

(Full title of the Plan)

Gregory Weaver

Secretary and Chief Financial Officer

Eloxx Pharmaceuticals, Inc.

950 Winter Street

Waltham, MA 02451

(781) 557-5300

(Name, address, including zip code, and telephone number,

including area code, of agent for service)

Copies to:

Carl Marcellino

Ropes & Gray LLP

1211 Avenue of the Americas

New York, NY 10036

(212) 841-0623

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer

Accelerated filer

Non-accelerated filer (Do not check if a smaller reporting company)

Smaller reporting company

Emerging growth company

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 7(a)(2)(B) of the Securities Act.

CALCULATION OF REGISTRATION FEE

Title of securities to be registered	Amount to be registered(1)	Proposed maximum offering price per share	Proposed maximum aggregate offering price	Amount of registration fee
Common Stock, \$0.01 par value per share				
- Non-Plan Inducement Grant	1,326,424	(2) \$ 8.00 (3)	\$ 10,611,392 (3)	\$ 1,321.12 (3)
- Eloxx Pharmaceuticals Ltd. Share Ownership and Option Plan (2013) (issued)	2,353,493	(4) \$ 2.28 (5)(8)	\$ 5,357,992.78 (5)(8)	\$ 667.07 (5)(8)
- Eloxx Pharmaceuticals Ltd. Share Ownership and Option Plan (2013) (available)	119,762	(6) \$ 7.06 (7)(8)	\$ 845,519.72 (7)(8)	\$ 105.27 (7)(8)
Total	3,799,679		\$ 16,814,904.50	\$ 2,093.46

Pursuant to Rule 416(a) under the Securities Act of 1933, as amended (the “Securities Act”), this Registration Statement also covers an indeterminate number of additional shares of common stock of Eloxx Pharmaceuticals, (1) Inc. (the “Registrant”) that become issuable pursuant to the above-named plans as a result of the anti-dilution and other adjustment provisions therein by reason of certain corporate transactions or events, including any stock dividend, stock split, recapitalization or other similar transactions.

(2) Represents shares of common stock reserved for issuance upon the exercise of a stock option grant by the Registrant to Robert E. Ward as a material inducement to his acceptance of employment with the Registrant.

(3) Such shares are issuable upon exercise of an outstanding stock option with a fixed exercise price. Pursuant to Rule 457(h) of the Securities Act, the aggregate offering price and the fee have been computed upon the basis of the price at which the option may be exercised, which was the closing price of a share of Registrant’s common stock on December 26, 2017, the date of grant of such option, as reported on the OTCQB Market.

(4) Represents shares of common stock of the Registrant subject to issuance upon the exercise of stock options outstanding and unexercised under the Eloxx Pharmaceuticals Ltd. Share Ownership and Option Plan (2013) and its U.S. appendix (the “2013 Plan”).

(5) Estimated solely for the purpose of calculating the registration fee in accordance with Rule 457(h) under the Securities Act, based on the weighted average option exercise prices of outstanding under the 2013 Plan, assumed by the Company, as adjusted upon conversion.

(6) Represents shares of common stock of the Registrant subject to issuance upon the exercise of stock options reserved for issuance pursuant to future awards under the 2013 Plan.

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Estimated solely for the purpose of calculating the registration fee in accordance with Rules 457(c) and 457(h) (7) under the Securities Act, based on the average of the high and low prices of the common stock as reported on the OTCQB Market on January 9, 2018.

(8) The U.S. dollar equivalent of the maximum offering price per share has been calculated using an exchange rate of 1:3.4429, as reported by Bloomberg on January 9, 2018 as of 6 p.m., Eastern Time.

