CERTIK

Preliminary Comments

PolkaEx

Sept 23rd, 2021

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Summary

This report has been prepared for PolkaEx to discover issues and vulnerabilities in the source code of the PolkaEx project as well as any contract dependencies that were not part of an officially recognized library. A comprehensive examination has been performed, utilizing Static Analysis and Manual Review techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifications and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

The security assessment resulted in findings that ranged from critical to informational. We recommend addressing these findings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective:

- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verified in public;
- Provide more transparency on privileged activities once the protocol is live.

Overview

Project Summary

Project Name	PolkaEx
Description	A Liquidity Pool
Platform	Ethereum
Language	Solidity
Codebase	https://polkaex.io/solidity/Pkex_Solidity_2021_07_17.zip https://github.com/PolkaEX/PolkaEx/
Commit	48b0ce61eae92aab0335955f5a5b5ce9484c8df1

Audit Summary

Delivery Date	Sept 23, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	0	0	0	0	0	0
Major	5	0	0	0	5	0
Medium	0	0	0	0	0	0
Minor	16	0	0	4	0	12
Informational	13	0	0	0	0	13
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
PLP	PrivateLunchpad.sol	d93d00ece2d8d455c7c9ff9497911c196589390db569585b7fffd663a14a53f2
PLE	PublicLunchpad.sol	e2ff890cb53b2fc4d10e88c8d1a982d7d7e5d7ee3f0cc80355603e16caaebd93
RPE	Reward.sol	6954841efc174c8a7ba3ba2326216d22daa2754b7a1bd6c29c965e33897e6806
PEP	claim_v5_pkex.sol	21c4fb7d8813b4bed55b8ecf3a5cd67bbc50efa52fbd46922fded96cb00f28b4
PCK	pkex-token.sol	27c84057ab6904ace8a479f575799b0cd5e2bf10b1d9fbd65e629934a8a87326

To bridge the trust gap between owner and users, the owner needs to express a sincere attitude regarding the consideration of the administrator team's anonymity.

The owner of `PkexTokenClaim` has the responsibility to notify users with the following capability:

- Add vestings by batches through `addMutiVestingInOneAddress()` and `addMutiVestingInMutiAddress()`
- Remove vestings through `removeVesting()`

The owner of `PrivateLaunchpad` has the responsibility to notify users with the following capability:

- Add user to a whitelist that only listed members may buy and withdraw tokens

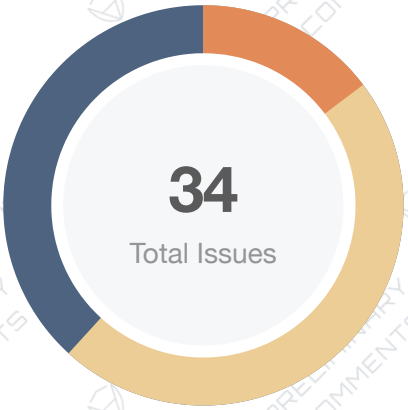
Pausers of `PrivateLaunchpad and` PublicLaunchpad` has the responsibility to notify users with the following capability:

- Pause/unpause the contract to disable/enable transactions

The reward distributor has the responsibility to notify users with the following capability:

- Add rewards and new pools through `notifyRewardAmound()`
- Transfer tokens other than stake or reward through `recoverERC20()`
- Set withdraw cooldown period through `setUnstakePeriod()`

Findings



Critical	0 (0.00%)
Major	5 (14.71%)
Medium	0 (0.00%)
Minor	16 (47.06%)
Informational	13 (38.24%)
Discussion	0 (0.00%)

