

## JDBC Maintenance Release 4.5

### Description:

Maintenance review of the JDBC 4.0 Specification

### Maintenance Lead:

Lance Andersen, Oracle Corporation

### Feedback:

Comments should be sent to [jsr221-comments@jcp.org](mailto:jsr221-comments@jcp.org)

### Rationale for Changes:

The goal is to address several specification issues as well as several minor enhancements requested by the JDBC EG and user community.

### Proposed Changes:

#### 1. AutoClosable Support

The following interfaces now support the AutoClosable interface:

- `java.sql.Array`
- `java.sql.Blob`
- `java.sql.Clob`
- `java.sql.NClob`
- `java.sql.SQLXML`

To support this feature, the following close method has been added to each interface:

```
default void close() throws SQLException {  
    free();  
};
```

## 2. **java.sql.Connection** changes

The following methods have been added to `java.sql.Connection`:

- default `String` `enquoteIdentifier(String identifier, Boolean alwaysQuote)` throws `SQLException`
- default `String` `enquoteLiteral(String val)` throws `SQLException`
- default `String` `enquoteNCharLiteral(String val)` throws `SQLException`
- default `boolean` `isSimpleIdentifier(String identifier)` throws `SQLException`

## 3. **java.sql.JDBCType** and **java.sql.Types** changes

The following SQL types have been added to **`java.sql.JDBCType`** and **`java.sql.Types`**:

- `DECFLOAT`
  - `Types.java` value: 2015
- `JSON`
  - `Types.java` value: 2016

## 4. **java.sql.Timestamp hashCode** changes:

The `Timestamp` `hashCode` method incorrectly indicated that the nanos value was not included in the calculation of the hash code.

## 5. **java.sql.SQLPermission** changes:

`java.sql.SQLPermission` has been marked deprecated for removal.

## 6. Selective Disabling of JDBC Escape Syntax processing and Parameter Markers ('?')

In a JDBC SQL String (i.e., a Java String literal), parameter markers are represented by the character '?'. With the introduction of the `MATCH_RECOGNIZE` operator in SQL:2016, the '?' character can also appear as a token within SQL statements

To accommodate this, JDBC allows for the disabling of parameter marker processing (for '?') and the evaluation of JDBC escape syntax within a specified section of a JDBC SQL String. This section is defined by the delimiters "{\\" at the start and "\\}" at the end.

The character sequence "\\\\" may be used to include a backslash within "{\\" and "\\}".

The following is an example of a SQL query which selectively disables Escape processing:

```
String sql = """
    select T.firstw, T.lastz, ? from tkpattern_s11
    MATCH_RECOGNIZE (
        MEASURES A.c1 as firstw, last(Z.c1) as lastz
        ALL MATCHES
        {\ PATTERN (A? X*? Y+? Z??) \}
        DEFINE
            X as X.c2 > prev(X.c2),
            Y as Y.c2 < prev(Y.c2),
            Z as Z.c2 > prev(Z.c2)
        ) as T
    """;
```

The JDBC driver will not process the PATTERN clause "{\ PATTERN (A? X\*? Y+? Z??) \}" and will result in:

```
PATTERN (A? X*? Y+? Z??)
```

Additional examples:

| String Literal                            | Result                            |
|-------------------------------------------|-----------------------------------|
| "{\ _foo_}"                               | _foo_                             |
| "{\ q{\ \ \ \ foo \ \ \ \}"               | q{\ foo \}                        |
| "{\ {ts '1999-01-09 20:11:11.123455'} \}" | {ts '1999-01-09 20:11:11.123455'} |
| "{\ ? \}"                                 | ?                                 |
| "{\ /* \ \ \ \ */ \}"                     | /* \ */                           |
| "{\ // \ \ \ \ \n hi \}"                  | // \ ↵ hi                         |
| "{\ '\ \ \ \ ' \}"                        | '                                 |
| "{\ \"\ \ \ \ \" \}"                      | "                                 |
| "{\ '\ \ \ \ ' \}"                        | '\                                |
| "{\ \"\ \ \ \ \" \}"                      | "\                                |
| "{\ \ \ \ \ \}"                           | SQLException thrown               |
| "{\ \ \ \ \ \}"                           | \                                 |
| "{\ q{\ \abc\}"                           | Compilation error                 |
| "{\ q{\ \abc\ \}"                         | SQLException thrown               |
| "{\ q{\ \ \ \abc \ \ \ \}"                | q{\abc\}                          |
| "{\ 'literal with {\.\}\}"                | Compilation error                 |
| "{\ 'literal with {\ \ \ \.\ \ \ \ \}"    | 'literal with {\.\}'              |
| "{\ /* comment {\.\} */ \}"               | Compilation error                 |
| ""<br><br>{\ // \ \ \ \<br>hi \}<br>""    | // \<br>hi                        |

7. Appendix B updates

The Data Type Conversion tables have been updated to address missing conversions as well as adding conversions for the JSON and DECFLOAT SQL Data types.