EXPLANATORY NOTE

Eloxx Pharmaceuticals, Inc. (the “Company” or the “Registrant”) is filing this Registration Statement on Form S-8 for the purpose of registering (i) 2,353,493 shares common stock of the Company, \$0.01 par value per share (the “Common Stock”) issuable pursuant to outstanding but unexercised option awards previously issued under the Eloxx Pharmaceuticals Ltd. Share Ownership and Option Plan (2013) and its U.S. appendix (the “2013 Plan”), (ii) 119,762 shares of Common Stock issuable upon the exercise of stock options reserved for issuance pursuant to future awards under the 2013 Plan, and (iii) 1,326,424 shares of Common Stock granted to Robert E. Ward on December 26, 2017 to induce him to accept employment as Chief Executive Officer and Chairman of the Board of Directors of the Company.

Pursuant to the terms and conditions of an Agreement, dated as of May 31, 2017 (as amended on August 1, 2017 and on November 23, 2017, the “Agreement”), by and among Eloxx Pharmaceuticals Ltd., an Israeli company (“Eloxx Ltd.”) and Sevion Sub Ltd., an Israeli company (“Acquisition Sub”), a wholly-owned subsidiary of Sevion Therapeutics Inc. (“Sevion”), Acquisition Sub merged with and into Eloxx Ltd. on December 19, 2017 (the “Effective Date”), with Eloxx Ltd. surviving the merger as the wholly-owned subsidiary of the Company (the “Transaction”). Upon completion of the Transaction, Sevion changed its name to Eloxx Pharmaceuticals, Inc.

In accordance with the Agreement, as of the Effective Date, the 2013 Plan was assumed by the Company and each option to purchase ordinary shares of Eloxx Ltd. granted under the 2013 Plan and outstanding immediately prior to the effective time of the Transaction was assumed by the Company and converted into an option to purchase shares of Common Stock.

PART I

INFORMATION REQUIRED IN THE SECTION 10(a) PROSPECTUS

The documents containing the information specified in Part I of this registration statement will be sent or given to participants in the 2013 Plan, as specified by Rule 428(b)(1) under the Securities Act of 1933, as amended (the “Securities Act”). Such documents need not be filed with the Securities and Exchange Commission (“SEC”), either as part of this registration statement or as prospectuses or prospectus supplements pursuant to Rule 424 under the Securities Act. These documents and the documents incorporated by reference pursuant to Item 3 of Part II of this registration statement, taken together, constitute a prospectus that meets the requirements of Section 10(a) of the Securities Act.

Part II

Information Required in the Registration Statement

Item 3. Incorporation of Documents by Reference.

The following documents, which have been filed with the SEC by the Company, are incorporated by reference in this registration statement:

- (a) The Company's Annual Report on Form 10-K for the year ended June 30, 2017, filed with the SEC on October 13, 2017 (the "Annual Report");
- (b) The Company's Quarterly Report on Form 10-Q for the quarter ended September 30, 2017, filed with the SEC on November 14, 2017;
- (c) The Company's Current Reports on Form 8-K, filed on August 3, 2017, November 29, 2017, December 8, 2017, December 22, 2017, and December 27, 2017; and

The description of the Company's Common Stock contained in the Company's Registration Statement on Form (d)8-A, filed with the SEC on May 14, 2002 (File No. 001-31326), and any other amendment or report filed for the purpose of updating such description.

All documents subsequently filed by the Company pursuant to Sections 13(a), 13(c), 14 and 15(d) of the Securities Exchange Act of 1934, as amended (the "Exchange Act"), prior to the filing of a post-effective amendment which indicates that all securities offered hereby have been sold or which deregisters all securities remaining unsold, shall be deemed to be incorporated by reference in this registration statement and to be a part hereof from the date of filing of such documents; provided, however, that documents or information deemed to have been furnished and not filed in accordance with SEC rules shall not be deemed incorporated by reference in this registration statement. Any statement contained herein or in a document incorporated by reference in this registration statement shall be deemed to be modified or superseded for purposes of this registration statement to the extent that a statement contained herein or in any other subsequently filed document which also is or is deemed to be incorporated by reference herein modifies or supersedes such statement. Any such statement so modified or superseded shall not be deemed, except as so modified or amended, to constitute a part of this registration statement.