ID	Title	Category	Severity	Status
PCK-01	Lack of Input Validation	Volatile Code	Minor	Resolved
PCK-02	Delegation Initialization	Logical Issue	Informational	Resolved
PCK-03	Unlocked and Inconsistent Compiler Version	Language Specific	Minor	Resolved
PEP-01	Inaccurate Error Message	Inconsistency	Informational	Resolved
PEP-02	Lack of Error Messages	Control Flow	Minor	Resolved
PEP-03	Unlocked and Inconsistent Compiler Version	Language Specific	Minor	Resolved
PEP-04	Logic Issues of `addVesting()`	Logical Issue	Major	Partially Resolved
PEP-05	Privileged Ownership	**Centralization / Privilege**	**Major**	Partially Resolved
PEP-06	Improper Usage of `public` and `external` Types	Gas Optimization	Informational	Resolved
PEP-07	Typo in Function Name	Language Specific	Informational	Resolved
PEP-08	Third Party Dependencies	Volatile Code	Minor	Acknowledged
PLE-01	Set `constant` to Variables	Gas Optimization	Informational	Resolved
PLE-02	Logic Issue of `buy()`	Logical Issue	Minor	Resolved
PLE-03	Lack of Input Validation	Volatile Code	Minor	Resolved

ID	Title	Category	Severity	Status
PLE-04	Typos in Contract Name	Coding Style	Informational	Resolved
PLE-05	Unlocked and Inconsistent Compiler Version	Language Specific	Minor	Resolved
PLE-06	Privileged Ownership	**Centralization / Privilege**	**Major**	Partially Resolved
PLE-07	Improper Usage of `public` and `external` Types	Gas Optimization	Informational	Resolved
PLE-08	Third Party Dependencies	Volatile Code	Minor	Acknowledged
PLP-01	Set `constant` to Variables	Gas Optimization	Informational	Resolved
PLP-02	Lack of Input Validation	Volatile Code	Minor	Resolved
PLP-03	Typos in Contract Name	Coding Style	Informational	Resolved
PLP-04	Unlocked and Inconsistent Compiler Version	Language Specific	Minor	Resolved
PLP-05	Privileged Ownership	**Centralization / Privilege**	**Major**	Partially Resolved
PLP-06	Improper Usage of `public` and `external` Types	Gas Optimization	Informational	Resolved
PLP-07	Typo in Function Name	Language Specific	Informational	Resolved
PLP-08	Third Party Dependencies	Volatile Code	Minor	Acknowledged
RPE-01	Privileged Ownership	**Centralization / Privilege**	**Major**	Partially Resolved
RPE-02	Lack of Input Validation	Volatile Code	Minor	Resolved
RPE-03	Missing Emit Events	Volatile Code	Informational	Resolved
RPE-04	Improper Usage of `public` and `external` Types	Gas Optimization	Informational	Resolved
RPE-05	Logical Issue of `getTotalRewarded`	Logical Issue	Minor	Resolved
RPE-06	Third Party Dependencies	Volatile Code	Minor	Acknowledged

ID	Title	Category	Severity	Status
RPE-07	Safetransfer for Reward	Logical Issue	Minor	Resolved

PCK-01 | Lack of Input Validation

Category	Severity	Location	Status
Volatile Code	Minor	pkex-token.sol: 271	Resolved

Description

The assigned value to `account` should be verified as a non-zero value to prevent being mistakenly assigned as `address(0)` in the `constructor()` function.

Recommendation

We advise the client to check that the address is not zero in `constructor()` like as follows.

```
    require(account != address(0), "Zero address");
```

Alleviation

The client added a validator as we had suggested and resolved this issue.

PCK-02 | Delegation Initialization

Category	Severity	Location	Status
Logical Issue	Informational	pkex-token.sol: 271~274	Resolved

Description

Delegates are not assigned to any account in `constructor()`. We would like to enquire on how the voting system is initialized.

Alleviation

The client removed the vote functionalities and this is no longer an issue.

