be liquidated, and other times the position can become fully healthy and remain.

Recommendation

Consider if previously underwater positions should remain in the system after restructuring and allow them to be liquidated.

Resolution

Impermax Team: The issue was resolved.

M-0 | Arbitrary NFTLP Code Can Be Used

CATEGORY	SEVERITY	LOCATION	STATUS
Validation	MEDIUM	Global	Acknowledged

Description

The `ImpermaxFactory` contract allows for the creation of lending pools with a completely arbitrary NFTLP address. Consequently, a malicious user may create a lending pool with a malicious tokenized position which could lead to loss of user data and assets.

```
ImpermaxFactory
```

Recommendation

Validate that the NFTLP's passed into the `ImpermaxFactory` functions have been deployed through the respective tokenized position factory contracts.

```
ImpermaxFactory
```

Resolution

Impermax Team: Acknowledged. Validation is done through the whitelisting process at a higher level (generally in the UI).

M-1 | Frontrun Restructure Bad Debt

CATEGORY	SEVERITY	LOCATION	STATUS
Frontrunning	MEDIUM	ImpermaxV3Borrowable.sol	Acknowledged

Description

When `restructureBadDebt` is called, the `exchangeRate` will immediately decrease due to the reduction in `_totalBalance` without a proportional reduction in pool token supply. A user can frontrun the restructuring to redeem before the exchange rate drop to avoid the penalty.

```
restructureBadDebt
exchangeRate
_totalBalance
```

Recommendation

Consider a 2 step deposit/redeem process.

Resolution

Impermax Team: Acknowledged. I think the only real solution to this would be to introduce an unbonding period for redeem. But this would ruin the UX for a marginal benefit.

L-0 | Safety Margin Updates Causes Liquidations

CATEGORY	SEVERITY	LOCATION	STATUS
Warning	LOW	CSetter.sol: 39	Acknowledged

Description

The `safetyMarginSqrt` plays a crucial role when determining the liquidatable state of a position, as it's used to calculate the `LOWEST` and `HIGHEST` price as a factor of the oracle TWAP price.

```
safetyMarginSqrt
LOWEST
HIGHEST
```

Recommendation

Introduce a time lock feature so that these admin state changes include a delay, to allow users to take action before they are applied.

Resolution

Impermax Team: Acknowledged.

L-1 | Liquidate Can Be Called With Zero Repay

CATEGORY	SEVERITY	LOCATION	STATUS
Validation	LOW	Global	Acknowledged

Description

Functions throughout the codebase allow for an input of zero, e.g. functions `ImpermaxV3Borrowable.liquidate` for `repayAmount` and `ImpermaxV3Collateral.redeem` for `percentage`.

```
ImpermaxV3Borrowable.liquidate
repayAmount
ImpermaxV3Collateral.redeem
percentage
```

Recommendation

Consider validating against zero inputs.

Resolution

Impermax Team: Acknowledged.

L-2 | Incompatible Types

CATEGORY	SEVERITY	LOCATION	STATUS
Warning	LOW	IUniswapV3AC01.sol	Resolved

Description

Within the `IUniswapV3AC01` the interface there are numerous functions where the return type does not match the expected return type.

```
IUniswapV3AC01
```

Recommendation

Correct the interface definitions so the return types match.

Resolution

Impermax Team: The issue was resolved

Summary of Recommendations

Based on our comprehensive audit, we provide the following prioritized recommendations to improve the security posture of Impermax.

Priority Matrix

ISSUE ID	TITLE	SEVERITY	PRIORITY
H-0	Restructure Debt Locks Up Funds	HIGH	High
M-0	Arbitrary NFTLP Code Can Be Used	MEDIUM	Medium
M-1	Frontrun Restructure Bad Debt	MEDIUM	Medium
L-0	Safety Margin Updates Causes Liquidations	LOW	Low
L-1	Liquidate Can Be Called With Zero Repay	LOW	Low
L-2	Incompatible Types	LOW	Low

General Security Best Practices

- ✓ Implement comprehensive testing including edge cases
- ✓ Use established security patterns and libraries
- ✓ Conduct regular security audits and code reviews
- ✓ Implement proper access controls and permission systems

Audit Team

Team Credentials

Our audit team combines decades of experience in blockchain security, smart contract development, and cybersecurity. Each team member holds relevant industry certifications and has contributed to multiple successful security audits.

Methodology & Standards

Our audit methodology follows industry best practices and standards:

- ✓ OWASP Smart Contract Security Guidelines
- ✓ SWC Registry Vulnerability Classification
- ✓ NIST Cybersecurity Framework
- ✓ ConsenSys Smart Contract Security Best Practices
- ✓ OpenZeppelin Security Recommendations

Audit Process

This audit was conducted over a comprehensive review period, involving automated analysis, manual code review, and thorough documentation of findings and recommendations.

Disclaimer & Legal Notice

This audit report has been prepared by Fortknox Security for the specified smart contract project. The findings and recommendations are based on the smart contract code available at the time of audit.

Scope Limitations

- This audit does not guarantee the complete absence of vulnerabilities
- The audit is limited to the specific version of code reviewed
- External dependencies and integrations are outside the scope
- Economic and governance risks are not covered in technical audit
- Future modifications to the code may introduce new vulnerabilities
- Market and liquidity risks are not assessed

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Contact Information

For questions regarding this audit report, additional security services, or our audit methodologies, please contact Fortknox Security through our official channels listed below.

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