APPENDIX B

B. Data Type Conversion Tables

This appendix describes mappings and conversions that drivers must support. The following mappings and conversions are covered:

- JDBC Types Mapped to Java Types
- Java Types Mapped to JDBC Types
- JDBC Types Mapped to Java Object Types
- Java Object Types Mapped to JDBC Types
- Conversions by setObject and setNull from Java Object Types to JDBC Types
- Type Conversions Supported by ResultSet getter Methods

B.1 JDBC Types Mapped to Java Types

TABLE B-1 shows the conceptual correspondence between JDBC types and Java types. A programmer should write code with this mapping in mind. For example, if a value in the database is a SMALLINT, a short should be the data type used in a JDBC application.

All CallableStatement getter methods except for getObject use this mapping. The getObject methods for both the CallableStatement and ResultSet interfaces use the mapping in TABLE B-3.

TABLE B-1 JDBC Types Mapped to Java Types

| JDBC Type     | Java Type            |
|---------------|----------------------|
| CHAR          | String               |
| VARCHAR       | String               |
| LONGVARCHAR   | String               |
| NUMERIC       | java.math.BigDecimal |
| DECIMAL       | java.math.BigDecimal |
| BIT           | boolean              |
| BOOLEAN       | boolean              |
| TINYINT       | byte                 |
| SMALLINT      | short                |
| INTEGER       | int                  |
| BIGINT        | long                 |
| REAL          | float                |
| FLOAT         | double               |
| DOUBLE        | double               |
| BINARY        | byte[]               |
| VARBINARY     | byte[]               |
| LONGVARBINARY | byte[]               |
| DATE          | java.sql.Date        |
| TIME          | java.sql.Time        |
| TIMESTAMP     | java.sql.Timestamp   |

| JDBC Type               | Java Type                             |
|-------------------------|---------------------------------------|
| CLOB                    | <code>java.sql.Clob</code>            |
| BLOB                    | <code>java.sql.Blob</code>            |
| ARRAY                   | <code>java.sql.array</code>           |
| DISTINCT                | Mapping of underlying type            |
| STRUCT                  | <code>java.sql.Struct</code>          |
| REF                     | <code>java.sql.Ref</code>             |
| DATALINK                | <code>java.net.URL</code>             |
| JAVA_OBJECT             | Underlying Java class                 |
| ROWID                   | <code>java.sql.RowId</code>           |
| NCHAR                   | <code>String</code>                   |
| NVARCHAR                | <code>String</code>                   |
| LONGNVARCHAR            | <code>String</code>                   |
| NCLOB                   | <code>java.sql.NClob</code>           |
| SQLXML                  | <code>java.sql.SQLXML</code>          |
| JSON                    | <code>String</code>                   |
| DECFLOAT                | <code>java.math.BigDecimal</code>     |
| TIMESTAMP_WITH_TIMEZONE | <code>java.time.OffsetDatetime</code> |
| TIME_WITH_TIMEZONE      | <code>java.time.OffsetTime</code>     |

**B.2 Java Types Mapped to JDBC Types**

TABLE B-2 shows the mapping a driver should use for the updater methods in the `ResultSet` interface and for IN parameters. `PreparedStatement` setter methods and `RowSet` setter methods use this table for mapping an IN parameter, which is a Java type, to the JDBC type that will be sent to the database. Note that the `setObject` methods for these two interfaces use the mapping shown in TABLE B-4.

TABLE B-2 Standard Mapping from Java Types to JDBC Types

| Java Type            | JDBC Type                                                         |
|----------------------|-------------------------------------------------------------------|
| String               | CHAR, VARCHAR, LONGVARCHAR, NCHAR, NVARCHAR, LONGNVARCHAR or JSON |
| java.math.BigDecimal | DECIMAL, NUMERIC or DECFLOAT                                      |
| boolean              | BIT or BOOLEAN                                                    |
| byte                 | TINYINT                                                           |
| short                | SMALLINT                                                          |
| int                  | INTEGER                                                           |
| long                 | BIGINT                                                            |
| float                | REAL                                                              |
| double               | DOUBLE                                                            |
| byte[]               | BINARY, VARBINARY, or LONGVARBINARY                               |
| java.sql.Date        | DATE                                                              |
| java.sql.Time        | TIME                                                              |
| java.sql.Timestamp   | TIMESTAMP                                                         |
| java.sql.Clob        | CLOB                                                              |

| Java Type       | JDBC Type   |
|-----------------|-------------|
| java.sql.Blob   | BLOB        |
| java.sql.Array  | ARRAY       |
| java.sql.Struct | STRUCT      |
| java.sql.Ref    | REF         |
| java.net.URL    | DATALINK    |
| Java class      | JAVA_OBJECT |
| java.sql.RowId  | ROWID       |
| java.sql.NClob  | NCLOB       |
| java.sql.SQLXML | SQLXML      |