PCK-03 | Unlocked and Inconsistent Compiler Version

Category	Severity	Location	Status
Language Specific	Minor	pkex-token.sol: 18	Resolved

Description

The contract has unlocked and inconsistent compiler versions. An unlocked compiler version in the contract's source code permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to ambiguity when debugging as compiler-specific bugs may occur in the codebase that would be difficult to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

It is general practice to alternatively lock the compiler at a specific version rather than allow a range of compiler versions to be utilized to avoid compiler-specific bugs and be able to identify ones more easily. We recommend locking the compiler at the lowest possible version that supports all the capabilities wished by the codebase. This will ensure that the project utilizes a compiler version that has been in use for the longest time and as such is less likely to contain yet-undiscovered bugs.

Alleviation

The client locked the compiler versions to `0.7.0`.

PEP-01 | Inaccurate Error Message

Category	Severity	Location	Status
Inconsistency	Informational	claim_v5_pkex.sol: 259	Resolved

Description

The current error message may not give accurate feedback for contract construction as the token address is not bound to be matic tokens.

Recommendation

We advise the client to review their functionalities and change the require statements to make them consistent with function logic.

Alleviation

The client changed the error message to "Invalid PKEX token address".

PEP-02 | Lack of Error Messages

Category	Severity	Location	Status
Control Flow	Minor	claim_v5_pkex.sol	Resolved

Description

Most `require` statements in libraries in the linked file have the error message omitted.

Recommendation

We advise the client to add error messages to all `require` statements, as this pattern helps the user identify all the relevant procedural requirements.

Alleviation

The client added missing error messages to the validators in `PkexTokenClaim`.

PEP-03 | Unlocked and Inconsistent Compiler Version

Category	Severity	Location	Status
Language Specific	Minor	claim_v5_pkex.sol: 18	Resolved

Description

The contract has unlocked and inconsistent compiler versions. An unlocked compiler version in the contract's source code permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to ambiguity when debugging as compiler-specific bugs may occur in the codebase that would be difficult to identify over a span of multiple compiler versions rather than a specific one.

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Alleviation

The client locked the compiler versions to `0.7.0`.

PEP-04 | Logic Issues of `addVesting()`

Category	Severity	Location	Status
Logical Issue	Major	claim_v5_pkex.sol: 336~338	Partially Resolved

Description

The function is declared `private` which contradicts its purpose. Besides, `Tokenamount` is not properly updated.

Recommendation

We advise the client to review its functionality and fix the implementation.

Alleviation

The client changed the visibility to `external` and added `Tokenamount` attribute in the function.

PEP-05 | Privileged Ownership

Category	Severity	Location	Status
Centralization / Privilege	Major	claim_v5_pkex.sol	Partially Resolved

Description

To bridge the gap in trust between owner and users, the owner needs to express a sincere attitude regarding the considerations of the administrator team's anonymity. Owner of `PkexTokenClaim` has the responsibility to notify users with the following capability:

- Add vestings by batches through `addMutiVestingInOneAddress()` and `addMutiVestingInMutiAddress()`
- Remove vestings through `removeVesting()`

Recommendation

We advise the client to carefully oversee the manager account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol to be improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g. Multisignature wallets. Here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 48 hours, for awareness on privileged operations;
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

[Client]: After doing a few IDOs this will be changed to a DAO in due time. More information would be available on our website.

PEP-06 | Improper Usage of `public` and `external` Types

Category	Severity	Location	Status
Gas Optimization	Informational	claim_v5_pkex.sol	Resolved

Description

`public` functions that are never called by the contract could be declared `external` . When the inputs are arrays external functions are more efficient than “public” functions.

Examples:

- `retrieveExcessTokens()`
- `mutiRelease()`
- `addMutiVestingInMutiAddress()`
- `addMutiVestingInOneAddress()`
- `removeVesting()`
- `myNextRelease()`
- `releaseAll()`
- `myVestings()`
- `token()`

Recommendation

We advise the client to use the `external` attribute for functions never called from the contract.

Alleviation

The client revised the code as we had suggested and resolved this issue.

