InterFi NETWORK

SMART CONTRACT AUDIT

interfinetwork

hello@interfi.network

https://interfi.network

PREPARED FOR

SUPERWHALE STAKING CONTRACT

INTRODUCTION

Auditing Firm	InterFi Network
Client Firm	SuperWhale
Methodology	Automated Analysis, Manual Code Review
Language	Solidity
Contract	0xbA14Ab6AfD92ec6FC00A5723735e1B68F85252a7
Blockchain	Binance Smart Chain
Centralization	Active Ownership
Commit	4a00de4b7b164a7581b701a09d4249da1c3ecc64
Website	https://superwhale.co/
Report Date	May 16, 2024

ℹ️ Verify the authenticity of this report on our website: https://www.github.com/interfinetwork

EXECUTIVE SUMMARY

InterFi has performed the automated and manual analysis of solidity codes. Solidity codes were reviewed for common contract vulnerabilities and centralized exploits. Here's a quick audit summary:

Status	Critical 🔴	Major 🟠	Medium 🟡	Minor 🟢	Unknown 🟤
Open	0	1	1	1	0
Acknowledged	0	0	0	1	1
Resolved	0	0	0	1	0
Important Functions	Stake, Restake, Claim, Unstake				

ℹ️ Please note that smart contracts deployed on blockchains aren't resistant to exploits, vulnerabilities and/or hacks. Blockchain and cryptography assets utilize new and emerging technologies. These technologies present a high level of ongoing risks. For a detailed understanding of risk severity, source code vulnerability, and audit limitations, kindly review the audit report thoroughly.

ℹ️ Please note that centralization privileges regardless of their inherited risk status - constitute an elevated impact on smart contract safety and security.

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SCOPE OF WORK

InterFi was consulted by SuperWhale to conduct the smart contract audit of their solidity source codes.

The audit scope of work is strictly limited to mentioned solidity file(s) only:

- SPWStaking.sol

ℹ️ If source codes are not deployed on the main net, they can be modified or altered before main-net deployment. Verify the contract's deployment status below:

Public Contract Link	
https://testnet.bscscan.com/address/0xbA14Ab6AfD92ec6FC00A5723735e1B68F85252a7#code	
Contract Name	SPWStaking
Compiler Version	0.8.24
License	MIT

AUDIT METHODOLOGY

Smart contract audits are conducted using a set of standards and procedures. Mutual collaboration is essential to performing an effective smart contract audit. Here's a brief overview of InterFi's auditing process and methodology:

CONNECT

- The onboarding team gathers source codes, and specifications to make sure we understand the size, and scope of the smart contract audit.

AUDIT

- Automated analysis is performed to identify common contract vulnerabilities. We may use the following third-party frameworks and dependencies to perform the automated analysis:
  - Remix IDE Developer Tool
  - Open Zeppelin Code Analyzer
  - SWC Vulnerabilities Registry
  - DEX Dependencies, e.g., Pancakeswap, Uniswap
- Simulations are performed to identify centralized exploits causing contract and/or trade locks.
- A manual line-by-line analysis is performed to identify contract issues and centralized privileges. We may inspect below mentioned common contract vulnerabilities, and centralized exploits:

Centralized Exploits	○ Token Supply Manipulation ○ Access Control and Authorization ○ Assets Manipulation ○ Ownership Control ○ Liquidity Access ○ Stop and Pause Trading ○ Ownable Library Verification

Common Contract Vulnerabilities	○ Integer Overflow ○ Lack of Arbitrary limits ○ Incorrect Inheritance Order ○ Typographical Errors ○ Requirement Violation ○ Gas Optimization ○ Coding Style Violations ○ Re-entrancy ○ Third-Party Dependencies ○ Potential Sandwich Attacks ○ Irrelevant Codes ○ Divide before multiply ○ Conformance to Solidity Naming Guides ○ Compiler Specific Warnings ○ Language Specific Warnings

REPORT

- The auditing team provides a preliminary report specifying all the checks which have been performed and the findings thereof.
- The client's development team reviews the report and makes amendments to solidity codes.
- The auditing team provides the final comprehensive report with open and unresolved issues.

PUBLISH

- The client may use the audit report internally or disclose it publicly.

ℹ️ It is important to note that there is no pass or fail in the audit, it is recommended to view the audit as an unbiased assessment of the safety of solidity codes.