### B.3 JDBC Types Mapped to Java Object Types

`ResultSet.getObject` and `CallableStatement.getObject` use the mapping shown in TABLE B-3 for standard mappings.

**Note** – The JDBC 1.0 specification defined the Java object mapping for the `SMALLINT` and `TINYINT` JDBC types to be `Integer`. The Java language did not include the `Byte` and `Short` data types when the JDBC 1.0 specification was finalized. The mapping of `SMALLINT` and `TINYINT` to `Integer` is maintained to preserve backwards compatibility.

TABLE B-3 Mapping from JDBC Types to Java Object Types

| JDBC Type   | Java Object Type     |
|-------------|----------------------|
| CHAR        | String               |
| VARCHAR     | String               |
| LONGVARCHAR | String               |
| NUMERIC     | java.math.BigDecimal |
| DECIMAL     | java.math.BigDecimal |
| BIT         | Boolean              |
| BOOLEAN     | Boolean              |
| TINYINT     | Integer              |
| SMALLINT    | Integer              |
| INTEGER     | Integer              |
| BIGINT      | Long                 |
| REAL        | Float                |

| JDBC Type               | Java Object Type               |
|-------------------------|--------------------------------|
| FLOAT                   | Double                         |
| DOUBLE                  | Double                         |
| BINARY                  | byte[]                         |
| VARBINARY               | byte[]                         |
| LONGVARBINARY           | byte[]                         |
| DATE                    | java.sql.Date                  |
| TIME                    | java.sql.Time                  |
| TIMESTAMP               | java.sql.Timestamp             |
| DISTINCT                | Object type of underlying type |
| ROWID                   | java.sql.RowId                 |
| NCHAR                   | String                         |
| NVARCHAR                | String                         |
| LONGNVARCHAR            | String                         |
| NCLOB                   | java.sql.NClob                 |
| SQLXML                  | java.sql.SQLXML                |
| TIMESTAMP_WITH_TIMEZONE | java.time.OffsetDatetime       |
| TIME_WITH_TIMEZONE      | java.time.OffsetTime           |
| DECFLOAT                | java.math.BigDecimal           |
| JSON                    | String                         |

**B.4      Java Object Types Mapped to JDBC Types**

PreparedStatement.setObject, PreparedStatement.setNull, RowSet.setNull and RowSet.setObject use the mapping shown TABLE B-4 when no parameter specifying a target JDBC type is provided.

TABLE B-4   Mapping from Java Object Types to JDBC Types

| Java Object Type     | JDBC Type                                                         |
|----------------------|-------------------------------------------------------------------|
| String               | CHAR, VARCHAR, LONGVARCHAR, NCHAR, NVARCHAR, LONGNVARCHAR or JSON |
| java.math.BigDecimal | DECIMAL, NUMERIC or DECFLOAT                                      |
| Boolean              | BIT or BOOLEAN                                                    |
| Byte                 | TINYINT                                                           |
| Short                | SMALLINT                                                          |
| Integer              | INTEGER                                                           |
| Long                 | BIGINT                                                            |
| Float                | REAL                                                              |
| Double               | DOUBLE                                                            |
| byte[]               | BINARY, VARBINARY, or LONGVARBINARY                               |
| java.math.BigInteger | BIGINT                                                            |
| java.sql.Date        | DATE                                                              |
| java.sql.Time        | TIME                                                              |
| java.sql.Timestamp   | TIMESTAMP                                                         |

| Java Object Type         | JDBC Type               |
|--------------------------|-------------------------|
| java.sql.Clob            | CLOB                    |
| java.sql.Blob            | BLOB                    |
| java.sql.Array           | ARRAY                   |
| java.sql.Struct          | STRUCT                  |
| java.sql.Ref             | REF                     |
| java.net.URL             | DATALINK                |
| Java class               | JAVA_OBJECT             |
| java.sql.RowId           | ROWID                   |
| java.sql.NClob           | NCLOB                   |
| java.sql.SQLXML          | SQLXML                  |
| java.util.Calendar       | TIMESTAMP               |
| java.util.Date           | TIMESTAMP               |
| java.time.LocalDate      | DATE                    |
| java.time.LocalDateTime  | TIME                    |
| java.time.OffsetTime     | TIMESTAMP               |
| java.time.OffsetDateTime | TIME_WITH_TIMEZONE      |
| java.time.OffsetDatetime | TIMESTAMP_WITH_TIMEZONE |