Item 4. Description of Securities.

Not applicable.

Item 5. Interests of Named Experts and Counsel.

Not applicable.

Item 6. Indemnification of Directors and Officers.

Delaware General Corporation Law. Section 145 of the General Corporation Law of the State of Delaware provides as follows:

“A corporation shall have the power to indemnify any person who was or is a party or is threatened to be made a party to any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative (other than an action by or in the right of the corporation) by reason of the fact that the person is or was a director, officer, employee or agent of the corporation, or is or was serving at the request of the corporation as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against expenses (including attorneys’ fees), judgments, fines and amounts paid in settlement actually and reasonably incurred by him in connection with such action, suit or proceeding if the person acted in good faith and in a manner the person reasonably believed to be in or not opposed to the best interest of the corporation, and, with respect to any criminal action or proceeding, had no reasonable cause to believe his conduct was unlawful. The termination of any action, suit or proceeding by judgment, order, settlement, conviction or upon a plea of nolo contendere or its equivalent shall not, of itself, create a presumption that the person did not act in good faith and in a manner which the person reasonably believed to be in or not opposed to the best interests of the corporation, and, with respect to any criminal action or proceeding, had reasonable cause to believe that his conduct was unlawful.

A corporation shall have the power to indemnify any person who was or is a party or is threatened to be made a party to any threatened, pending or completed action or suit by or in the right of the corporation to procure a judgment in its favor by reason of the fact that the person is or was a director, officer, employee or agent of the corporation, or is or was serving at the request of the corporation as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise against expenses (including attorneys’ fees) actually and reasonably incurred by him in connection with the defense or settlement of such action or suit if the person acted in good faith

and in a manner the person reasonably believed to be in or not opposed to the best interests of the corporation and except that no indemnification shall be made with respect to any claim, issue or matter as to which such person shall have been adjudged to be liable to the corporation unless and only to the extent that the Court of Chancery or the court in which such action or suit was brought shall determine upon application that, despite the adjudication of liability but in view of all the circumstances of the case, such person is fairly and reasonably entitled to indemnity for such expenses which the Court of Chancery or such other court shall deem proper.”

Certificate of Incorporation. The Company's Certificate of Incorporation provides that it will indemnify each officer and director to the fullest extent authorized or permitted by law, as now or hereafter in effect, and such right to indemnification shall continue as to a person who has ceased to be a director or officer of the Company and shall inure to the benefit of his or her heirs, executors and personal and legal representative; provided, however, that, except for proceedings to enforce rights to indemnification, the Company shall not be obligated to indemnify any director or officer or his or her heirs, executors or personal or legal representatives in connection with a proceeding (or part thereof) initiated by such person unless such proceeding (or part thereof) initiated by such person was authorized or consented to by the board of directors of the Company (the "Board of Directors"). The right to indemnification includes the right to be paid by the Company the expenses incurred in defending or otherwise participating in any proceeding in advance of its final disposition. The Company may, to the extent authorized from time to time by the Board of Directors, provide rights to indemnification and to the advancement of expenses to employees and agents of the Company similar to those conferred to directors and officers of the Company.

Amended and Restated Bylaws. The Company's Amended and Restated Bylaws provide that the Company shall indemnify, defend and hold harmless, to the fullest extent permitted by applicable law as it presently exists or may hereafter be amended, any person who was or is made or is threatened to be made a party or is otherwise involved in any action, suit or proceeding, whether civil, criminal, administrative or investigative, by reason of the fact that he or she, or a person for whom he or she is the legal representative, is or was a director or officer of the Company elected by the Board of Directors or, while a director or officer of the Company elected by the Board of Directors, is or was serving at the request of the Company as a director, officer, employee, member, trustee or agent of another corporation, or of a partnership, joint venture, trust, nonprofit entity or other enterprise, including service with respect to employee benefit plans, against all liability and loss suffered and expenses (including expenses (including attorneys' fees and expenses), judgments, fines and amounts paid in settlement actually and reasonably incurred by such person in connection with such a proceeding). Notwithstanding the preceding sentence, the Company shall be required to indemnify any such person in connection with any such proceeding (or part thereof) commenced by such person in connection with a proceeding (or part thereof) commenced by such person only if the commencement of such proceeding (or part thereof) was authorized by the Board of Directors or the proceeding (or part thereof) relates to the enforcement of the Company's obligations under the Amended and Restated Bylaws.