RISK CATEGORIES

A successful external attack may allow the external attacker to directly exploit. A successful centralization-related exploit may allow the privileged role to directly exploit. All risks which are identified in the audit report are categorized:

Risk Type	Definition
Critical 🔴	These risks pose immediate and severe threats, such as asset theft, data manipulation, or complete loss of contract functionality. They are often easy to exploit and can lead to significant, irreparable damage. Immediate fix is required.
Major 🟠	These risks can significantly impact code performance and security, and they may indirectly lead to asset theft and data loss. They can allow unauthorized access or manipulation of sensitive functions if exploited. Fixing these risks are important.
Medium 🟡	These risks may create attack vectors under certain conditions. They may enable minor unauthorized actions or lead to inefficiencies that can be exploited indirectly to escalate privileges or impact functionality over time.
Minor 🟢	These risks may include inefficiencies, lack of optimizations, code-style violations. These should be addressed to enhance overall code quality and maintainability.
Unknown 🟤	These risks pose uncertain severity to the contract or those who interact with it. Immediate fix is required to mitigate risk uncertainty.

All statuses which are identified in the audit report are categorized here:

Status Type	Definition
Open	Risks are open.
Acknowledged	Risks are acknowledged, but not fixed.
Resolved	Risks are acknowledged and fixed.

CENTRALIZED PRIVILEGES

Centralization risk is the most common cause of cryptography asset loss. When a smart contract has a privileged role, the risk related to centralization is elevated.

There are some well-intended reasons have privileged roles, such as:

- Privileged roles can be granted the power to `pause()` the contract in case of an external attack.
- Privileged roles can use functions like, `include()`, and `exclude()` to add or remove wallets from fees, swap checks, and transaction limits. This is useful to run a presale and to list on an exchange.

Authorizing privileged roles to externally-owned-account (EOA) is dangerous. Lately, centralization-related losses are increasing in frequency and magnitude.

- The client can lower centralization-related risks by implementing below mentioned practices:
- Privileged role's private key must be carefully secured to avoid any potential hack.
- Privileged role should be shared by multi-signature (multi-sig) wallets.
- Authorized privilege can be locked in a contract, user voting, or community DAO can be introduced to unlock the privilege.
- Renouncing the contract ownership, and privileged roles.
- Remove functions with elevated centralization risk.

ℹ Understand the project's initial asset distribution. Assets in the liquidity pair should be locked. Assets outside the liquidity pair should be locked with a release schedule.

AUTOMATED ANALYSIS

Symbol	Definition
🛑	Function modifies state
💸	Function is payable
🔒	Function is internal
🔐	Function is private
!	Function is important

ReentrancyGuard	Implementation			
└	<Constructor>	Public !	🛑	NO!
└	_nonReentrantBefore	Private 🔐	🛑	
└	_nonReentrantAfter	Private 🔐	🛑	
└	_reentrancyGuardEntered	Internal 🔒		
IERC20	Interface			
└	totalSupply	External !		NO!
└	balanceOf	External !		NO!
└	transfer	External !	🛑	NO!
└	allowance	External !		NO!
└	approve	External !	🛑	NO!
└	transferFrom	External !	🛑	NO!
SPWStaking	Implementation	ReentrancyGuard		
└	<Constructor>	Public !	🛑	NO!
└	stake	External !	🛑	NO!
└	restake	External !	🛑	NO!

| └ | claim | External ! | 🛑 | nonReentrant |

| └ | unstake | External ! | 🛑 | nonReentrant |

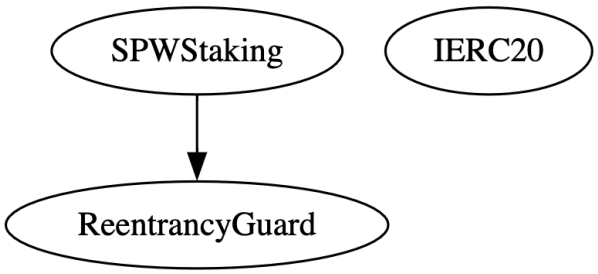
| └ | calculateReward | Public ! | | NO! |

| └ | getAPRForLockPeriod | Public ! | | NO! |

| └ | getAPRForDuration | Public ! | | NO! |

| └ | getUserInfo | Public ! | | NO! |

INHERITANCE GRAPH



MANUAL REVIEW

Identifier	Definition	Severity
LOG-01	Insufficient input checks	Medium 🟡

- Constructor does not check if the provided `_stakingToken` address is non-zero.
- `lockWeeks` input in `stake()` function should be validated to ensure it is a positive integer.
- Check for contract balance to make sure contract has sufficient tokens to pay out rewards or return stakes

RECOMMENDATION

Establish clear input checks. All input parameters should remain within safe and rational ranges.

Identifier	Definition	Severity
LOG-02	Potential front-running	Minor

Front-running is a form of attack where an adversary observes a pending transaction in the mempool and attempts to exploit it by submitting their own transaction with higher gas fees to get it executed first. Below mentioned functions are called without setting restrictions on slippage or minimum output:

```
stake()
restake()
claim()
unstake()
```


RECOMMENDATION

Functions that execute critical state changes should enforce minimum output thresholds. Setting these minimums above zero can deter malicious actors by reducing the predictability and profitability of front-running strategies.