**B.5**      **Conversions by setObject and setNull from Java Object Types to JDBC Types**

TABLE B-5 shows which JDBC types may be specified as the target JDBC type to the methods `PreparedStatement.setObject`, `PreparedStatement.setNull`, `RowSet.setNull`, and `RowSet.setObject`.

**TABLE B-5** Conversions Performed by setObject and setNull Between Java Object Types and Target JDBC Types

| Java Object Type     | Supported JDBC Type                                                                                                                                                                                                                                                     |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String               | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, BINARY, VARBINARY, LONVARBINARY, DATE, TIME, TIMESTAMP, NCHAR, NVARCHAR, LONGNVARCHAR, TIME_WITH_TIMEZONE, TIMESTAMP_WITH_TIMEZONE, JSON, DECFLOAT |
| java.math.BigDecimal | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT                                                                                                                                           |
| Boolean              | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR                                                                                                                                                     |
| Byte                 | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT                                                                                                                                           |
| Short                | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT                                                                                                                                           |

| Java Object Type     | Supported JDBC Type                                                                                                           |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Integer              | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT |
| Long                 | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT |
| Float                | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT |
| Double               | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT |
| byte[]               | BINARY, VARBINARY, or LONGVARBINARY                                                                                           |
| java.math.BigInteger | BIGINT, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT                                                                                  |
| java.sql.Date        | CHAR, VARCHAR, LONGVARCHAR, DATE, TIMESTAMP                                                                                   |
| java.sql.Time        | CHAR, VARCHAR, LONGVARCHAR, TIME, TIMESTAMP                                                                                   |
| java.sql.Timestamp   | CHAR, VARCHAR, LONGVARCHAR, DATE, TIME, TIMESTAMP                                                                             |
| java.sql.Array       | ARRAY                                                                                                                         |
| java.sql.Blob        | BLOB                                                                                                                          |

| Java Object Type        | Supported JDBC Type                                      |
|-------------------------|----------------------------------------------------------|
| java.sql.Clob           | CLOB                                                     |
| java.sql.Struct         | STRUCT                                                   |
| java.sql.Ref            | REF                                                      |
| java.net.URL            | DATALINK                                                 |
| Java class              | JAVA_OBJECT                                              |
| java.sql.RowId          | ROWID                                                    |
| java.sql.NClob          | NCLOB                                                    |
| java.sql.SQLXML         | SQLXML                                                   |
| java.util.Calendar      | CHAR, VARCHAR, LONGVARCHAR, DATE, TIME, TIMESTAMP, ARRAY |
| java.util.Date          | CHAR, VARCHAR, LONGVARCHAR, DATE, TIME, TIMESTAMP, ARRAY |
| java.time.LocalDate     | CHAR, VARCHAR, LONGVARCHAR, DATE                         |
| java.time.LocalDateTime | CHAR, VARCHAR, LONGVARCHAR, TIME                         |
| java.time.LocalDateTime | CHAR, VARCHAR, LONGVARCHAR, DATE, TIME, TIMESTAMP        |

| Java Object Type                      | Supported JDBC Type                                                           |
|---------------------------------------|-------------------------------------------------------------------------------|
| <code>java.time.OffsetTime</code>     | CHAR, VARCHAR, LONGVARCHAR,<br>TIME_WITH_TIMEZONE                             |
| <code>java.time.OffsetDatetime</code> | CHAR, VARCHAR, LONGVARCHAR,<br>TIME_WITH_TIMEZONE,<br>TIMESTAMP_WITH_TIMEZONE |

**B.6      Type Conversions Supported by ResultSet getter Methods**

TABLE B-6 shows which JDBC types may be returned by `ResultSet` getter methods. This table also shows the conversions used by the `SQLInput` reader methods, except that they use only the recommended conversions.