The Company's Amended and Restated Bylaws provide that the Company shall to the fullest extent permitted by applicable law pay, on an as-incurred basis, all expenses (including attorneys' fees and expenses) actually and reasonably incurred by indemnified persons in defending any proceeding which may be indemnifiable under the Amended and Restated Bylaws, in advance of its final disposition. Such advancement shall be unconditional, unsecured and interest free and shall be made without regard to an indemnified person's ability to repay any expenses advanced; provided, however, that, to the extent required by law, such payment of expenses in advance of the final disposition of the proceeding shall be made only upon receipt of an unsecured undertaking by the indemnified person to repay all amounts advanced if it should be ultimately determined that the indemnified person is not entitled to be indemnified under the Amended and Restated Bylaws or otherwise.

Indemnification Agreements. The Company has entered into an indemnification agreement with each of its directors and executive officers, which provides, among other things, that the Company will indemnify each such person to the

fullest extent permitted by law, subject to limitations contained therein, obligate the Company to cover expenses that a director or officer incurs or amounts that a director or officer becomes obligated to pay because of any proceeding to which he or she is made or threatened to be made a party or participant by reason of his service as a current or former director, officer, employee or agent of the Company, provided that he acted in good faith and in a manner he reasonably believed to be in or not opposed to the best interests of the Company. The indemnification agreements also create certain rights in favor of the Company, including the right to assume the defense of claims and to consent to settlements. The indemnification agreements do not exclude any other rights to indemnification or advancement of expenses to which the indemnitee may be entitled under applicable law, the Company's Certificate of Incorporation, Amended and Restated Bylaws, any agreement, or otherwise.

Other Insurance. The Company maintains directors' and officers' liability insurance which covers certain liabilities and expenses of the Company's directors and officers and covers the Company for reimbursement of payments to the Company's directors and officers in respect of such liabilities and expenses.

The above discussion of the Company's Certificate of Incorporation, Bylaws, indemnification agreements and insurance arrangements, as well as the Delaware General Corporation Law, is not intended to be exhaustive and is qualified in its entirety by reference to such Certificate of Incorporation, Bylaws, indemnification agreements, insurance arrangements and statutes.

Item 7. Exemption from Registration Claimed.

Not applicable.

Item 8. Exhibits.

**Exhibit
No. Description of Exhibit**

4.1 Amended and Restated Certificate of Incorporation of Senesco Technologies, Inc. filed with the State of Delaware on January 22, 2007. (Incorporated by reference to the Company's Quarterly Report on Form 10-Q for the period ended December 31, 2006.)

4.2 Certificate of Amendment to the Amended and Restated Certificate of Incorporation of Senesco Technologies, Inc. filed with the State of Delaware on January 22, 2008. (Incorporated by reference to Exhibit 3.1 of the Company's Quarterly Report on Form 10-Q for the period ended December 31, 2007.)

4.3 Certificate of Amendment to the Amended and Restated Certificate of Incorporation of Senesco Technologies, Inc. filed with the State of Delaware on September 22, 2009. (Incorporated by reference to Exhibit 3.3 of the Company's Annual Report on Form 10-K for the period ended June 30, 2009.)

4.4 Certificate of Amendment to the Amended and Restated Certificate of Incorporation of Senesco Technologies, Inc. filed with the State of Delaware on May 25, 2010. (Incorporated by reference to Exhibit 3.1 to the Company's Current Report on Form 8-K filed on May 28, 2010.)