PEP-07 | Typo in Function Name

Category	Severity	Location	Status
Language Specific	Informational	claim_v5_pkex.sol	Resolved

Description

"Multi" is misspelt as "Muti" in all functions involving batched transactions.

Recommendation

We advise the client to adopt the more accepted spelling in those function names.

Alleviation

The client fixed all the typos we mentioned.

PEP-08 | Third Party Dependencies

Category	Severity	Location	Status
Volatile Code	Minor	claim_v5_pkex.sol	Acknowledged

Description

The contract is serving as the underlying entity to interact with third-party protocols, including:

- `pkexToken` that interacts with `PkexTokenClaim`
- `USDC` that interacts with `PrivateLunchpad` and `PublicLunchPad`
- `Token` that interacts with `PrivateLunchpad` and `PublicLunchPad`
- `rewardsToken` that interacts with `StakingRewardsV2`
- `stakingToken` that interacts with `StakingRewardsV2`

The scope of the audit treats 3rd party entities as black boxes and assumes their functional correctness. However, in the real world, 3rd parties can be compromised and this may lead to lost or stolen assets. In addition, upgrades of 3rd parties can possibly create severe impacts, such as increasing fees of 3rd parties, migrating to new LP pools, etc.

Recommendation

We understand that the business logic of PolkaEx requires interaction with the aforementioned protocols. We encourage the team to constantly monitor the status of 3rd parties to mitigate side effects when unexpected activities are observed.

PLE-01 | Set `constant` to Variables

Category	Severity	Location	Status
Gas Optimization	Informational	PrivateLunchpad.sol	Resolved

Description

Some variables are not changed throughout the smart contract and can be set as `constant`:

- `isWhite`
- `rate`
- `lockRate`
- `USDCap`
- `personCap`
- `personMinCap`
- `maxGasPrice`
- `TokenCap`

Recommendation

We advise the client to set them as constant variables and adopt the `UPPERCASE` naming convention.

Alleviation

The client set them as constants as we had suggested.

PLE-02 | Logic Issue of `buy()`

Category	Severity	Location	Status
Logical Issue	Minor	PublicLunchpad.sol: 719	Resolved

Description

According to the logic of the `buy()` function, the unlocked amount of `msg.sender` should not be `tokenLocked` but the difference of `tokenBought` and `tokenLocked`. Even though the result would be the same given the current `lockRate`, the current implementation is unsound and may introduce unnecessary rounding errors.

Recommendation

We advise the client to modify as follows:

```
719     userUnLocked[msg.sender] =
userUnLocked[msg.sender].add(tokenBought).sub(tokenLocked);
```

Alleviation

The client revised the code as we had suggested and resolved this issue.

PLE-03 | Lack of Input Validation

Category	Severity	Location	Status
Volatile Code	Minor	PublicLunchpad.sol: 685~700	Resolved

Description

Input arguments of `constructor()` are not validated and could be volatile.

Recommendation

We advise the client to add a argument validator to check if the value of `_USDC`, `_Token`, `_fundWallet` and `TokenWallets` is set as address(0). Besides, consider add validator to ensure `startTime < endTime`.

Alleviation

The client added validators for all the arguments we had mentioned.

PLE-04 | Typos in Contract Name

Category	Severity	Location	Status
Coding Style	Informational	PublicLunchpad.sol: 731	Resolved

Description

The contract name `PirvateLunchpad` should be `PrivateLunchpad`. Besides, "LaunchPad" instead of "LunchPad" seems to be the correct word judging from website sources.

Recommendation

We recommend correcting this typo.

Alleviation

The client fixed all the typos we mentioned.

PLE-05 | Unlocked and Inconsistent Compiler Version

Category	Severity	Location	Status
Language Specific	Minor	PublicLunchpad.sol: 18, 3	Resolved

Description

The contract has unlocked and inconsistent compiler versions. An unlocked compiler version in the contract's source code permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to ambiguity when debugging as compiler-specific bugs may occur in the codebase that would be difficult to identify over a span of multiple compiler versions rather than a specific one.