TABLE B-6   Use of `ResultSet` getter Methods to Retrieve JDBC Data Types

| Java Object Type      | Recommended JDBC Type | Supported JDBC Type                                                                                                                  |
|-----------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <code>getByte</code>  | TINYINT               | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, ROWID, DECFLOAT |
| <code>getShort</code> | SMALLINT              | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT        |
| <code>getInt</code>   | INTEGER               | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT        |
| <code>getLong</code>  | BIGINT                | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT        |
| <code>getFloat</code> | REAL                  | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT        |

| Java Object Type | Recommended JDBC Type | Supported JDBC Type                                                                                                                                                                                                                                                                |
|------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| getDouble        | FLOAT, DOUBLE         | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT                                                                                                                                                      |
| getBigDecimal    | DECIMAL, NUMERIC      | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, DECFLOAT                                                                                                                                                      |
| getBoolean       | BIT, BOOLEAN          | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR                                                                                                                                                                |
| getString        | CHAR, VARCHAR         | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, BINARY, VARBINARY, LONGVARBINARY, DATE, TIME, TIMESTAMP, DATALINK, NCHAR, NVARCHAR, LONGNVARCHAR, TIME_WITH_TIMEZONE, TIMESTAMP_WITH_TIMEZONE, JSON, DECFLOAT |
| getNString       | NCHAR, NVARCHAR       | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, BINARY, VARBINARY, LONGVARBINARY, DATE, TIME, TIMESTAMP, DATALINK, NCHAR, NVARCHAR, LONGNVARCHAR, TIME_WITH_TIMEZONE, TIMESTAMP_WITH_TIMEZONE, JSON, DECFLOAT |
| getBytes         | BINARY, VARBINARY     | BINARY, VARBINARY, LONGVARBINARY                                                                                                                                                                                                                                                   |

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| Java Object Type    | Recommended JDBC Type | Supported JDBC Type                                                                                              |
|---------------------|-----------------------|------------------------------------------------------------------------------------------------------------------|
| getDate             | DATE                  | CHAR, VARCHAR, LONGVARCHAR, DATE, TIMESTAMP                                                                      |
| getTime             | TIME                  | CHAR, VARCHAR, LONGVARCHAR, TIME, TIMESTAMP                                                                      |
| getTimestamp        | TIMESTAMP             | CHAR, VARCHAR, LONGVARCHAR, DATE, TIME, TIMESTAMP                                                                |
| getAsciiStream      | LONGVARCHAR           | CHAR, VARCHAR, LONGVARCHAR, BINARY, VARBINARY, LONGVARBINARY, CLOB, NCLOB                                        |
| getBinaryStream     | LONGVARBINARY         | BINARY, VARBINARY, LONGVARBINARY                                                                                 |
| getCharacterStream  | LONGVARCHAR           | CHAR, VARCHAR, LONGVARCHAR, BINARY, VARBINARY, LONGVARBINARY, CLOB, NCHAR, NVARCHAR, LONGNVARCHAR, NCLOB, SQLXML |
| getNCharacterStream | LONGNVARCHAR          | CHAR, VARCHAR, LONGVARCHAR, BINARY, VARBINARY, LONGVARBINARY, CLOB, NCHAR, NVARCHAR, LONGNVARCHAR, NCLOB, SQLXML |
| getClob             | CLOB                  | CLOB, NCLOB                                                                                                      |

| Java Object Type | Recommended JDBC Type  | Supported JDBC Type                                                                                                                                                                                                                                                                                                                                   |
|------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| getNClob         | NCLOB                  | CLOB, NCLOB                                                                                                                                                                                                                                                                                                                                           |
| getBlob          | BLOB                   | BLOB                                                                                                                                                                                                                                                                                                                                                  |
| getArray         | ARRAY                  | ARRAY                                                                                                                                                                                                                                                                                                                                                 |
| getRef           | REF                    | REF                                                                                                                                                                                                                                                                                                                                                   |
| getURL           | DATALINK               | DATALINK                                                                                                                                                                                                                                                                                                                                              |
| getObject        | STRUCT,<br>JAVA_OBJECT | TINYINT, SMALLINT, INTEGER, BIGINT, REAL, FLOAT, DOUBLE, DECIMAL, NUMERIC, BIT, BOOLEAN, CHAR, VARCHAR, LONGVARCHAR, BINARY, VARBINARY, LONGVARBINARY, DATE, TIME, TIMESTAMP, CLOB, BLOB, ARRAY, REF, DATALINK, STRUCT, JAVA_OBJECT, ROWID, NCHAR, NVARCHAR, LONGNVARCHAR, NCLOB, SQLXML, TIME_WITH_TIMEZONE, TIMESTAMP_WITH_TIMEZONE, JSON, DECFLOAT |
| getRowId         | ROWID                  | ROWID                                                                                                                                                                                                                                                                                                                                                 |

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| Java Object Type | Recommended JDBC Type | Supported JDBC Type |
|------------------|-----------------------|---------------------|
| getSQLXML        | SQLXML                | SQLXML              |