4.5 Certificate of Amendment to the Amended and Restated Certificate of Incorporation of Senesco Technologies, Inc. filed with the State of Delaware on December 22, 2011. (Incorporated by reference to Exhibit 3.1 to the Company's Quarterly Report on Form 10-Q for the period ended December 31, 2011.)

4.6 Certificate of Amendment to the Amended and Restated Certificate of Incorporation of Senesco Technologies, Inc. filed with the State of Delaware on April 1, 2013. (Incorporated by reference to Exhibit 3.1 to the Company's Quarterly Report on Form 10-Q for the period ended March 31, 2013.)

4.7

Certificate of Amendment to the Company's Amended and Restated Certificate of Incorporation, as filed with the Secretary of State of the State of Delaware on October 16, 2013. (Incorporated by reference to Exhibit 3.1 of the Company's Current Report on Form 8-K filed on October 21, 2013.)

4.8 Certificate of Amendment to the Company's Amended and Restated Certificate of Incorporation, as filed with the Secretary of State of the State of Delaware on September 29, 2014. (Incorporated by reference to Exhibit 3.1 of the Company's Current Report on Form 8-K filed on October 3, 2014.)

4.9 Certificate of Amendment to the Company's Amended and Restated Certificate of Incorporation, as filed with the Secretary of State of the State of Delaware on December 19, 2017. (Incorporated by reference to Exhibit 3.1 of the Company's Current Report on Form 8-K filed on December 22, 2017.)

4.10 Certificate of Amendment to the Company's Amended and Restated Certificate of Incorporation, as filed with the Secretary of State of the State of Delaware on December 19, 2017. (Incorporated by reference to Exhibit 3.2 of the Company's Current Report on Form 8-K filed on December 22, 2017.)

4.11 Amended and Restated Bylaws of Eloxx Pharmaceuticals, Inc. (Incorporated by reference to Exhibit 3.2 of the Company's Current Report on Form 8-K filed on December 27, 2017.)

5.1 Opinion of Ropes & Gray LLP.

23.1 Consent of Ropes & Gray LLP (included in Exhibit 5.1).

23.2 Consent of Kost Forer Gabbay & Kasierer, Independent Registered Public Accounting Firm.

23.3 Consent of RSM US LLP, Independent Registered Public Accounting Firm.

24.1 Power of Attorney (included on the signature page hereto).

99.1 Eloxx Pharmaceuticals Ltd. Share Ownership and Option Plan (2013).

99.2 U.S. Appendix to the Eloxx Pharmaceuticals Ltd. Share Ownership and Option Plan (2013).

Item 9. Undertakings.

(a) The undersigned Registrant hereby undertakes:

(1) To file, during any period in which offers or sales are being made, a post-effective amendment to this Registration Statement:

(i) To include any prospectus required by Section 10(a)(3) of the Securities Act;

(ii) To reflect in the prospectus any facts or events arising after the effective date of the Registration Statement (or the most recent post-effective amendment thereof) which, individually or in the aggregate, represent a fundamental change in the information set forth in this Registration Statement. Notwithstanding the foregoing, any increase or decrease in volume of securities offered (if the total dollar value of securities offered would not exceed that which was registered) and any deviation from the low or high end of the estimated maximum offering range may be reflected in the form of prospectus filed with the Commission pursuant to Rule 424(b) if, in the aggregate, the changes in volume and price represent no more than a 20 percent change in the maximum aggregate offering price set forth in the "Calculation of Registration Fee" table in the effective Registration Statement; and

(iii) To include any material information with respect to the plan of distribution not previously disclosed in this Registration Statement or any material change to such information in this Registration Statement;

provided, however, that the undertakings set forth in paragraphs (a)(1)(i) and (a)(1)(ii) above do not apply if the information required to be included in a post-effective amendment by those paragraphs is contained in reports filed with or furnished to the Commission by the Registrant pursuant to Section 13 or Section 15(d) of the Exchange Act that are incorporated by reference in this Registration Statement.