Recommendation

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Alleviation

The client locked the compiler versions to `0.7.0`.

PLE-06 | Privileged Ownership

Category	Severity	Location	Status
Centralization / Privilege	Major	PublicLunchpad.sol	Partially Resolved

Description

To bridge the trust gap between owner and users, the owner needs to express a sincere attitude regarding the considerations of the administrator team's anonymity. The owner of `PrivateLunchpad` has the responsibility to notify users with the following capability:

- Add user to a whitelist that only listed members may buy and withdraw tokens

Pausers of `PrivateLunchpad` and `PublicLunchpad` has the responsibility to notify users with the following capability:

- Pause/unpause the contract to disable/enable transactions

Recommendation

We advise the client to carefully oversee the manager account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol to be improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g. Multisignature wallets. Here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 48 hours, for awareness on privileged operations;
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

[Client]: After doing a few IDOs this will be changed to a DAO in due time. More information would be available on our website.

PLE-07 | Improper Usage of `public` and `external` Types

Category	Severity	Location	Status
Gas Optimization	Informational	PublicLunchpad.sol	Resolved

Description

`public` functions that are never called by the contract could be declared `external` . When the inputs are arrays external functions are more efficient than `public` functions.

Examples:

- `addMutiWhitelist()`
- `withdraw()`
- `buyToken()`

Recommendation

We advise the client to use the `external` attribute for functions never called from the contract.

Alleviation

The client changed the function visibilities as we had suggested and resolved this issue.

PLE-08 | Third Party Dependencies

Category	Severity	Location	Status
Volatile Code	Minor	PublicLunchpad.sol	Acknowledged

Description

The contract is serving as the underlying entity to interact with third-party protocols, including:

- `pkexToken` that interacts with `PkexTokenClaim`
- `USDC` that interacts with `PrivateLunchpad` and `PublicLunchPad`
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We understand that the business logic of PolkaEx requires interaction with the aforementioned protocols. We encourage the team to constantly monitor the status of 3rd parties to mitigate side effects when unexpected activities are observed.

PLP-01 | Set `constant` to Variables

Category	Severity	Location	Status
Gas Optimization	Informational	PublicLunchpad.sol	Resolved

Description

Some variables are not changed throughout the smart contract and can be set as `constant`:

- `isWhite`
- `rate`
- `lockRate`
- `USDCap`
- `personCap`
- `personMinCap`
- `maxGasPrice`
- `TokenCap`

Recommendation

We advise the client to set them as constant variables and adopt the `UPPERCASE` naming convention.

Alleviation

The client set them as constants as we had suggested.

PLP-02 | Lack of Input Validation

Category	Severity	Location	Status
Volatile Code	Minor	PrivateLunchpad.sol: 776~791	Resolved

Description

Input arguments of `constructor()` are not validated and could be volatile.

Recommendation

We advise the client to add a argument validator to check if the value of `_USDC`, `_Token`, `_fundWallet` and `TokenWallets` is set as address(0). Besides, consider add validator to ensure `startTime < endTime`.

Alleviation

The client added validators for all the arguments we had mentioned.

PLP-03 | Typos in Contract Name

Category	Severity	Location	Status
Coding Style	Informational	PrivateLunchpad.sol: 731	Resolved

Description

The contract name `PirvateLunchpad` should be `PrivateLunchpad`. Besides, "LaunchPad" instead of "LunchPad" seems to be the correct word judging from website sources.

Recommendation

We recommend correcting this typo.

Alleviation

The client fixed all the typos we mentioned.

PLP-04 | Unlocked and Inconsistent Compiler Version

Category	Severity	Location	Status
Language Specific	Minor	PrivateLunchpad.sol: 18	Resolved

Description

The contract has unlocked and inconsistent compiler versions. An unlocked compiler version in the contract's source code permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to ambiguity when debugging as compiler-specific bugs may occur in the codebase that would be difficult to identify over a span of multiple compiler versions rather than a specific one.