Implement commit-reveal scheme where users first commit their intention to `stake()`, `restake()`, `claim()`, or `unstake()`, and then reveal their commitment in a subsequent transaction.

ACKNOWLEDGEMENT

Front-running is not avoidable on public blockchains. SuperWhale team commented that, most EVM chains are prone to some sort of front-running and external manipulation.

Identifier	Definition	Severity
LOG-03	Re-entrancy	Major 🟠
LOG-04	Checks-Effects-Interactions	

Below mentioned functions are used without Re-entrancy guard:

```
stake()
restake()
```

Below mentioned functions should adhere to Checks-Effects-Interactions pattern:

```
stake()
restake()
claim()
unstake()
```


RECOMMENDATION

Use Checks-Effects-Interactions (CEI) pattern when transferring control to external entities. This design pattern ensures that all state changes are completed before external interactions occur. Additionally, implement re-entrancy guard to block recursive calls from external contracts.

Identifier	Definition
LOG-05	Lack of emergency withdraw and emergency pause

- Implement a function that allows users to withdraw their staked tokens immediately in the event of an emergency. This ensures that users can access their funds if unexpected issues arise with the contract.
- Allow contract owner to pause all new staking activities in case of an emergency. This prevents new stakes from being made while the contract is under repair, ensuring that potential issues do not compound.

Identifier	Definition	Severity
COD-02	Timestamp dependence	Minor

Be aware that the timestamp of the block can be manipulated by miners. Since miners can slightly adjust the timestamp, they may influence contract outcomes to their advantage.

RECOMMENDATION

Avoid relying solely on timestamp of the block for critical contract functions. Follow 15 seconds rule, and scale time dependent events accordingly.

Identifier	Definition	Severity
COD-10	Direct and indirect dependencies	Unknown 🟤
COD-11	Reliance on `stakingToken` contract	

Smart contract is interacting with third party protocols e.g., DEX routers, external contracts, web3 applications, *OpenZeppelin* upgradeable and ERC20 libraries. The scope of the audit treats these entities as black boxes and assumes their functional correctness. However, in the real world, all of them can be compromised, and exploited. Moreover, upgrades in these entities can create severe impacts, e.g., increased transactional fees, deprecation of previous routers, etc.

RECOMMENDATION

Inspect third party dependencies regularly, and mitigate severe impacts whenever necessary.

ACKNOWLEDGEMENT

SuperWhale team will inspect third party dependencies regularly, and push upgrades whenever required.

Identifier	Definition	Severity
COM-02	Multiple pragma directives	Minor

Multiple pragmas are used in the smart contract.

RECOMMENDATION

Pragma should be fixed to stable compiler version. Fixing pragma ensures compatibility and prevents the contract from being compiled with incompatible compiler versions.

RESOLUTION

Smart contract will be deployed with stable compiler.

DISCLAIMERS

InterFi Network provides the easy-to-understand audit of solidity source codes (commonly known as smart contracts).

The smart contract for this particular audit was analyzed for common contract vulnerabilities, and centralization exploits. This audit report makes no statements or warranties on the security of the code. This audit report does not provide any warranty or guarantee regarding the absolute bug-free nature of the smart contract analyzed, nor do they provide any indication of the client's business, business model or legal compliance. This audit report does not extend to the compiler layer, any other areas beyond the programming language, or other programming aspects that could present security risks. Cryptographic tokens are emergent technologies, they carry high levels of technical risks and uncertainty. You agree that your access and/or use, including but not limited to any services, reports, and materials, will be at your sole risk on an as-is, where-is, and as-available basis. This audit report could include false positives, false negatives, and other unpredictable results.

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ABOUT INTERFI NETWORK

InterFi Network provides intelligent blockchain solutions. We provide solidity development, testing, and auditing services. We have developed 150+ solidity codes, audited 1000+ smart contracts, and analyzed 500,000+ code lines. We have worked on major public blockchains e.g., Ethereum, Binance, Cronos, Doge, Polygon, Avalanche, Metis, Fantom, Bitcoin Cash, Velas, Oasis, etc.

InterFi Network is built by engineers, developers, UI experts, and blockchain enthusiasts. Our team currently consists of 4 core members, and 6+ casual contributors.

Website: https://interfi.network

Email: hello@interfi.network

GitHub: https://github.com/interfinetwork

Telegram (Engineering): https://t.me/interfiaudits

Telegram (Onboarding): https://t.me/interfisupport

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SMART CONTRACT AUDITS | SOLIDITY DEVELOPMENT AND TESTING

RELENTLESSLY SECURING PUBLIC AND PRIVATE BLOCKCHAINS