(2) That, for the purpose of determining any liability under the Securities Act, each such post-effective amendment shall be deemed to be a new Registration Statement relating to the securities offered therein, and the offering of such securities at that time shall be deemed to be the initial bona fide offering thereof.

(3) To remove from registration by means of a post-effective amendment any of the securities being registered which remain unsold at the termination of the offering.

(b) The undersigned Registrant hereby further undertakes that, for purposes of determining any liability under the Securities Act, each filing of the Registrant's annual report pursuant to Section 13(a) or 15(d) of the Exchange Act (and, where applicable, each filing of an employee benefit plan's annual report pursuant to Section 15(d) of the Exchange Act) that is incorporated by reference in this Registration Statement shall be deemed to be a new Registration Statement relating to the securities offered therein, and the offering of such securities at that time shall be deemed to be the initial bona fide offering thereof.

(c) Insofar as indemnification for liabilities arising under the Securities Act may be permitted to directors, officers and controlling persons of the Registrant pursuant to the foregoing provisions, or otherwise, the Registrant has been advised that in the opinion of the Securities and Exchange Commission such indemnification is against public policy as expressed in the Securities Act and is, therefore, unenforceable. In the event that a claim for indemnification against such liabilities (other than the payment by the Registrant of expenses incurred or paid by a director, officer or controlling person of the Registrant in the successful defense of any action, suit or proceeding) is asserted by such director, officer or controlling person in connection with the securities being registered, the Registrant will, unless in the opinion of its counsel the matter has been settled by controlling precedent, submit to a court of appropriate jurisdiction the question whether such indemnification by it is against public policy as expressed in the Securities Act and will be governed by the final adjudication of such issue.

Signatures

Pursuant to the requirements of the Securities Act of 1933, the Registrant certifies that it has reasonable grounds to believe that it meets all of the requirements for filing on Form S-8 and has duly caused this registration statement to be signed on its behalf by the undersigned, thereunto duly authorized, in the City of Waltham in the Commonwealth of Massachusetts, on January 10, 2018.

Eloxx Pharmaceuticals, inc.

By: /s/ Gregory Weaver
Gregory Weaver
Chief Financial Officer, Secretary and Treasurer

Power of Attorney

Each person whose signature appears below constitutes and appoints Richard Ward and Gregory Weaver, and each of them acting individually, his or her true and lawful attorney-in-fact and agent with full power of substitution and resubstitution, for him or her and in his or her name, place and stead, in any and all capacities, to sign any and all amendments (including post-effective amendments) to this Registration Statement on Form S-8 to be filed by Eloxx Pharmaceuticals, Inc., and to file the same, with all exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents full power and authority to be done in and about the premises, as fully to all intents and purposes as he or she might or could do in person, hereby ratifying and confirming all that said attorneys-in-fact and agents, or their substitutes, may lawfully do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Act of 1933, this Registration Statement has been signed by the following persons in the capacities indicated on January 10, 2018.

Signature	Title	Date
/s/ Richard Ward Richard Ward	Chief Executive Officer and Director (Principal Executive Officer)	January 10, 2018
/s/ Gregory Weaver	Chief Financial Officer, Secretary and Treasurer	January 10, 2018

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Gregory Weaver	(Principal Financial Officer and Principal Accounting Officer)	
/s/ Tomer Kariv	Director	January 10, 2018
Tomer Kariv		
/s/ Ran Nussbaum	Director	January 10, 2018
Ran Nussbaum		
/s/ Silvia Noiman	Director	January 10, 2018
Silvia Noiman		
/s/ Gadi Veinrib	Director	January 10, 2018
Gadi Veinrib		

/s/ Zafrira Avnur Director January 10, 2018
Zafrira Avnur

/s/ Martijn Kleijwegt Director January 10, 2018
Martijn Kleijwegt

/s/ Steven Rubin Director January 10, 2018
Steven Rubin

EXHIBIT INDEX

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