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Alleviation

The client locked the compiler versions to `0.7.0`.

PLP-05 | Privileged Ownership

Category	Severity	Location	Status
Centralization / Privilege	Major	PrivateLunchpad.sol	Partially Resolved

Description

To bridge the trust gap between owner and users, the owner needs to express a sincere attitude regarding the considerations of the administrator team's anonymity. The owner of `PrivateLunchpad` has the responsibility to notify users with the following capability:

- Add user to a whitelist that only listed members may buy and withdraw tokens

Pausers of `PrivateLunchpad` and `PublicLunchpad` has the responsibility to notify users with the following capability:

- Pause/unpause the contract to disable/enable transactions

Recommendation

We advise the client to carefully oversee the manager account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol to be improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g. Multisignature wallets. Here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 48 hours, for awareness on privileged operations;
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

[Client]: After doing a few IDOs this will be changed to a DAO in due time. More information would be available on our website.

PLP-06 | Improper Usage of `public` and `external` Types

Category	Severity	Location	Status
Gas Optimization	Informational	PrivateLunchpad.sol	Resolved

Description

`public` functions that are never called by the contract could be declared `external` . When the inputs are arrays external functions are more efficient than `public` functions.

Examples:

- `addMutiWhitelist()`
- `withdraw()`
- `buyToken()`

Recommendation

We advise the client to use the `external` attribute for functions never called from the contract.

Alleviation

The client changed the function visibilities as we had suggested and resolved this issue.

PLP-07 | Typo in Function Name

Category	Severity	Location	Status
Language Specific	Informational	PrivateLunchpad.sol	Resolved

Description

"Multi" is misspelt as "Muti" in all functions involving batched transactions.

Recommendation

We advise the client to adopt the more accepted spelling in those function names.

Alleviation

The client fixed all the typos we mentioned.

PLP-08 | Third Party Dependencies

Category	Severity	Location	Status
Volatile Code	Minor	PrivateLunchpad.sol	Acknowledged

Description

The contract is serving as the underlying entity to interact with third-party protocols, including:

- `pkexToken` that interacts with `PkexTokenClaim`
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Recommendation

We understand that the business logic of PolkaEx requires interaction with the aforementioned protocols. We encourage the team to constantly monitor the status of 3rd parties to mitigate side effects when unexpected activities are observed.

RPE-01 | Privileged Ownership

Category	Severity	Location	Status
Centralization / Privilege	Major	Reward.sol	Partially Resolved

Description

To bridge the trust gap between owner and users, the owner needs to express a sincere attitude regarding the considerations of the administrator team's anonymity. The reward distributor has the responsibility to notify users with the following capability:

- Add rewards and new pools through `notifyRewardAmount()`
- Transfer tokens other than stake or reward through `recoverERC20()`
- Set withdraw cooldown period through `setUnstakePeriod()`

Recommendation

We advise the client to carefully oversee the manager account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol to be improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g. Multisignature wallets. Here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, i.e. 48 hours, for awareness on privileged operations;
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

[Client]: After doing a few IDOs this will be changed to a DAO in due time. More information would be available on our website.

RPE-02 | Lack of Input Validation

Category	Severity	Location	Status
Volatile Code	Minor	Reward.sol: 863~873	Resolved

Description

The input address arguments are not validated as non-zero values.

Recommendation

We advise the client to add argument validators to check if any value of `_rewardsDistribution`, `_rewardsToken`, and `_stakingToken` is set as address(0).

Alleviation

The client added argument validators as we had suggested and resolved this issue.

RPE-03 | Missing Emit Events

Category	Severity	Location	Status
Volatile Code	Informational	Reward.sol: 1095~1097	Resolved

Description

The `setUnstakePeriod()` function affects the status of a sensitive variable and should be able to emit events as notifications to customers.

Recommendation

We advise the client to add an event for sensitive actions, and emit them in the function.

Alleviation

The client changed added the event as we had suggested and resolved this issue.

RPE-04 | Improper Usage of `public` and `external` Types

Category	Severity	Location	Status
Gas Optimization	Informational	Reward.sol	Resolved

Description

`public` functions that are never called by the contract could be declared `external`. When the inputs are arrays external functions are more efficient than “public” functions.

Examples:

- `setUnstakePeriod()`
- `myStakeInfo()`

Recommendation

We advise the client to use `external` attribute for functions never called from the contract.

Alleviation

The client revised these attributes and fixed this issue.

RPE-05 | Logical Issue of `getTotalRewarded`

Category	Severity	Location	Status
Logical Issue	Minor	Reward.sol: 952	Resolved

Description

When `pool.from > block.timestamp` for the current pool, the same condition will hold for all subsequent pools and the for loop should end.

Recommendation

We advise the client to `break` instead of `continue` the for loop.

Alleviation

The client revised the code as we had suggested and resolved this issue.

RPE-06 | Third Party Dependencies

Category	Severity	Location	Status
Volatile Code	Minor	Reward.sol	Acknowledged

Description

The contract is serving as the underlying entity to interact with third-party protocols, including:

- `pkexToken` that interacts with `PkexTokenClaim`
- `USDC` that interacts with `PrivateLunchpad` and `PublicLunchPad`
- `Token` that interacts with `PrivateLunchpad` and `PublicLunchPad`
- `rewardsToken` that interacts with `StakingRewardsV2`
- `stakingToken` that interacts with `StakingRewardsV2`

The scope of the audit treats 3rd party entities as black boxes and assumes their functional correctness. However, in the real world, 3rd parties can be compromised and this may lead to lost or stolen assets. In addition, upgrades of 3rd parties can possibly create severe impacts, such as increasing fees of 3rd parties, migrating to new LP pools, etc.

Recommendation

We understand that the business logic of PolkaEx requires interaction with the aforementioned protocols. We encourage the team to constantly monitor the status of 3rd parties to mitigate side effects when unexpected activities are observed.

RPE-07 | Safetransfer for Reward

Category	Severity	Location	Status
Logical Issue	Minor	Reward.sol: 1011	Resolved

Description

The reward may be stuck in the contract if the user's claim exceeds the token balance available as the `safeTransfer()` would revert in that situation. The user is still entitled to whatever reward tokens are left in the contract and should be able to retrieve them.

Recommendation

We advise the client to reimplement the `safeTransfer()` function that allows the transfer of all reward that is left in the aforementioned situation.

Alleviation

The client reimplemented the the `safeTransfer()` function as we had suggested and resolved this issue.

Appendix

Finding Categories

Centralization / Privilege

Centralization / Privilege findings refer to either feature logic or implementation of components that act against the nature of decentralization, such as explicit ownership or specialized access roles in combination with a mechanism to relocate funds.

Gas Optimization

Gas Optimization findings do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.

Logical Issue

Logical Issue findings detail a fault in the logic of the linked code, such as an incorrect notion on how block.timestamp works.

Control Flow

Control Flow findings concern the access control imposed on functions, such as owner-only functions being invoke-able by anyone under certain circumstances.

Volatile Code

Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases that may result in a vulnerability.

Language Specific

Language Specific findings are issues that would only arise within Solidity, i.e. incorrect usage of private or delete.

Coding Style

Coding Style findings usually do not affect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

Inconsistency

Inconsistency findings refer to functions that should seemingly behave similarly yet contain different code, such as a constructor assignment imposing different require statements on the input variables than a setter function.

Checksum Calculation Method

The "Checksum" field in the "Audit Scope" section is calculated as the SHA-256 (Secure Hash Algorithm 2 with digest size of 256 bits) digest of the content of each file hosted in the listed source repository under the specified commit.

The result is hexadecimal encoded and is the same as the output of the Linux "sha256sum" command against the target file.

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